HIS MAJESTY'S GOVERNMENT OF THE KINGDOM OF TONGA

TONGA
National Infrastructure Investment Plan

2013 -2023

PRIF
Pacific Region
Infrastructure Facility

This is a publication of His Majesty's Government of the Kingdom of Tonga.

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Abbreviations

AusAID	Australian Agency for International Development
CBD	Central Business District
CCA	Climate Change Adaptation
CEO	Chief Executive Officer
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DRM	Disaster Risk Management
DSA	Debt Sustainability Assessment
DSM	Demand-Side Management
EBIT	Earnings before Interest and Tax
EBITDA	Earnings before Interest, Tax, Depreciation and Amortisation
EIA	Environmental Impact Assessment
EU	European Union
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse gas
GIZ	Gesselschaft für International Zusammenarbeit
GoT	Government of Tonga
ICAO	International Civil Aviation Organisation
IMF	International Monetary Fund
IMO	International Maritime Organisation
IUCN	International Union for Conservation of Nature
IUDSP	Integrated Urban Development Sector Project
JICA	Japan International Cooperation Agency
JNAP	Joint National Action Plan on DRM and CCA for 2010 to 2015
M&E	Monitoring and Evaluation
MCA	Multi-Criterion Assessment
MDG	Millennium Development Goal
MLECCNR	Ministry of Lands, Environment, Climate Change & Natural Resources
MFNP	Ministry of Finance and National Planning
MLSNR	Ministry of Lands, Survey & Natural Resources
MIC	Ministry of Information and Communications
MOI	Ministry of Infrastructure
MPE	Ministry of Public Enterprises
OECD	Organisation for Economic Co-operation and Development
PE	Public Enterprises
M&E	Monitoring and Evaluation
MTBF	Medium-Term Budget Framework
MW	Mega watt
NEMO	National Emergency Management Office
NIIP	National Infrastructure Investment Plan
NIIP2010	the first NIIP covering the period from 2010/11
NIIP2013	this NIIP covering the period from 2013/14
NUDSP	Nuku'alofa Urban Development Sector Project
NZ	New Zealand
NZAID	New Zealand Agency for International Development
PAIP	Pacific Aviation Investment Program
PAT	Ports Authority of Tonga
PCRAFI	Pacific Catastrophic Risk Assessment and Financing Initiative
PE	Public Enterprise
PPCR	Pilot Program for Climate Resilience
PUMA	Planning and Urban Management Agency
QSW	Queen Salote Wharf (Nuku'alofa)
SOE	State-Owned Enterprise
SPC-SOPAC	Applied Geoscience and Technology Division of the Secretariat of the Pacific Community
SPREP	South Pacific Regional Environment Program
TA	Technical Assistance
TAL	Tonga Airports Ltd
TBC	Tonga Broadcasting Commission
TCC	Tonga Communications Corporation
TCCI	Tonga Chamber of Commerce and Industry

TCL	Tonga Cable Ltd
TFSCP	Tonga-Fiji Submarine Cable Project
TMO	Tonga Meteorological Office
TMS	Tonga Meteorological Service
TOP/T$	Tongan pa'anga
TPL	Tonga Power Ltd
TSCP	Transport Sector Consolidation Project
TSDF	Tonga Strategic Development Framework
TWB	Tonga Water Board
UNDP	United Nations Development Program
UPMS	Urban Planning and Management System Project
USAID	United States Agency for International Development
USD	US Dollars
WAL	Waste Authority Ltd
WB	World Bank

Exchange rates

All figures quoted in the NIIP are in Tongan pa'anga (TOP). Exchange rates as at December 2012 are:

TOP 1 =	USD 0.580	NZD 0.692	RMB 3.575
	AUD 0.551	EUR 0.444	JPY 48.67

Source: *Tonga Reserve Bank Bulletin*, December 2012.

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- Ministry of Infrastructure
- Ministry of Lands, Environment, Climate Change & Natural Resources
- Ministry of Public Enterprises
- Ministry of Information & Communications
- Tonga Energy Roadmap Implementation Unit
- Planning and Urban Management Authority
- National Spatial Planning Authority
- Joint National Action Plan on CCA/DRM Secretariat
- National Emergency Management Office
- Ports Authority Tonga
- Tong Broadcasting Commission
- Tonga Communications Corporation
- Tonga Cable Ltd
- Tonga Airports Ltd
- Tonga Power
- Tonga Water Board
- Waste Authority Ltd
- Civil Society
- Tonga Chamber of Commerce and Industry
- Tonga Development Bank
- Westpac Bank
- National Retirement Benefits Fund
- ADB/World Bank Focal Office Tonga
- Australian High Commission
- Embassy of the People's Republic of China
- Embassy of Japan
- JICA
- New Zealand High Commission
- CSIRO/Pacific Climate Change Science Program
- Transport Sector Consolidation Project team
- Pacific Aviation Investment Project team
- Nuku'alofa Urban Development Sector Project team
- Pilot Projects in Climate Resilience project team

Executive Summary

Background

This National Infrastructure Investment Plan (NIIP) outlines the Government of Tonga's priorities and plans for major initiatives in economic infrastructure (energy, telecommunications, water, solid waste management, and transport) over the next five to 10 years. It responds to a number of challenges facing Government:

- the need to bring together various sub-sector and agency plans into a single document;
- the need for a longer term view and sector-wide approach to infrastructure planning and management, and a systematic approach to identifying future priorities;
- Government's constrained budget position and the to set priorities and develop sustainable mechanisms for funding infrastructure delivery and maintenance based on sound economic and financial principles;
- the need for greater attention to strategic asset management and consideration of the life cycle (especially maintenance) costs generated by new investments, including issues such as operating efficiencies and demand-side management (DSM), and the institutional and regulatory environment for infrastructure; and
- increased attention to climate change adaptation and disaster risk management aspects of infrastructure development, management and operation.

This is the second NIIP. It updates and builds on the successes of the first NIIP that was prepared in 2010. It continues the focus on responsible investment and improved asset management, and includes a stronger spotlight on climate change adaptation and disaster risk management.

The Plan is country owned and led, and was developed with the full participation of and in consultation with internal stakeholders, and private sector and community representatives. The process involved the following key steps:

1. Analysing the key drivers for investments in economic infrastructure that will improve the everyday lives of the people of Tonga and reduce the costs of doing business.
2. Assembling a comprehensive list of economic infrastructure projects in the pipeline based on information from Government, Public Enterprises, and development partners to identify those investment projects that are already underway or have committed funding.
3. Developing and applying a robust prioritisation methodology that reflects national objectives as outlined in the *Tonga Strategic Development Framework 2011-2014* (TSDF) to identify a set of infrastructure projects investments that are 'high priority' for implementation in the next five years.
4. Considering the whole-of-sector planning implications of high priority projects, and identifying linkages and complementary (non-infrastructure) measures required to obtain best long-term value from investments.
5. Assessing the financial sustainability and level of cost recovery of existing infrastructure, and the proposed investments and linkages with public sector financial management framework.
6. Assessing the current infrastructure funding position of Government and Public Enterprises, and developing a funding strategy that can form the basis for discussion between Government, national stakeholders, and development partners.

The findings are brought together in this National Infrastructure Investment Plan.

Key Findings

Government recognises that while infrastructure investment projects are important, they are only part of the story. They go hand in hand with the improved management of existing and new infrastructure, and initiatives to improve the overall institutional, regulatory, and operational environment for infrastructure development. As a result, this NIIP is much more than a list of project proposals. **The NIIP is an integrated program for management of existing assets, new investments, supporting complementary measures, and linked projects**. Complementary measures include the development of sector road maps, policy changes, institutional/regulatory/financial reforms, training and capacity building, and technical assistance in support of the Government policy to capitalise on existing infrastructure and obtain best value from new investments.

Over the three years since the first NIIP was prepared in 2010, there has been a peak in infrastructure investment, with an estimated T$300 million invested in economic infrastructure projects (note that all costs are in Tongan pa'anga, T$). This includes around:

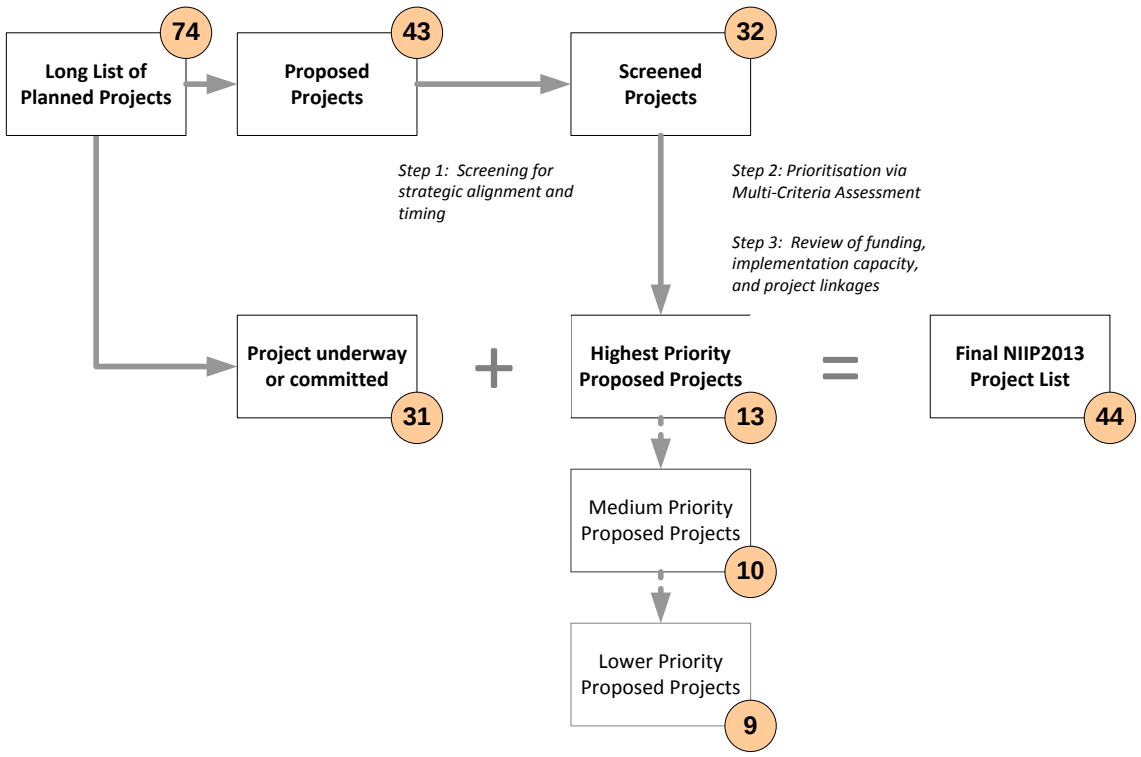
- T$100 million in road rehabilitation and upgrade projects;
- T$60 million in electricity generation and distribution upgrades;
- T$30 million in telecommunications upgrades; and
- T$50 million in the Nuku'alofa central business district infrastructure redevelopment and Vuna Wharf cruise ship terminal.

In addition, there are a range of investment projects already underway or committed. The first priority of this NIIP is to successfully complete projects that are already underway and committed, and to consolidate infrastructure that we already have through better infrastructure management, use, and maintenance. However, there are still a range of infrastructure challenges and opportunities that need to be addressed.

The complete list of future investment projects identified by this NIIP includes 74 projects spread across the economic infrastructure sectors, totalling around T$560 million of investment over the next five years; and an additional T$130 million in years the next five to 10 years. This includes projects that are currently underway, projects that are not underway but have committed funding, and proposed projects that currently have no confirmed funding but are proposed for possible implementation within the next five to ten years. Almost T$180 million of investment is already underway or committed for the next 10 years. This includes more than T$50 million of investment self-funded by Public Enterprises.

It will not be possible to fund all of the projects that have been proposed. Therefore priorities have been set. Projects that are not already underway or have committed funding were progressively screened to identify those that meet identified demands, are planned to proceed in the next five years, align well with national priorities, and deliver strong benefits to the Tongan people. A formal Multi-Criterion Assessment process was used to prioritise these projects into Highest, Medium, and Lower priority bands. The process and the number of projects at each stage of the process are shown in the following diagram (Figure A).

Figure A: Multi-Criterion Assessment process



The outcome of the prioritisation process is 13 'high priority' proposed projects for the next five years, totalling some T$170 million. These projects have been rated as high priority because they are planned to commence within the next five years and are strongly aligned with the objectives of the TSDF; are sustainable in terms of having a foundation of adequate financial, technical, and institutional structures in place; are expected to deliver the highest levels of economic/social/environmental/resilience benefits to Tonga; and are consistent with available financial resources and implementation capacity. These 13 projects have no confirmed source of funding at this stage and represent Government's priority aspirations for additional infrastructure development over the next five years. In conjunction with ongoing and committed projects, they form the basis for development strategies for each of the infrastructure sectors over the next five to ten years.

The 13 high priority projects are listed in the table below. If the highest priority projects are all implemented, together with ongoing and already committed projects, the total investment in economic infrastructure over the next five years would be some T$350 million. About 50 per cent of this investment is in projects already underway (T$100 million), or already committed (T$70 million).

Table A: Summary of highest priority proposed projects

Sector	Ref	Project	Estimated Cost (T$m)	FY2014-18
Energy	E11	Additional 1-2MW of Solar PV on Tongatapu	24	
	E16	Outer Islands On-Grid Renewable Energy	9	
Telecoms	T9	Fibre-Optic Cable to Ha'apai and Vava'u[1]	30	
	T10	Communications for Early Warning and Disaster Recovery	6	
Water	W3	Outer Islands water supply improvements	15	
	W4	Expand Nuku'alofa system to growth areas	11	
Solid Waste	S6	New Landfill or Transfer Station on Ha'apai	4	
Roads	R10	Outer Islands Roads Upgrading Program	10	
Ports	P9	Maritime Sector Safety and Resilience	20	
Airports	A11	Resurfacing Ha'apai Airport runway, apron, taxiway	9	
	A12	New Control Tower at Fua'amotu International Airport	7	
Multi-sector	M2	Coastal Protection - Eastern Tongatapu	15	
	M4	Disaster Response & Evacuation Infrastructure	12	
		Sub-total – High Priority proposed projects	172	
		+ Projects Underway and Committed	173	
		TOTAL	T$345	

To obtain full value from any new capital investments, the investment must be supported with initiatives to improve the management of existing and new infrastructure, and measures to improve the overall institutional and regulatory environment. This integrated framework of priority investments and complementary measures is the essence of the NIIP. The framework is summarised in Table B, structured in terms of Government's four priority themes for the development of economic infrastructure over the next five years: *Connecting Tonga*, *Infrastructure for Communities*, *Reliable and Affordable Energy*, and *Sustainability, Safety and Resilience*.

[1] This project is linked to a proposed extension of the Fibre-Optic cable from Tonga to Samoa.

Table B: Summary of priority projects and complementary initiatives by theme

Theme	Sector	Priority Investment Projects	Complementary Initiatives
Connecting Tonga	Telecoms	▪ T9: Undersea fibre-optic cable linking Ha'apai and Vava'u with international networks (T$30m)[2] ▪ T 10: Communications for Early Warning and Disaster Recovery (T10 T$6.0m)	▪ Update the access/regulatory regime for telecoms sector ▪ Private sector and Government initiatives (e-Government) that take advantage of opportunities emerging from improved internet access
	Roads	▪ R10 : Outer Islands Roads Upgrading Program (T$10m)	▪ Develop private sector capacity for road maintenance (TSCP)
	Ports	▪ See *Sustainability, Safety and Resilience* theme.	▪ Post-harvest facilities for fishing and agricultural produce (handling, storage, processing) (initial support provided EU and Australian Aid)
	Airports	▪ A11: Resurface the runway at Salote Pilolevu airport (Ha'apai) (T$9m) ▪ A12: New Control Tower for Fua'amotu Airport (T$7m)	▪ Update the policy environment for domestic aviation ▪ Post-harvest facilities (initial support under EU program)
Infrastructure for Communities	Water	▪ W3: Outer islands water supply system improvements (Vava'u, Ha'apai, 'Eua) (T$15.0m) ▪ W4: Expand Nuku'alofa system to new growth areas. T$11.4m)	▪ Prepare a roadmap for the Water Sector that examines the full water cycle, including sanitation and drainage. The roadmap should - clarify and simplify institutional responsibilities for water and sanitation - prepare a situation report for the Sanitation sector, that identifies issues, problems and responses - prepare a drainage plan for Nuku'alofa - prepare an investment plan for the next 10 years - explore demand-side management (DSM) and other non-infrastructure options for making better use of existing and planned infrastructure
	Solid Waste	▪ S6: Improved Solid Waste disposal arrangements for Ha'apai (T$4m)	▪ Prepare a sector roadmap that addresses the institutional, financial and operational model for the sector and provides a five to 10 year investment plan.
Reliable and Affordable Energy	Energy	▪ Additional on-grid solar electricity generation - E11: 1-2 MW on Tongatapu (T$24m) - E16: Outer islands (Vava'u Ha'apai, 'Eua) (T$9m)	▪ Non-Infrastructure aspects of the Energy Roadmap - Policy, legal, regulatory reform supporting the Energy Roadmap - Research and feasibility studies of alternative energy sources (wind, wave, coconut oil, etc) - Improved fuel supply chain logistics - Other non-infrastructure aspects of the Energy Roadmap (DSM, etc)
Sustainability, Safety, Resilience	Sustainability		▪ Institutional reform to clarify/simplify responsibilities across all sectors ▪ Develop and implement a national policy and strategy for strategic asset management ▪ Implement new arrangements for sustainable road maintenance funding and delivery (TSCP) ▪ Update arrangements for managing and maintaining ports for inter-island shipping ▪ Strengthen EIA system and capacity, and environmental monitoring
	Safety	▪ Maritime Sector Safety and Resilience project (preliminary estimate of T$20 million but specific investments can be split out)	▪ Upgrading and capacity development in maritime safety and pollution response ▪ Update/upgrade maritime safety and pollution facilities; hydrographical charts, etc ▪ Upgrading and capacity development in aviation safety
	Resilience	▪ M2: Coastal Protection – Eastern Tongatapu (T$3.0m) ▪ M4: Disaster Response and Evacuation Infrastructure (T$12.0m)	▪ Mainstream CCA/DRM into infrastructure planning, design, standards and management ▪ Upgrade Meteorological services and capability ▪ Improved arrangements for coordination of major projects with multi-sector implications

[2] Linked to the proposed extension of the international fibre-optic cable between Tonga and Samoa

Capacity to financially sustain existing and new infrastructure

As discussed above, there has been a peak in infrastructure investment over the last three to five years, and investment is expected to continue under this NIIP. This creates a major challenge for Tonga to fund and sustainably maintain existing infrastructure and high priority new investments. Under current arrangements, responsibility for economic infrastructure operation and maintenance is split between Public Enterprises and Ministries, with all economic infrastructure except roads and outer islands ports currently under the management of Public Enterprises.

The financial performance of Public Enterprises has improved since the NIIP of 2010, but in terms of capacity for infrastructure financing, the picture is mixed. Table C summarises the results of an analysis of the capacity of Public Enterprises to self-fund infrastructure maintenance and renewal.

Table C: Analysis of capacity for self-funding infrastructure costs

Sector	Agency	Operations	Maintenance	Small CAPEX	Medium CAPEX	Large CAPEX
Energy	Tonga Power	High	High	High	High	Medium
Telecoms	Tonga Communications Corp. (TCC)	High	High	High	High	Medium
	Tonga Broadcasting Commission (TBC)	High	Medium	Medium	Low	Low
Water	Tonga Water Board (TWB)	High	High	Medium	Low	Low
Waste	Waste Authority Ltd	Medium	Low	Low	Low	Low
Transport	Tonga Airports Ltd (TAL)	High	High	High	High	Low
	Ports Authority Tonga (PAT)	High	High	High	High	Low

Several Public Enterprises (Tonga Power Ltd (TPL), Tonga Communications Corporation (TCC), Ports Authority of Tonga (PAT), and Tonga Airports Ltd (TAL)) have effective maintenance and investment programs in place, and can fully fund routine maintenance and small-medium asset renewal from their own resources. However, these Public Enterprises would struggle to self-fund investments to replace or rehabilitate the largest item of infrastructure that the Public Enterprise owns (such as the airport runway) or is required in order to transform the sector (such as an undersea fibre-optic cable).

The financial position of the Tonga Water Board (TWB) is improving, with strong growth in revenues and an improved capacity to meet operating and maintenance costs and small capital expenditures. The Tonga Broadcasting Commission (TBC) can fund operations, but is struggling to keep pace with maintenance requirements, resulting in a gradually deteriorating infrastructure condition. The Waste Authority cannot fully fund the cost of operations and maintenance from its own resources and requires a Government subsidy to remain financially viable. Public Enterprises (with the possible exception of TPL, the TCC, and PAT) have a limited capacity for additional borrowings based on an analysis of their debt carrying capacity.

The Government has a very limited capacity to finance economic infrastructure activities either from its Budget or through borrowing:

- The economy is improving but Budget conditions are expected to remain tight. The economy is growing slowly (0.8 per cent in real terms in 2011/12) and after several years of deficits, Government has budgeted for a small surplus in 2012/13, and surpluses of the order of one per cent of Gross Domestic Product (GDP) are projected in the next three financial years.
- The level of existing Government debt and impending principal and interest repayments also pose significant challenges. The country's present value of debt to GDP and present value of debt to exports are expected to exceed their debt sustainability thresholds of 100 per cent and 30 per cent until at least 2018. In response to this challenge, Government has adopted an interim 'no new loans' policy.
- Dividends from Public Enterprises are not a significant revenue source, nor are they likely to be so in the medium term.

These conditions severely limit the capacity of Government to self-fund infrastructure initiatives.

Funding strategy

The table below combines the requirements for capital expenditure on infrastructure over the period 2013/14 to 2017/18 with estimated expenditures on complementary initiatives and the costs of maintenance of infrastructure (including pre-existing assets). It also provides a summary of the total demand for infrastructure finance over this period.

Table D: Total demand for infrastructure finance (T$ million)

	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Capital Investment						
NIIP2010 underway and committed	104	49	7	8	5	173
NIIP2013 high priority	16	62	60	24	10	172
Other smaller items of capital expenditure	8	8	8	8	8	40
Complementary initiatives						
NIIP2013	3	3	3	3	3	15
Maintenance						
Pre-existing assets [1]	10.5	10.5	10.5	10.5	10.5	52.5
NIIP2010 underway and committed	0.5	2.5	2.5	2.5	2.5	10.4
NIIP2013 high priority	0.3	0.8	1.5	2.0	2.1	6.7
Total	142	136	92	58	41	470

Notes: [1] Including NIIP2010 assets operational in 2011/12

Based on the analysis of financial capacity of the Government, Public Enterprises, and past and planned external assistance programs, the Government plans to fund the above program as follows:

- Public Enterprises are expected to lift spending on infrastructure through revenues from user fees, contribute approximately T$35 million to maintenance, and some T$80 million to financing capital expenditure in infrastructure over the five year period. This includes contributions to NIIP2013 high priority projects and to major investment projects already underway or committed, and to planned smaller investments that are part of the Public Enterprises' own investment program. In particular, the proposed new control tower at Fua'amotu and the expansion of the Nuku'alofa water system are two NIIP priority projects that could involve partial self-financing by the TAL and TWB respectively.

- Government is planning to contribute roughly T$5 million to infrastructure investment and T$35 million to maintenance, consisting of increased spending on maintenance for outer islands ports and the establishment of a 'Road Fund' that will be phased in over several years and when fully operational will provide more than T$6 million each year for routine and periodic maintenance.

- Development Partners are expected to continue providing support for economic infrastructure and associated technical assistance and capacity building with an amount of approximately T$300 million. During past years, major development partners have committed some T$380 million in assistance for ongoing and planned infrastructure projects. With the Government's 'no new loans' policy in place, it is expected that grant finance will increase to make up for lower concessional loan finance. A greater contribution is also expected from regional and global funds for Climate Change Adaptation (CCA)/Disaster Risk Management (DRM) activities. Government will take a lead role in facilitating CCA/DRM investments, a key emerging priority in the NIIP process.

- The private sector is not expected to contribute significantly to capital investment in infrastructure in the short-medium term, but will play a critical and increasing role as a service provider in terms of design, construction, operations, and specialist technical services in the maintenance and construction of infrastructure. In the event that the extension of the undersea cable from Tonga to Samoa materialises, it is expected that part of the costs of linking up Ha'apai and Vava'u (project T9) will be covered from revenues from the use of that cable.

The funding strategy as explained above is summarised in the table below.

Table E: Indicative infrastructure budget for 2013/14 - 2017/18 (T$ million)

		Funding Source		
	Demand for Funding	Government	Public Enterprises	Development Partners
Capital Investment	$385	$5	$80	$300
Complementary Activities	$15	-	-	$15
Maintenance	$70	$35	$35	-
Total	$470	$40	$115	$315

In the short-medium term, making better use of existing infrastructure is also critical. Government considers that despite current financial constraints, substantial progress can be made towards optimising the use of existing and new infrastructure assets through improved asset management and operating efficiencies. In particular, advancements can be made with relatively modest budgets and development partner support for complementary initiatives (mostly technical assistance) aimed at building the foundation of sustainability, safety, and resilience that underpins the NIIP. This will include:

- working with Ministries and Public Enterprises to strengthen their capacity in planning, financial evaluation, business case development, implementation, and management of proposed infrastructure investments. All proposed investments should be supported by life-cycle costing and an asset management plan;
- retaining the clear commercial focus of Public Enterprises and accelerating progress on improving their financial performance as a way of strengthening capacity to meet maintenance and investment needs;
- promoting the principles of strategic asset management as a framework for improved infrastructure management and facilitating a 'maintenance culture' at the Board and Chief Executive Officer (CEO) level;
- placing a greater emphasis on making better use of existing infrastructure through measures such as demand-side management (DSM), improved efficiency of service delivery, and alternative service delivery options;
- ensuring that environmental impact assessments (EIA) and environmental management planning is undertaken for major infrastructure projects, and strengthening and harmonising environmental monitoring and enforcement of legislative requirements;
- strengthening the capability of the MOI for oversight of safety standards, especially in the maritime and aviation sectors. Safety, especially in the transport sector, is one of Government's highest priorities; and
- mainstreaming climate change adaptation and disaster risk management into all aspects of infrastructure planning, management and operation, especially through the JNAP process (*Joint National Action Plan on DRM and CCA*), and *Strategic Program for Climate Resilience for the Kingdom Of Tonga*.

In addition to specific complementary initiatives, Government intends to strengthen the policy and operational environment for funding and managing infrastructure by:

- using the NIIP process to provide clear direction about Government's infrastructure development priorities, and making sure that the NIIP is widely available within Government and to the broader community;
- continuing initiatives under the Government Structural Reform process to clarify and simplify institutional responsibilities and streamline Government procedures in the infrastructure sector;
- strengthening the role of the Ministry of Infrastructure (MOI) in creating an improved environment for infrastructure development, financing, and delivery, because infrastructure relies on having effective public policies, institutions and legislation;
- strengthening forward planning requirements by requiring that all economic infrastructure sectors have a 10-year infrastructure strategy and a three-year investment plan; and
- engaging further with the private sector, and continuing the reform and private sector development initiatives already launched by Government.

Updating the NIIP

The NIIP is an integral part of the Government's national planning and budgeting process. With many infrastructure projects and reforms already underway and more in the NIIP priority pipeline, it is important to keep the NIIP updated to ensure it remains relevant to emerging challenges and opportunities. The update cycle will align with the Medium-

Term Budget Framework (MTBF) process that is being introduced by the Government from 2013 and with updates to the TSDF.

Every four to five years, a full update of the NIIP will be prepared. A partial update will be released after two to three years with developments regarding the list of high priority projects and complementary initiatives; highlights of emerging challenges; and notes of any major changes to overall Government policies and priorities for the infrastructure sector.

The Ministry of Finance and National Planning (MFNP) in collaboration with the MOI will monitor progress on implementation of the NIIP and prepare brief annual progress reports. The Government intends to make these annual progress reports available to national stakeholders and development partners, and aims to present them at annual infrastructure coordination meetings.

1 Context

1.1 About the National Infrastructure Investment Plan (NIIP)

The National Infrastructure Investment Plan (NIIP) outlines the Government of Tonga's priorities and plans for major infrastructure initiatives over the next five to 10 years. This is the second NIIP (NIIP2). It updates and builds on the successes of the first NIIP that was prepared in 2010 (referred to as NIIP 2010, or NIIP1). Of the 12 priority investment projects proposed in the first NIIP, most are now underway and many of the supporting reforms and capacity building initiatives are also moving forward. The success of NIIP1 in terms of formal adoption by Government; facilitating dialog with Development Partners; and facilitating funding for priority projects and initiatives suggests that NIIP1 got it about right in terms of capturing the prevailing key themes and priorities for the infrastructure sector. But NIIP 2010 has been less successful in terms of achieving broad and lasting awareness and impact at a working-level in the Government of Tonga (GoT) and the broader community. A more detailed review of the outcomes and impact of NIIP 2010 are provided in Annex G and the lessons learned have been applied in preparing NIIP2.

This Plan covers major infrastructure initiatives with national, regional, or local significance. It looks at the next five years to 2018 in detail and the five years from 2018 to 2023 in terms of broad directions for infrastructure development. It is the result of extensive consultation with infrastructure managers, users, and funding partners.

This Plan focuses on economic infrastructure facilities that support everyday life and business activity, such as energy supply systems, telecommunications, water and waste management, and transportation. In particular, the NIIP includes priorities and plans for major initiatives in the following sectors:

- Energy (electricity, fuel)
- Telecommunications (telephone, internet, broadcasting)
- Water and waste related services (water supply, waste water, drainage, solid waste)
- Transport (airports, roads, sea ports)

Other categories of built infrastructure supporting social services and governance, such as education, healthcare, and correctional services, are not included in this Plan and generally have their own sector plans. Government is considering extending the scope of the NIIP to provide broader coverage of social and administrative infrastructure as a second stage of the NIIP process.

1.2 Why is the plan needed

Infrastructure service delivery in Tonga is quite mature in terms of the availability and capacity of basic services. Tonga also has some of the best human development outcomes in the region in terms of the Millennium Development Goals (MDGs). But in other areas of infrastructure asset management, such as the cost, quality, and sustainability of infrastructure and services, Tonga is not keeping pace with needs and community expectations.

This Plan is a step towards a more systematic approach to infrastructure planning, coordination, and asset management. It is needed for a number of reasons:

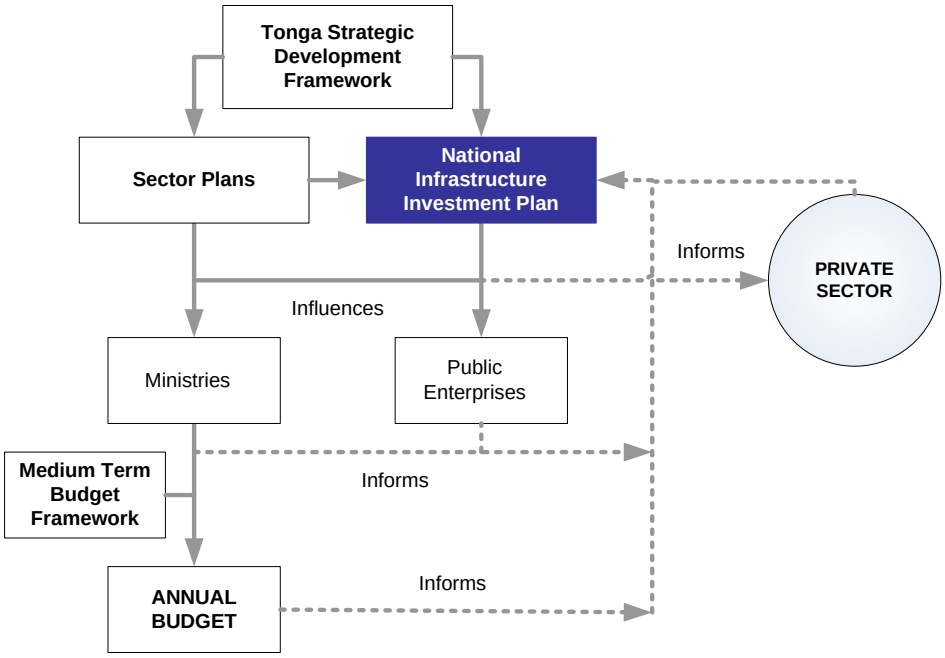
- Planning tends to be undertaken separately in each sub-sector, often on a project basis. The NIIP takes a sector-wide approach that brings together the various sub-sector and agency plans into a single resource about infrastructure priorities and plans. This provides a catalyst for a more coordinated and integrated approach to infrastructure planning, development, and service delivery by Government agencies, Public Enterprises, and the private sector.
- The NIIP is an important step towards establishing asset management as a core function of Government and infrastructure managers; instilling a greater emphasis on maintenance; and incorporating a life-cycle approach to infrastructure management.
- The NIIP is also a catalyst for a greater emphasis on Climate Change Adaptation (CCA) and Disaster Risk Management (DRM) in infrastructure planning, implementation, and operation. The aim is to ensure that all infrastructure is more resilient to the potential impacts of climate change and natural disasters.
- In addition, the NIIP is a key input to medium and longer term budget planning. It provides a picture of the scale and sequencing of future investment and financing needs, and ongoing maintenance requirements.

- Finally, by providing greater certainty about the nature and timing of infrastructure projects, the NIIP improves the investment environment for the private sector. It also provides development partners with clear information about Government priorities and plans for infrastructure development, and the areas where assistance is most needed.

1.3 How does NIIP relate to other plans

The NIIP is an important part of the national planning and budgeting process. This process and the role of the NIIP in the overall infrastructure planning process is summarised in Figure 1.1.

Figure 1.1: Relationship between NIIP and the planning process



The overall direction and priorities of national infrastructure planning and the NIIP are shaped by the *Tonga Strategic Development Framework 2011-2014* (TSDF). The TSDF is the Kingdom's principal document for setting economic and social development objectives. It sets the following development vision for the Kingdom:

> "To develop and promote a just, equitable and progressive society in which the people of Tonga enjoy good health, peace, harmony and prosperity, in meeting their aspirations in life".

More specifically, the TSDF highlights "dynamic public and private sector partnership as the engine of growth" (TSDF Outcome Objective 2), and Government's emphasis on strong inclusive communities, equitable development, and its belief that "all parts of the country should enjoy similar economic and social opportunities, enabling the outer islands and rural development programmes to contribute to national prosperity" (TSDF Objective 1).
Infrastructure and the NIIP play a major part in meeting these TSDF goals. In particular, TSDF Outcome Objective 3 specifies the need for:

> "Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business, by the adequate funding and implementation of the National Infrastructure Investment Plan (NIIP)".

This objective, and in particular the TSDF emphasis on quality of life; inclusive development; access to infrastructure services; affordability, safety and reliability; private sector development; maintenance and asset management; environmental sustainability; and resilience to climate change and natural disasters, provide an integrating framework for the NIIP and identifying infrastructure priorities.

As well as being influenced by the TSDF, the NIIP is also shaped by sector development strategies/plans, including the *Joint National Action Plan on Disaster Risk Management and Climate Change Adaptation* (JNAP). Together, the TSDF, NIIP, and sector plans then influence Ministries and Public Enterprises in their corporate and investment planning. The

Corporate Plans and the Annual Management Plans of Ministries set out a three-year strategic plan for the Ministry and a one-year management plan for allocation of resources. This aligns closely with the annual budgeting process of Government, and the Medium-Term Budget Framework (MTBF) which incorporates forward projections of aggregate expenditure and revenue. Full implementation of the MTBF is expected for the 2013/14 Budget. A similar process occurs in Public Enterprises where Statements of Corporate Intent play an equivalent role in forward planning and budgeting. The NIIP also provides important information on planned future investments that can be used by the private sector in its planning and decision-making.

Finally, each update of the NIIP is informed by national and corporate investment plans and budgets plus the priorities of the private sector. At this stage the planning loop is completed. More details of the planning process in the infrastructure sector are provided in Annex B.

1.4 How to read the plan

The NIIP outlines Government priorities and plans for economic infrastructure for the next five to 10 years and lists priority initiatives planned for this period. The Plan is organised as follows:

- Chapter 2 commences with an analysis of the current situation, economic and social factors that drive the need for infrastructure, the specific challenges for Tonga, and the way that the Government of Tonga intends to respond to these challenges.
- Chapter 3 looks at each infrastructure sub-sector (energy, telecommunications, water, solid waste management, transport) in more detail. It provides an overview of the key developments, challenges, and demand drivers in each sub-sector, and then outlines a set of initiatives (investments, supporting measures) that Government sees as priority areas for the sub-sector. This section also briefly describes the process that was used to determine these priorities.
- Chapter 4 examines broader issues of sustainability (financial, operational, environmental, institutional), safety, and resilience (climate change, natural disasters) that underpin infrastructure development.
- Chapter 5 follows with a discussion of how the infrastructure will be delivered, including demand for infrastructure finance, funding strategy, and partnership arrangements.
- Finally, Chapter 6 of the Plan concludes with a brief description of how it will be monitored and updated. The Government intends that the plan will be regularly updated to reflect progress on implementation of the Plan's milestones and changing needs.

The Plan also includes several Technical Annexes that provide further detail on the following topics:

- A summary of the long list of projects and project sheets for the priority infrastructure projects (Annex A).
- A status report of each sector, current challenges, and investment plans (Annex B).
- The process and methodology of project prioritisation (Annex C).
- An overview of CCA/DRM issues (Annex D).
- The financial performance of the economic infrastructure sector, strategic asset management, life cycle costing, and maintenance (Annex E).
- An assessment of the current financial environment for economic infrastructure and a proposed funding strategy (Annex F).
- A review of the outcomes and impact of the NIIP 2010 (Annex G).

2 The infrastructure challenge

Infrastructure investment responds to the needs and the challenges facing Tonga, and to national social and economic development goals as expressed in the TSDF. The starting point for this NIIP is an understanding of the link between infrastructure and economic and social development; the factors that are driving the need for infrastructure investment in Tonga; and the strategic framework that guides the Government in formulating its response to these challenges. Key demographic and economic indicators are provided in Table 2.1 below.

Table 2.1: Key demographic, economic and sector indicators

Indicator		
Demographic		
Population (2011)	103,040 persons	
- Tongatapu	75,160 persons	
- Outer Islands	27,880 persons	
Average growth rate (5 years to 2011)	0.2%	
- Tongatapu	0.8%	
- Outer Islands	-1.4%	
No. of Households (2011)	18,160	
Average Household Size	5.7 persons	
Economic		
GDP (2010-11)	T$782 million (USD 453 million)	
GDP per capita (2010-11)	T$7,600 (USD 4,400)	
Growth in GDP (real terms)	0.8% (2011/12r); 2.9% (10/11r); 3.3% (09/10); 3.2% (08/09)	
Government Budget Surplus/Deficit (%GDP)	0.1% (2012/13e); -3.0% (11/12e); -7.3% (10/11p); -5.3% (09/10)	
Growth in Consumer Prices	6.1% (2010/11); 1.7% (2009/10); 5.5% (2008/09)	
Exchange Rate:	0.545 (USD/T$: 2010/11 average)	
Sector Contributions		
Key Components of GDP 2010-11	Agriculture, forests and fisheries -	17%
	Commerce, restaurants and hotels -	13%
	Government services -	12%
	Construction -	11%
Key Components of Exports 2010-11	Live animals, animal products -	50%
	Vegetable products -	41%

Sources: Tonga Census 2011; Tonga National Accounts Statistics (Tonga Statistics Department, June 2012 and February 2013); Government of Tonga Budget Statement for year ending 30th June 2013

2.1 The link between infrastructure and development

Infrastructure plays a critical role in achieving the goals of the TSDF because there is a clear and positive linkage between infrastructure, social development, and economic growth. International research provides evidence of this strong, positive association. There is still much to be debated about the size of infrastructure impacts on economic output; short-term versus long-term benefits; which infrastructure categories give the best results; and the influence of certain policies and practices. However, there is consensus that:

- There is a positive correlation between infrastructure and economic outcomes. Investment in core economic infrastructure (such as electricity, telecoms, transport, sewerage, and water systems) produces the largest gains in productivity. Investments in roads and telecommunications typically deliver the greatest social returns.
- Maintenance is less 'visible' but is likely to have a greater positive influence on economic output than new projects.
- When access to core infrastructure has been addressed, the best economic results come from improving efficiency and then from reducing service prices.

This means that well-targeted investment in infrastructure can have significant benefits for economic growth and quality of life. But the reverse is also true. Inadequate infrastructure is a bottleneck to economic activity and also reduces the day-to-day wellbeing of people; their quality of life; and the ability to withstand and respond to disasters. Sustainability is also compromised because resources are used wastefully.

It is also important to assess whether or not existing infrastructure is being used and managed efficiently. When it is not, service coverage, pricing, and quality are all compromised, and the benefits of appropriate infrastructure are not realised. As a result, this NIIP focuses not just on physical infrastructure but also on the way it is used and managed.

2.2 What drives the need for infrastructure investment?

Tonga is generally well-placed in terms of access to basic infrastructure, associated services, and the coverage and capacity of those services. Overall, basic services and service coverage are good, with full national coverage of basic telecommunications and improving; a high level of access to reticulated power and water, and off-grid arrangements in place elsewhere; one of the highest levels of road density in the region; and a strategically located network of ports and airports throughout the country (see Chapter 3 and Annex B for more details). However, many challenges still remain.

The main priority for the development of Tonga's infrastructure sector is to use infrastructure as a catalyst for improved macroeconomic, social, and environmental outcomes in line with key TSDF objectives, while at the same time, continuing to improve basic services. In other words, to use infrastructure to improve quality of life, underpin economic development, and meet changing needs. This determines the main drivers for continued infrastructure investment and improved infrastructure management in Tonga as presented in the NIIP 2013 – 2023:

- Improved operation and maintenance of current infrastructure to provide basic infrastructure that is appropriate, well planned, and maintained. As well as ensuring access to basic services, there are growing community expectations regarding improving the quality, safety, and reliability of the services provided.

- Improved infrastructure and services in the outer islands to achieve national goals of inclusive growth by developing the country as a whole, in line with TSDF Outcome Objective 1. The small population, multi-island geography, remoteness from markets, and small market size of Tonga creates special challenges for the development and operation of infrastructure in support of these goals,[3] and adds significantly to the cost and difficulty of supplying economic infrastructure services throughout the country.

- Leveraging infrastructure as a catalyst and enabling factor for economic growth. In particular, lowering the cost of doing business and creating the enabling environment for the private sector to increase the output of the productive sectors, especially tourism, agriculture, forestry, and fisheries (TSDF Outcome Object 2 and Government Budget Strategy). Tourism, agriculture, forestry, and fisheries activity currently comprises around 30 per cent of GDP and 90 per cent of exports. These sectors rely on access to quality basic services (power, telecommunications, water, waste management, roads) and have a high level of reliance on international/domestic aviation and maritime links. In doing so, the infrastructure sector also creates employment and direct opportunities for private sector participation in construction, maintenance, and management. Government expects the private sector to take an increasing role in the infrastructure sector as part of its economic growth strategy.

- Population trends, especially drift to urban areas and the opportunities arising from new technology (such as online services), are changing the nature and pattern of demand for infrastructure services. The total population of Tonga is around 103,000 and is growing slowly (average of 0.2 per cent per year over the last five years), but the pattern is not uniform. There is a strong trend of urban drift, with the population of Nuku'alofa (especially in urban fringe areas) growing much more quickly than the national average (up to an average 2.5 per cent growth per year in some areas). Around 75 per cent of the national population is now concentrated in Tongatapu. This creates pressure on urban services on Tongatapu and inter-island connectivity.

- Improving the resilience of infrastructure to the impacts of climate change and natural disasters to protect the community and provide a safeguard so that infrastructure services are still available when they are needed most. Tonga averages T$30 million per year in losses from cyclones and earthquakes and has a 50 per cent chance of experiencing a loss exceeding T$300 million in the next 50 years.[4] According to the best available scientific advice, Tonga's climate is changing and infrastructure will need to increasingly cope with more powerful cyclones, more very hot days, and increased rainfall intensity.

[3] For a general overview of the challenges facing Tonga and other Pacific nations, see Asian Development Bank, *Swimming Against the Tide* (2004).
[4] From the Pacific Catastrophic Risk Assessment and Financing Initiative (2011).

- Ensuring that Tonga maintains its compliance with international safety and security regulations in the international aviation and maritime sectors, so that connectivity to international and national markets is not constrained such as to become a brake on economic development and an impediment to social connectivity. This is particularly critical to development of export-based industries.

These key drivers of demand for infrastructure development and their relative significance for each of the infrastructure sub-sectors are discussed in more detail in Chapter 3 and in Annex B.

There is also a wider issue that remains one of Tonga's greatest infrastructure challenges. The role of government in relation to the infrastructure sector is changing. Government has largely moved away from taking responsibility for infrastructure investment and service delivery, to being a facilitator of infrastructure service outcomes. Under current arrangements, all economic infrastructure except roads and outer islands ports, are now under the management and operation of Public Enterprises. This change is consistent with international good practice, but it requires a continuing focus by Government on the policy, legislation, institutional, and regulatory environment that underpins the infrastructure management system. As a result, this Plan takes an integrated approach that considers the need for investment in infrastructure and also the need for continual improvement in infrastructure management and the infrastructure policy environment.

2.3 Strategic framework for infrastructure development

This NIIP represents the Government's recognition of the importance of infrastructure as a catalyst for economic and social development; and a response to the pressures to respond to changing patterns of demand, and continue to improve the quality, sustainability, resilience, and safety of infrastructure in Tonga. The situation is complex, but to guide Government's response to the challenge of infrastructure development and maintain focus on the key issues and objectives, it is important to have a clear vision for developing infrastructure to best benefit Tonga. The TSDF Outcome Objective for the infrastructure sector (Objective 3) provides a starting point:

> "Appropriate, well planned, and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business…".

As noted above, this means leveraging infrastructure as a catalyst and enabling factor for economic growth and inclusive development. However, it is important for the NIIP to provide more specific guidance about the reasons for investing in infrastructure and the objectives that Government seeks to achieve. Government's strategic framework for the infrastructure sector can be distilled into three core themes and one enabling theme:

- ***Connecting Tonga*** – this theme is about connecting people and business to each other within Tonga and internationally through transport and communications links. This connectivity is vital for bringing people, activities, and economic development together, especially in terms of access to international markets and ensuring that all parts of the country share similar economic and social opportunities.

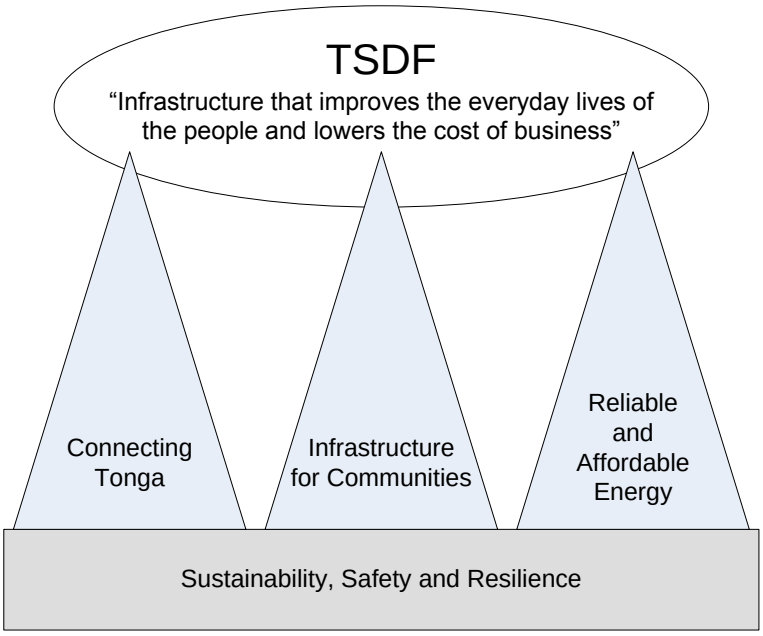
- ***Infrastructure for Communities*** – this theme is about developing the basic utilities and associated infrastructure services that support vibrant communities and economic development, including electricity, water, sanitation, solid waste management, and drainage. Inadequate basic utilities can be a bottleneck to economic growth, and also reduce the day-to-day well-being of people and their quality of life.

- ***Reliable and Affordable Energy*** – as well as basic access to electricity, energy supplies need to be reliable and affordable. This theme is about transforming the Tonga energy sector to make it more sustainable in terms of affordability; greater use of renewable energy sources; and reduced reliance on imported fuels. In the longer term, this will also underpin sustainable economic growth.

- ***Sustainability, Safety and Resilience*** – these qualities are not optional extras, but are an essential part of any infrastructure development. Sustainability, safety, and resilience to climate change and natural disasters provide the foundation that underpins all infrastructure in Tonga. In this context, sustainability means that the infrastructure is affordable on a full life-cycle cost basis (financial sustainability); that the infrastructure assets are properly maintained and managed (operational sustainability); that impacts on the local and global environment are minimised and preferably reduced (environmental sustainability); and that adequate institutional frameworks and capabilities are in place to support the development (institutional sustainability).

These themes and their relationship to each other and the TSDF are shown in the following diagram (Figure 2.1). As mentioned above, the importance of these themes and the overall strategic framework is that they provide a touchstone for maintaining a clear focus on the rationale and objectives for infrastructure development in Tonga. In a nutshell, **the reason for investing in developing the infrastructure sector is to connect people and business to social and economic opportunities; to provide the basic infrastructure services that support vibrant communities and the economy; and to provide access to reliable and affordable energy, in a way that is sustainable, safe and resilient.**

Figure 2.1: Relationship between themes



3 Priorities for infrastructure development

There is already a substantial amount of infrastructure investment underway, committed or proposed.[5] At the same time, there are also a range of infrastructure challenges and opportunities that need to be addressed. This part of the NIIP outlines Government's priorities for investment in the infrastructure sector over the next five to 10 years. It provides an overview of the current investment program for economic infrastructure and a summary of priorities for new initiatives for each sector. To provide a more complete picture of investment plans for each sector, it includes Government and Public Enterprise projects. More details of each of the projects are provided in Annexes A and B.

3.1 How the priorities have been determined

The first priority is to successfully complete projects that are already underway and committed, and to consolidate the infrastructure that we already have through better infrastructure management, use, and maintenance. Government is increasingly adopting a sector-wide approach to planning and improving infrastructure performance, and has several major medium/long-term infrastructure programs that are underway or in preparation (Table 3.1). These programs include:

- Tonga Energy Roadmap (TERM) implementation, which is a diverse and multi-year program aimed at improving quality access to modern energy services; increasing use of alternative (especially renewable) energy sources; reducing vulnerability to external price shocks; and implementing related institutional and regulatory reforms and DSM initiatives (support from multiple development partners).
- Tonga-Fiji Submarine Cable Project (TFSCP), which will develop a communications cable linking Tonga with existing international networks at Fiji, and provide technical assistance and capacity strengthening to improve the regulatory framework (supported by the Asian Development Bank (ADB), Australian Government, World Bank (WB)).
- Nuku'alofa Urban Development Sector Project (NUDSP), which is implementing high priority investments in urban infrastructure, especially in the water and solid waste sector; and strengthening the policy, planning, and management environment for delivery of urban services, including asset management (supported by ADB and Australian Government).
- Integrated Urban Development Sector Program (IUDSP), which is improving urban infrastructure in Nuku'alofa through high priority road and drainage projects (supported by the ADB).
- Transport Sector Consolidation Project (TSCP), which is supporting development of the transport sector through a program of investment in airports, roads, and ports; technical assistance; and capacity building (supported by the WB and Australian Government).
- Pacific Aviation Investment Program (PAIP), which aims to improve operational safety and oversight in the international air transport sector through investment (including resurfacing of Fua'amotu and Vava'u airport runways) and capacity building (supported by the WB).

In addition, there are a large number of smaller economic infrastructure projects already underway or committed (see Annex A).

[5] In this Plan, a project is defined as *committed* if funding has already been identified and confirmed for the investment and there is a high probability that it will proceed, and *proposed* if it is proposed for future implementation but funding has not been confirmed and timing is less certain. Planned investments include all those project that are underway, committed or proposed.

Table 3.1: Major projects already underway or in preparation in each sector

Project	FY14	FY15	FY16	FY17	FY18	after FY18
Energy (TERM Implementation)	■■	■■	■■	■■	■■	■■
Communications (TFSCP)	■■	□□	□□	□□		
Water (NUDSP)	■■	■■	■■	■■		
Solid Waste (NUDSP)	■■	■■	■■	■■		
Roads (TSCP, IUDSP)	■■	□□	□□			
Airports (TSCP, PAIP)	■■	■■	■■	■■		
Maritime (TSCP)	■■	□□	□□	□□	□□	

■■ Underway
□□ Follow-up project under preparation or discussion

These ongoing projects provide a foundation for improving economic infrastructure over the next five to 10 years, but will not address all of the current and emerging challenges. Therefore, additional investment and related initiatives will be required where it is needed, is affordable, and will deliver benefits to the economy and community.

Priorities for additional projects over the next five to ten years were identified through a process of consultation and analysis. The first step was to carry out an analysis of the current status of infrastructure and services, and assess demand for new infrastructure. The second step involved consultation with infrastructure managers (Ministries, Public Enterprises) and users (community and private sector) to identify a long list of proposals for infrastructure projects and related initiatives that address current deficiencies and emerging infrastructure needs. These project ideas were then refined in discussions with infrastructure managers to ensure that the project objectives, concept, and likely costs were clearly identified. This process generated more than 40 proposals for new major projects that would improve the national infrastructure system at a total cost estimated to be around T$500 million. These project proposals, as well as projects already underway and committed, are listed in Annex A and described in Annex B.

However, with available financial resources and implementation capacity it will not be possible to deliver all of these projects over the next five years. Therefore decisions needed to be made about investment priorities. The long list of proposed projects was progressively screened to identify projects that are strongly aligned with national goals; planned to proceed in the next five years; and which deliver strongest benefits to the Tongan people. The first test checked whether each project concept is aligned with TSDF goals and MDGs; and is consistent with the relevant sector and corporate plan. Projects that demonstrated a high level of strategic alignment were retained and moved forward to the next stage in the screening process. The next step was to set aside all projects that are not planned to commence in the next five years. The timing of projects beyond five years is less certain and in most cases, these longer-term proposals are still in the development phase.

The remaining proposed projects were then assessed using a formal multi-criterion assessment (MCA) methodology which ranked the projects according to their performance against criteria linked to key TSDF outcome objectives.[6] The criteria included economic (access to markets; effect on the cost/quality/capacity of infrastructure services); social (access to social opportunities and interaction; effect on service coverage/ quality/reliability/safety); environmental (effect on soil/water/air/ecosystems); climate change and disaster management factors (climate change adaptation/mitigation, CCA/DRM resilience); and sustainability (financial, technical, institutional). The starting point for the selection and weighting of criteria for the multi-criteria assessment was a review of the criteria and weights used in NIIP2010. The review considered developments since the preparation of NIIP2010, most notably the release of the TSDF 2011-2014 and Government's new strategic vision and priorities as described above.

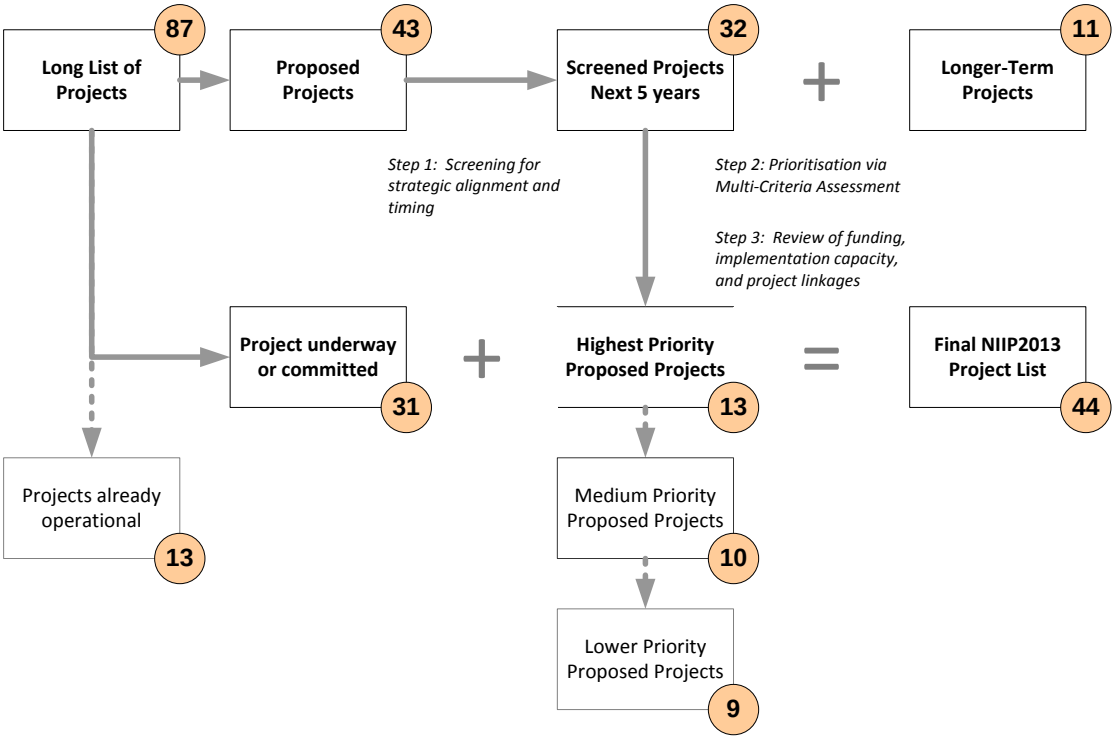
The major changes introduced in the criteria used in this NIIP were the addition of a headline criterion dealing specifically with climate change adaptation and disaster risk management, and broadening the scope of the readiness headline criterion used in NIIP2010 into a project sustainability headline criterion, with financial, technical and institutional dimensions. The criteria and sub-criteria selected for the MCA are described in detail in Annex C. The review also considered the weighting attached to each criterion, with the aim of simplifying the weightings, better reflecting the balance of economic, social and environmental objectives of TSDF, and the need for project sustainability. In summary, the headline criteria and weightings used in the multi-criteria assessment were:

[6] MCA provides a rapid appraisal for screening projects, but for all projects, detailed feasibility/economic/financial evaluation will be required to confirm their value-for-money before a final commitment to investment.

Economic	30%
Social	30%
Environmental	10%
Climate change / DRM	10%
Project sustainability	20%

As noted above, it will not be possible to deliver all of the proposed projects over the next five years. The last step was to divide the projects into high/medium/lower priority bands based on the results of the MCA and considering potential availability of finance (see Chapter 5 and Annex F for more details); implementation capacity (both in relation to the institutions responsible for the projects and those implementing projects, in particular the construction sector); and potential linkages and synergies among projects. The overall process used to identify infrastructure priorities is shown in Figure 3.1, and the process and full results are described in detail in Annex C.

Figure 3.1: Preparation of the NIIP project list



The outcome is 13 high priority proposed projects (Table 3.2) that are:

- planned to commence within the next five years and have strong alignment with the objectives of the TSDF;
- sustainable in terms of having adequate financial, technical, and institutional structures in place;
- expected to deliver the highest levels of economic/social/ environmental/resilience benefits to Tonga;
- consistent with available financial resources and implementation capacity.

The 13 priority projects have no confirmed source of funding and represent Government's priority aspirations for additional infrastructure development over the next five years. In conjunction with ongoing and committed projects, they form the basis for strategies for each of the infrastructure sectors over the next five to 10 years. More details on each of these projects are provided in the following discussion of priorities for each sector, and in Annex A in the form of a detailed Project Sheet for each of the 13 high priority projects. Note that each specific investment project has a reference code (such as E11) that is used to track the projects and the same code number is used throughout the NIIP and Annexes.

Table 3.2: Highest priority proposed projects

Sector	Ref	Project	Estimated Cost T$ x million	FY2014-18
Energy	E11	Additional 1-2MW of Solar PV on Tongatapu	24	
	E16	Outer Islands On-Grid Renewable Energy Project	9	
Telecoms	T9	Fibre-Optic Cable to Ha'apai and Vava'u[7]	30	
	T10	Communications for Early Warning and Disaster Recovery	6	
Water	W3	Outer Islands water supply improvements	15	
	W4	Expand Nuku'alofa system to growth areas	11	
Solid Waste	S6	New Landfill or Transfer Station on Ha'apai	4	
Roads	R10	Outer Islands Roads Upgrading Program	10	
Ports	P9	Maritime Sector Safety and Resilience	20	
Airports	A11	Resurfacing Ha'apai Airport runway, apron, taxiway	9	
	A12	New Control Tower at Fua'amotu International Airport	7	
Multi-sector	M2	Coastal Protection - Eastern Tongatapu	15	
	M4	Disaster Response & Evacuation Infrastructure	12	
		Sub-total – High Priority proposed projects	172	
		+ Projects Underway	100	
		+ Committed Projects	73	
		TOTAL	T$345	

The total package of investment priorities (underway, committed, proposed) of T$345 million is smaller than the NIIP2010 priority program, which amounted to some T$480 million. This reflects the unusually high level of infrastructure investment in the last five years. Government also intends to achieve a balance of new investment at a sustainable level, consolidate of existing infrastructure, and ensure that all parts of the country as much as possible share similar economic and social opportunities. For these reasons, the proportion of new investments in outer islands is higher compared to the previous NIIP, and the overall balance of investments of ongoing and new projects is about 70 percent in Tongatapu versus 30 per cent in the Outer Islands, which is close to the number of people living in the respective areas.

The investment projects listed in Table 3.2 are Government's highest priorities based on currently available information. However, it is recognised that needs change and new opportunities arise. When promising projects and activities are identified between each update of the NIIP, these projects will be analysed by the Government using the same prioritisation methodology provided in Annex C. In this way, the chances of developing projects that are not consistent with good planning principles used in this NIIP will be reduced significantly.

3.2 NIIP is an integrated strategy

The priority investment projects cannot be considered in isolation because 'hard' infrastructure cannot be separated from its supporting framework of 'soft' infrastructure (institutional/policy/regulatory/legal/ financial/planning/training and capacity building). In addition, some projects rely on other initiatives happening first or at the same time so that they can deliver their full value.

As a result, the NIIP priorities for development of the economic infrastructure sector extend beyond investment projects. **The NIIP is an integrated program of investment projects and supporting complementary initiatives.** These complementary initiatives are mostly non-infrastructure measures that support the investments and will lead to achieving better long-term and sustainable value from the investments.

Taking into account all these factors, the overall NIIP priority program for each sector has four components:

- major projects and initiatives already underway or committed;
- proposed investment projects that are assessed to be a high priority;
- complementary initiatives that support these projects and their life cycle management; and
- linked projects that work in conjunction with or rely on another initiative (priority project, complementary initiative) to enable the full benefits to be realised.

Some of the priority measures relate to cross-sectoral issues, while others are specific to a particular sector. For convenience, the integrated strategy for development of the economic infrastructure sector as a whole is presented in

[7] This project is linked to a proposed extension of the fibre-optic cable from Tonga to Samoa.

the following sections in two ways: firstly, on a sector-by-sector basis (energy, telecommunications, water, solid waste, transport, multi-sector), and then in terms of the cross-sectoral themes linked to the NIIP strategic framework described above.

3.3 Priorities for each sector

For each sector, the priorities are presented in a consistent way, starting with a brief overview of the current situation and initiatives already underway; then a discussion of the key challenges driving the need for investment in the sector; and concluding with a description of the integrated strategy of priorities for the sector. These priorities are also tabulated in Appendix A which provides a Summary Strategy Matrix for the NIIP, and a more detailed background profile of each sub-sector (infrastructure, services, demand, institutional structure) is provided in Annex B.

ENERGY

Current status and ongoing programs

Tonga has one of the highest levels of access to electricity in the region with around 85 per cent of the population on-grid and high levels of supply reliability. But at the same time, Tonga has historically had one of the highest costs of electricity in the region.[8] In part, this was a result of Tonga's almost 100 per cent reliance on diesel-powered generation for on-grid services. System losses were also high at around 17-18 per cent in 2011 but are coming down and are expected to be reduced to around 14 per cent by 2013, and reduce further to around 10 per cent through network improvements. This is more consistent with international benchmarks.

The energy sector is in a phase of rebuilding and transformation. Tonga Power is investing heavily from its own resources to rehabilitate the electricity generation and supply system to increase efficiency and safety; and is working with development partners (the Australian Agency for International Development (AusAID), European Union (EU), New Zealand Aid, and the WB) to upgrade village power supply systems and off-grid supply (Japan International Cooperation Agency (JICA)). It will be important to continue these initiatives as part of overall measures to increase efficiency and reduce the cost of electricity. At the same time, initiatives are underway to transform electricity production with a move towards greater stability and self-sufficiency. In 2009, Government responded to the twin challenges of reducing the Tongan contribution to global Greenhouse Gas (GHG) emissions and improving national energy security by endorsing a policy of 50 per cent of energy from renewable resources. This is a challenging target providing a clear indication that environmental sustainability and reducing the vulnerability of the country to future oil price shocks are key Government objectives. Renewable energy is a major element of the strategy to enhance energy security for the Kingdom.

Government's response to this target is set out in the *Tonga Energy Road Map (TERM) 2010-2020.*[9] A number of projects are already underway that contribute to meeting the renewable energy target and TERM objectives. These include installation of a 1.3 MW solar generation facility on Tongatapu (with assistance from the New Zealand (NZ) Government); an on-grid solar generation facility on Vava'u (with assistance from Abu Dhabi); investment in off-grid solar power systems for households in outer-islands (with support from the Japanese Government); research into other sources of renewable energy (such as wind power, tidal power, producing bio-fuel from coconuts, etc); and investigation of options for stabilising and potentially reducing the cost of petroleum fuels by measures such as hedging and/or improving the fuel supply chain.

Challenges

Reducing the cost of doing business, improving the quality of life of people, and Government's commitment to addressing climate change are driving the need for improved energy infrastructure. Under current conditions, Tonga has sufficient generation capacity to meet current demand[10] and growth in demand is not a major factor driving the need for investment in the short-medium term. As noted above, Tonga has historically had some of the highest costs of electricity in the region as a result of a high level of reliance on imported petroleum and past under-investment in the distribution network. This has a negative impact on business costs and on household budgets. In addition, the high level of reliance on imported petroleum creates energy security and price stability issues. The major challenge in the Energy sector is to diversify sources of energy and improve energy efficiency by rehabilitating and upgrading the

[8] Pacific Power Association, *Performance Benchmarking for Pacific Power Utilities- Benchmarking Report 2011*(2012).
[9] World Bank, *Tonga Energy Road Map 2010-2020* (2010).
[10] As measured by capacity factor, see Pacific Power Association, *Performance Benchmarking for Pacific Power Utilities- Benchmarking Report 2011*.

distribution network to provide reliable, sustainable, safe, and affordable energy to households and businesses in Tonga.

Priority initiatives

The energy sector in Tonga is responding to this challenge. TPL is heavily investing from its own sources in improvements in the distribution network and in replacing old and inefficient generation capacity. In addition, the TERM outlines a range of investments and supporting initiatives. The major priorities for additional investment in the Energy sector are:

- an additional 1-2MW of solar generation capacity on Tongatapu (E11 - T$24 million); and
- solar generation capacity on outer-islands (E16 - T$9 million).

These priority investments continue and will accelerate the program of installing on-grid solar electricity generation and extend renewable energy generation to outer islands. This is supported by complementary measures and linked investments. The complementary initiatives involve implementing TERM initiatives, in particular:

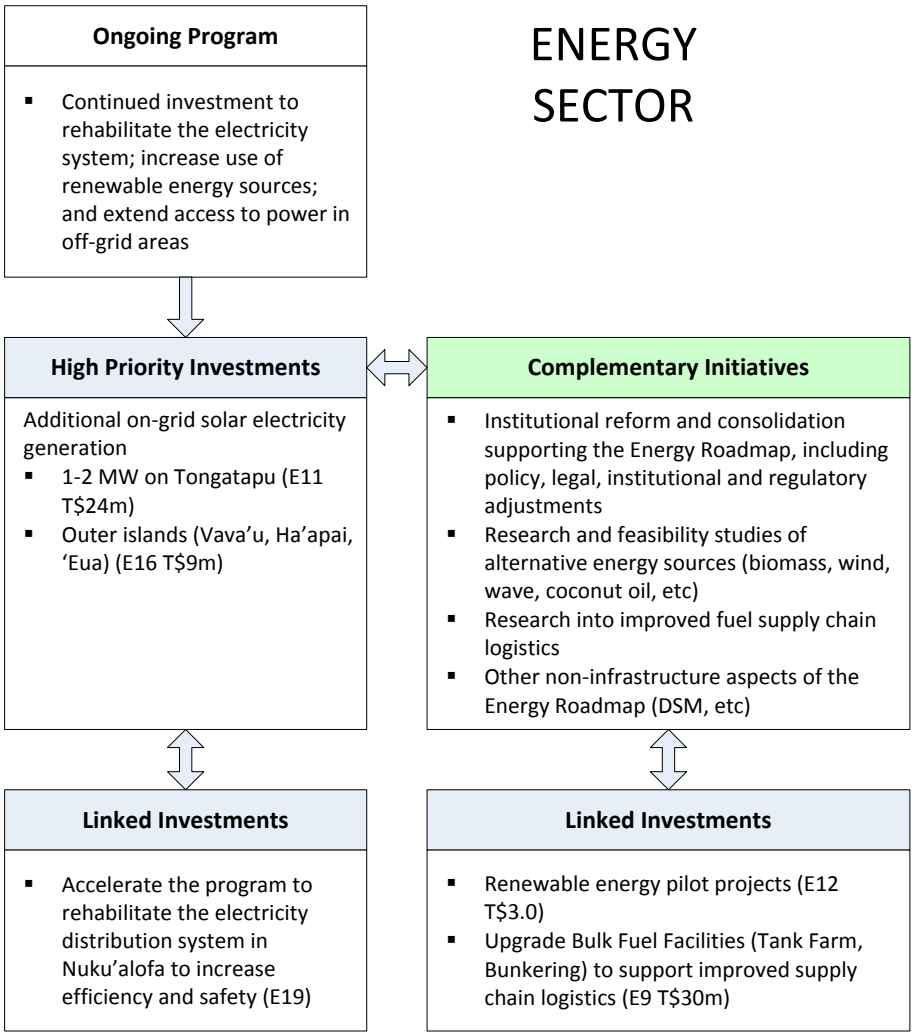
- technical assistance for institutional reform and consolidation in the energy sector, including policy, legal, institutional and regulatory adjustments;
- data gathering, resource assessments, and technical studies into options for diversifying energy sources, especially renewable energy options such as biomass, wind, wave, hydropower, etc. Depending on the outcome of research into these alternative renewable sources, the next step would be pilot plants to validate the concept. This is expected to require investment of an estimated T$3-5 million for initial trials;
- end-use efficiency and DSM initiatives (such as energy awareness, energy efficient lighting, and appliances, etc) aimed at reducing inefficient use and waste of electricity; and
- initiatives to stabilise and potentially reduce the cost of fuel by measures such as hedging and/or improving the fuel supply chain. If the studies find that expanding the fuel storage capacity at Nuku'alofa is required, this would require investments estimated at around T$30 million.

Linked investments are also required to accelerate the process of rehabilitating and improving the electricity distribution network (power lines, power poles, customer connections) to increase efficiency and safety, and reduce maintenance and operating costs. The relatively large number of existing connections and degraded state of the network make Nuku'alofa a priority for grid rehabilitation.

The Energy sector has been identified as one of the infrastructure sectors at greatest risk from the impacts of climate change and natural disasters (see risk assessment in Annex D). In the longer term, consideration will have to be given to initiatives to reduce this vulnerability, for instance by moving bulk fuel storage facilities on Tongatapu to a new location outside of the tsunami and storm surge risk zone, and by relocating power lines to critical infrastructure (such as hospitals) underground to reduce vulnerability to natural disasters.

The priority program for the Energy sector is summarised in Figure 3.2.

Figure 3.2: Priority program for the energy sector



TELECOMMUNICATIONS

Current status and ongoing programs

Tonga is well positioned in terms of access to basic telecommunications services. Mobile phone and internet services are already available throughout the country, including smaller and more remote communities. Around 70 per cent of households have a fixed line connection and there are more than 50,000 mobile phone customers (equivalent to an average of three mobile phones per household). The completion of an undersea fibre-optic link to Fiji, scheduled for 2013, will deliver a step-change in speed, capacity, and quality that will redefine telecommunications in Tonga; offset some of the geographical disadvantage experienced by the country; and create new economic and social opportunities. In addition, TCC is investing from its own resources in local reticulation of broadband internet, and local telecoms infrastructure and services (telephone, radio, internet) are being progressively improved by TCC and Digicel to accommodate emerging applications (such as mobile internet, multi-media, and interactive applications), and to improve coverage in less-populated islands. As a result of these developments, internet use is expected to grow rapidly in the short-medium term, especially through the upgraded mobile phone network. Competition and private sector involvement in the telecommunications sector has been a strong force driving these developments.

Challenges

Business and social connectivity and reducing the cost of doing business are key factors driving the need for improved telecommunications infrastructure. As noted above, high standard telecommunications can offset some of the geographical disadvantage experienced by Tonga and increase the international competitiveness of Tongan business, for instance in the tourism industry.

In addition, telecommunications also serves a vital role during natural disasters and other emergency situations. In particular, AM radio continues to play an important role in sending messages to outer island communities including information about scheduled arrivals of shipping and airline services. It also has a critical role in broadcasting regular weather reports and cyclone and tsunami warnings, and during disaster recovery. Some of the infrastructure supporting this role is currently in locations that are at high risk from natural disasters and flooding (see risk assessment in Annex D). A major challenge facing the telecommunications sector is the continuation of reliable AM radio coverage throughout the country under all conditions; as well as strengthening the CCA/DRM resilience of other telecommunications media, such as the mobile phone system.

Priority initiatives

In addition to initiatives already underway and committed, Government's priorities for investment in the Telecoms sector are:

- extension of the undersea optic fibre cable to Ha'apai and Vava'u (T$30 million); and
- strengthening the resilience of AM radio in its communications role for early warning and disaster recovery (T$6.0 million).

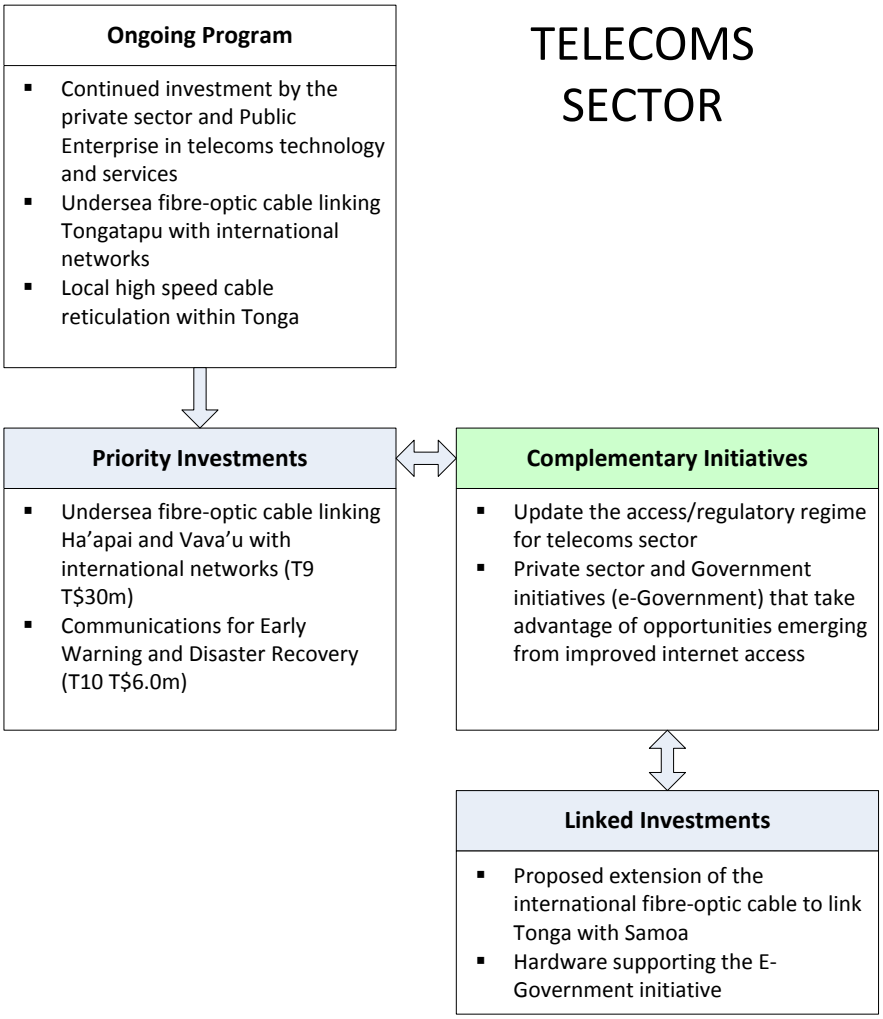
Government supports proposals to extend the international fibre-optic cable link to Ha'apai and Vava'u as soon as possible so that these northern island groups can share the economic development and social benefits of improved telecommunications within Tonga and internationally (estimated cost T$30 million). This project is linked to a proposed extension of the international undersea cable from Tonga to Samoa. If this extension materialises, Government is eager to use that opportunity to link the two island groups. If the link to Samoa will not be implemented, additional feasibility analysis will be necessary to identify the feasibility of this project.

Government recognises that this project needs to be part of a broader and commercially viable telecommunications network strategy that builds on the experience that will be gained from maximising the potential of the undersea cable connection to Tongatapu. In addition, there are two complementary initiatives that support the fibre-optic cable links and high-speed internet distribution. These are firstly, the establishment of an appropriate regulatory and access regime for wholesaling of high-speed internet access; and secondly, follow-up private sector and Government initiatives that build on opportunities emerging from improved internet access, such as e-commerce and e-government services. These follow-up activities are critical to maximising the national economic benefits from investment in the cable.

The second investment priority in this sector is upgrading the resilience of the AM radio system in its role as an early warning system for cyclones and in providing vital information during disaster recovery. This involves the construction of a new transmitter tower on Vava'u (estimated cost T$3.0 million) and climate proofing of transmission facilities and studios in Tongatapu and Vava'u (estimated cost T$3.0 million). A new transmission tower on Vava'u would address reception problems on northern islands, especially during cyclones and emergency situations. It will also provide a backup for the AM transmission tower on Tongatapu and provide resilience to AM system damage during natural disasters. The location of existing TBC studios and transmission equipment, especially on Tongatapu, is vulnerable to flooding from heavy rain and tsunami. Climate and disaster proofing of TBC facilities on Tongatapu and Vava'u is important for continuity of operation during natural disasters and in its everyday role in providing community information services.

A summary of the priority program for the Telecommunications sector is provided in Figure 3.3.

Figure 3.3: Priority program for the telecommunications sector



WATER AND SANITATION

Current situation

All Tongans have access to clean drinking water and around 85 per cent of households have reliable and continuous piped water supply. The TWB has sufficient production capacity from its well fields to meet demand. So in terms of meeting the MDGs and providing basic access to clean water, the water sector is performing well. However, problems exist in the efficiency of water supply, and a major challenge facing the reticulated water supply system is to reduce water losses. Significant progress has been made and current levels of non-revenue water[11] vary from 15-40 per cent, and average around 26 per cent overall. This compares to benchmark levels of 20-30 per cent achieved by some developing countries in the Asia-Pacific region and 10 per cent in developed countries.[12]

Ongoing projects in the water sector focus on reducing water losses and upgrading the efficiency of the Nuku'alofa water supply and distribution system under the NUDSP project. Additional programs include expert technical advice supported by the Government of Japan; upgrading village water supplies throughout the country; and upgrading the Neiafu water supply system on Vava'u. The TWB is implementing these projects in association with development partners.

[11] Non-revenue water is an important measure of efficiency. It refers to the difference between system input volume and the billed or authorised consumption, and includes un-billed consumption from faulty meters, illegal connections or under-billing as well as physical losses from leakages and overflows.

[12] Pacific Water and Wastes Association, *Benchmarking Report 2011* (2011); Asian Development Bank, *Asian Water Supplies: Reaching the Urban Poor* (2003).

Challenges

The need for infrastructure investment in the Water sector is driven by population trends; household consumption patterns; health and quality standards; and efficient management of valuable water supply resources. As noted above, the total population of Tonga is growing slowly (average of 0.2 per cent per year over the last five years), but the pattern is not uniform. In particular, the population of Nuku'alofa, especially in urban fringe areas, is growing much more quickly (up to an average 2.5 per cent growth per year). This creates a significant challenge for the TWB to keep pace with demand for system coverage and water quality in the Nuku'alofa system, whilst simultaneously monitoring and safeguarding water sources. Population growth on outer islands has not generated the same pressure, but similar challenges exist to improve water management, safeguard water quality, and improve the resilience of water supply systems to climate change.

Another challenge is reducing loss and waste of valuable water. The TWB is already working to reduce water losses and upgrade efficiency throughout its water supply and distribution system. There is also an opportunity for the TWB and village water supply managers to be proactive in promoting responsible use of water through DSM initiatives similar to the energy sector. This may involve measures such as reducing waste and leakage of water in houses; encouraging or mandating the use of water-saving fittings; and awareness campaigns that build an understanding of water as a scarce and valuable resource.

In many countries, the water sector also includes sanitation and drainage as part of the overall water cycle. Although Tonga does not currently have a central sewerage system in any urban area, important issues relating to disposal of grey water and septage (sludge pumped from septic tanks) are emerging and are likely to require a coordinated response in the short-medium term. As a partial response, a grey water collection system has been installed in central Nuku'alofa as part of the CBD redevelopment project. Sanitation is a growing challenge and an area where Government is planning to place greater emphasis in the future. In particular, there is an urgent need to develop a better understanding of current and emerging sanitation problems and issues, and options available for responding to these issues. A similar situation exists with drainage. Addressing the challenges of improved drainage, especially in the Nuku'alofa area, requires a better understanding of problems and available responses, a coordinated approach, and greater clarity on institutional responsibilities.

Priority initiatives

The priority program for the Water sector addresses these key challenges. In particular, the priority new investments are to:

- rehabilitate and expand the water systems on Vava'u, Ha'apai, 'Eua, and Niuafo'ou (wells, filtration, storage, distribution, etc) under an Outer Islands Water Supply Improvements Program (T$15 million); and
- expand the Nuku'alofa water supply system to peri-urban growth areas of Nuku'alofa (T$11.4 million).

The proposed outer islands water supply improvements will provide benefits to communities and businesses in terms of improved quality and reliability of water supply, and reduce the cost of water production. In particular, it will accelerate programs to replace pipes to reduce losses and lower costs; upgrade water treatment and storage facilities; replace diesel with solar pumps on well fields; extend the reticulation network to additional villages; and improve water supplies for around 24 schools and colleges. Where feasible, measures will also be put in place to improve the resilience of the water supplies to climate change and natural disasters. The projects will also include training and capacity building for the TWB outer island branches. In the longer term it will reduce the pressure on existing underground resources and delay the need for additional wells and other new investment.

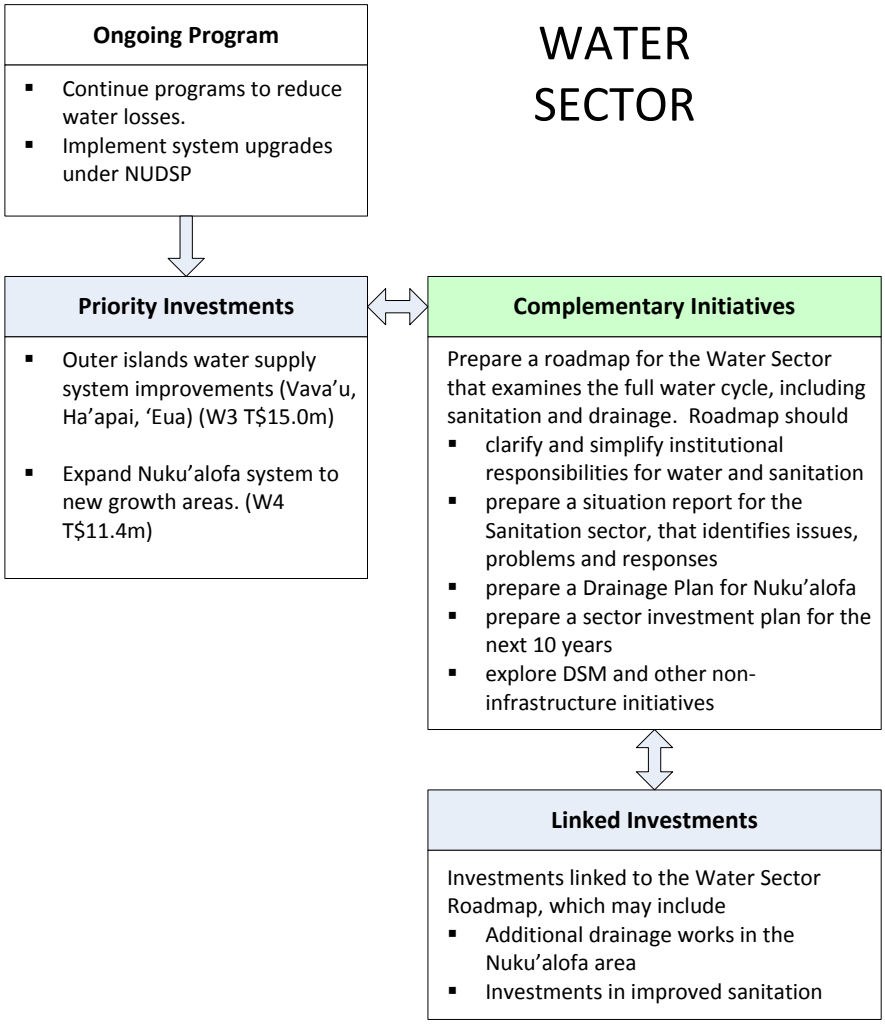
The second priority investment involves expanding the Nuku'alofa water supply. This will bring existing settlements on the edges of Nuku'alofa into the water supply system; deliver benefits to residents and businesses in terms of access to improved, reliable water supply; and also enable the TWB to obtain greater utilisation from existing systems. In addition, expanding services in a planned and systematic way can help to shape development in the rapidly growing peri-urban areas in conjunction with other urban planning initiatives, such as under the *National Spatial Planning and Management Act 2010*. Both investment priorities link with TSDF Outcome Objective 3 and Strategy 13, which prioritise "[m]aintaining and expanding access to safe water and sanitation for all communities."

These investments will address urgent gaps and deficiencies in the water sector, but in the longer term a strategic and coordinated approach is required that addresses the full water cycle. The Water sector currently does not have an up-to-date medium-long term development strategy. The preparation of a long-term master plan has been proposed

under the ADB-supported Urban Planning and Management System (UPMS) project and is supported by the TWB. Preparing a Water and Sanitation Roadmap is now a priority. The roadmap should examine the full water cycle, including waste water, sanitation, and drainage because of institutional gaps in these areas; include a long-term agenda for developments and investments in water supply and sanitation nationwide over the next 10-20 years; and a comprehensive drainage strategy for Nuku'alofa and investment plan for the next 10 years.

In summary, the priority program for the Water sector is shown in Figure 3.4.

Figure 3.4: Priority program for the water sector



SOLID WASTE

Current situation

In 2007, a new solid waste collection system was implemented on Tongatapu and the Waste Authority Limited (WAL) was established to take control of solid waste collection and disposal. This includes responsibility for the disposal of sewage sludge at the Tapuhia landfill facility on Tongatapu. WAL provides waste collection services covering all of Tongatapu, but on other islands, formal arrangements for solid waste collection are not in place. Likewise, formal arrangements for sanitary disposal of solid waste are not in place on other islands, except for Vava'u. WAL is progressively improving its performance but continues to require financial support from Government; is unable to fund adequate maintenance; and has a growing maintenance backlog. In addition there are problems with the design of WAL's existing equipment and facilities, and the illegal dumping of waste is an emerging issue.

Several projects are underway with the aim of improving solid waste management on Tongatapu and Vava'u. This includes activities under the NUDSP initiative to improve waste disposal operations at the Tapuhia landfill; improve

solid waste collection services on Tongatapu; and strengthen WAL's financial and asset management systems and capacity. On Vava'u, the existing landfill facility is being upgraded with assistance from the Government of Japan to improve its environmental performance. But this is a temporary measure, because the existing facility is in a vulnerable seaside location. In the longer term, it will be preferable to relocate solid waste disposal on Vava'u to a new site where a fully engineered sanitary landfill facility can be constructed.

Challenges

The need for infrastructure investment in the Solid Waste sector is driven by population trends; household consumption patterns; and health and quality standards. On Tongatapu, urban population growth at levels of up to 2.5 per cent per year in some areas is increasing the demand for collection and disposal services. This is straining the capacity of WAL to meet the demand, especially while WAL is in a rebuilding phase.

On outer islands, the challenge is to provide a long-term solution for sanitary and environmentally-acceptable disposal of solid waste. On Vava'u, current arrangements are not sustainable in the medium-long term; and on other outer islands, formal arrangements for solid waste disposal do not exist. A national, long-term approach to solid waste management is required.

Priority initiatives

Addressing the challenges facing the Solid Waste sector will require a combination of infrastructure investments and complementary initiatives. In conjunction with initiatives already underway and committed, the priority infrastructure investment for the Solid Waste sector for the next five years is:

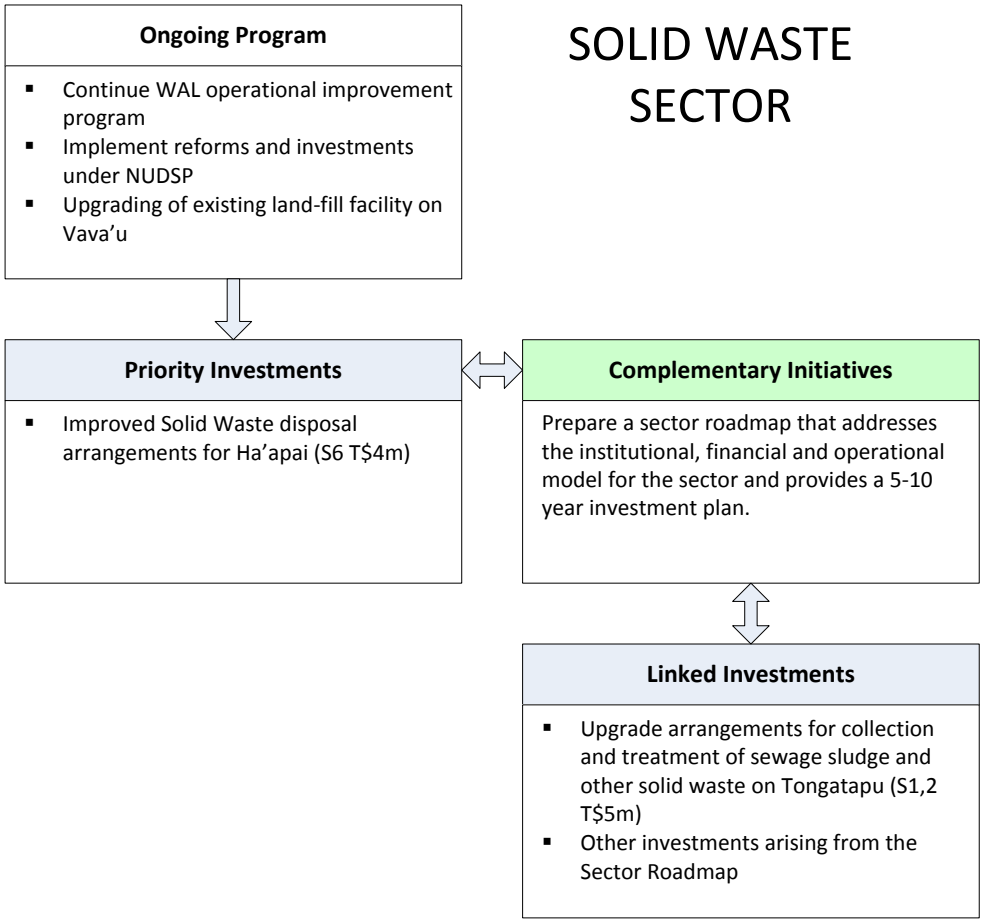
- Improved solid waste disposal arrangements for Ha'apai (T$4.0 million).

This investment responds to the current lack of formal arrangements for solid waste disposal on Ha'apai and resulting public health and environmental issues, including potential contamination of the water supply. It links with TSDF Outcome Objective 3 and Strategy 12, which prioritises "Improving and where possible expanding the safe collection, disposal and recycling of solid and liquid waste to protect people's health and the environment." Several options have been suggested, including the development of an engineered sanitary landfill on Ha'apai, or establishing a transfer station on Ha'apai then transporting the waste to Tongatapu for disposal in the existing Tapuhia landfill. The first step is to complete a feasibility study of options, and then investment will be required to implement the preferred option. As noted above, investment will also be required in the medium-longer term on Vava'u to provide a long term solution to its solid waste disposal needs.

These investments and initiatives, which are underway as part of the NUDSP, will address urgent problems. However, national, long-term approach to solid waste management is required. Initial work has been done on preparing a (*Draft) National Integrated Waste Management Strategy for Tonga*, but it is important now to finalise the strategy and prepare an implementation roadmap. Based on the outcomes of the sector strategy, further infrastructure investment in solid waste management infrastructure is likely to be warranted. These linked investments are likely to include additional steps in the WAL equipment renewal program (septage trucks, compactor, etc); a weighbridge at Tapuhia; and refurbishment/expansion of existing facilities to increase capacity to treat septage at Tapuhia, at total cost of around T$5.0 million.

In summary, the priority program for the Solid Waste sector is shown in Figure 3.5.

Figure 3.5: Priority program for the solid waste sector



ROADS

Current situation

Tonga's network of roads measures some 650km of which around 40 per cent is paved. Tonga has one of the highest levels of road network density in the region.[13] This network provides good access links to communities in terms of connectivity, but in some areas the condition of roads has deteriorated significantly due to insufficient emphasis on maintenance.

Government is addressing this problem by implementing several road rehabilitation and upgrading programs in association with its development partners. The National Roads Improvement Project has rehabilitated selected trunk roads throughout the country; the Nuku'alofa Redevelopment program improved roads in the town centre; the IUDSP is upgrading major routes into Nuku'alofa from the south; and some rehabilitation of select road sections has occurred as part of the TSCP. In total, around 150km of roads out of a total network of some 650km have been rehabilitated over the last five years, predominantly on Tongatapu.[14]

The TSCP is also trialling a new approach to road maintenance that makes greater use of private sector involvement. Contracts for routine maintenance have been awarded to private firms and are underway. Studies underway as part of the TSCP program provide a strategy for road maintenance over the next five to 10 years, including recommendations for road maintenance programming, institutional reform, and the role of the private sector. In addition to these broader programs, commitments are already in place for specific investments to rehabilitate the Vaipua Bridge (Vava'u) and Foa Causeway (Ha'apai). Furthermore, Government has approved the establishment of a dedicated Road Fund to ensure long term sustainable maintenance of the road network. The Road Fund will be progressively implemented from the second half of 2013, and when fully operational by 2017, is expected to collect around T$6-7 million per year for spending on routine and periodic maintenance of roads.

[13] Measured in terms of road length/square km of land area. See: Pacific Region Infrastructure Facility, *Pacific Infrastructure Performance Indicators* (2011).
[14] Of the 150km of roads rehabilitated under these programs, around 133km are on Tongatapu and 17 km on outer islands.

Challenges

Roads play a vital role in social and business connectivity. Recent road improvement programs have addressed problems with some parts of the national road network (especially trunk roads on Tongatapu), but other branches of the network continue to be in poor condition, especially outer islands and agricultural roads on Tongatapu. This is exerting a significant negative impact on the cost of road transport; links to market for agricultural and fisheries producers; the tourism industry; and social connectivity. The main challenge driving the need for investment in roads is to accelerate the process of progressively clearing the backlog of road repairs and rehabilitate the road system to a standard where it can be sustainably maintained in a cost-effective way using local resources and expertise. In the longer term, routine and periodic maintenance will be provided under the Road Fund, but many roads have already degraded to a point where urgent intervention is required.

Priority initiatives

Government's priority for the Roads sector is to continue the emphasis on maintenance. This will require investments in road rehabilitation and changes to the way that maintenance is funded and managed. As noted above, Government has already approved the establishment of a Road Fund to finance routine and periodic maintenance of roads. In addition, it is important to consolidate the role of the private sector in delivering vital road maintenance activities. This is already happening under the TSCP and it is important that these reforms continue.

From an additional investment perspective, the highest priority is:

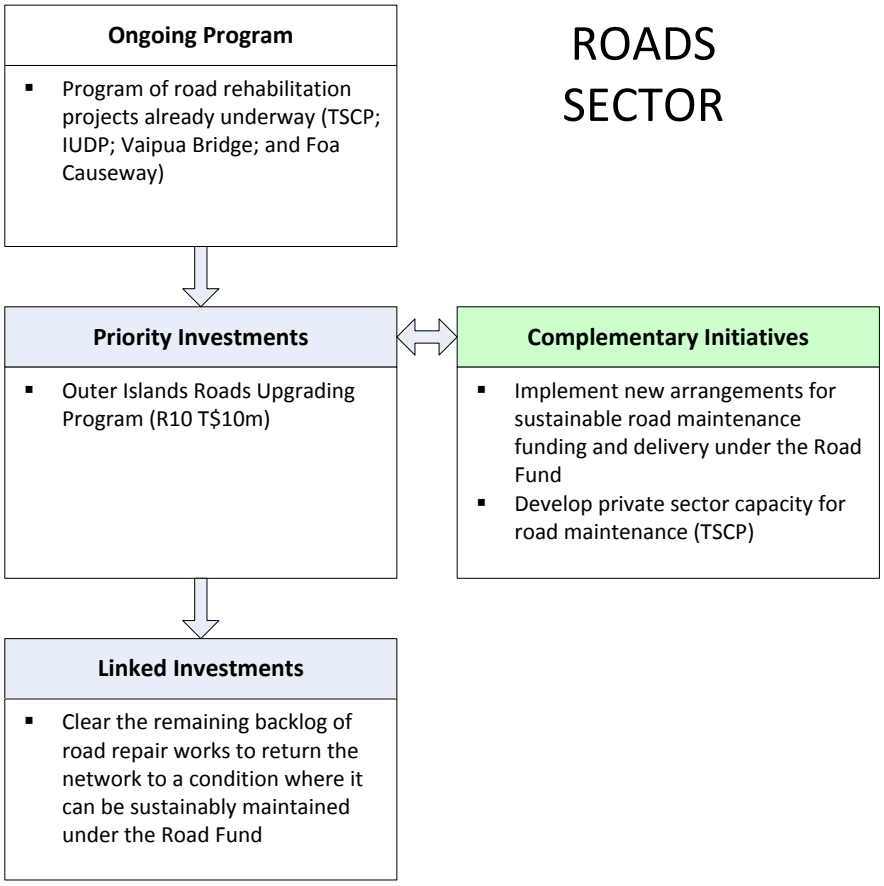
- Outer Islands Roads Upgrading Program (R10 - T$10 million).

This program would involve rehabilitation and resealing of around 60km of roads on Vava'u, Ha'apai, 'Eua, and Niuafo'ou. This will deliver significant benefits in terms of improved connectivity and economic development opportunities (especially for the priority sectors of agriculture, fisheries, and tourism); and will support strong inclusive communities in the outer islands. Priority will also be given to roads that could act as evacuation routes in times of natural disaster, or could be developed to incorporate a coastal protection function. In addition, the rehabilitation will improve the resilience of selected outer islands roads through the adoption of climate-proofing measures. Overall, the outer islands roads upgrading program will ensure that communities in outer islands share in the benefits from road upgrading programs. In the short-medium term, there is also a priority to clear the backlog of road repair works and rehabilitate trunk and agricultural roads on Tongatapu and other roads that were not addressed as part of recent road programs.

In the longer term, Government will continue the emphasis on road maintenance and rehabilitation, and may also consider options for a new road linking Nuku'alofa with the southern side of Fanga'uta Lagoon by bridge or causeway. This road would provide better access to the southern and eastern sides of Tongatapu and the airport, and could provide an alternative evacuation/access route in case of natural disaster. However, it will require detailed technical feasibility assessment, environmental approval, and identification of a suitable funding source. Issues related to evacuation routes in case of natural disasters are addressed further under the Multi-Sector category.

In summary, the priority program for the Roads sector is shown in Figure 3.6.

Figure 3.6: Priority program for the road sector



MARITIME

Current situation

The maritime sector plays a vital role in the Tonga economy and community. It supports tourism; inter-island and international commerce; and inter-island travel for social, educational and medical needs. Based on utilisation estimates from the Tonga Transport Sector Review 2005 and updated in 2012, the existing ports have sufficient capacity for foreseeable needs and there are no plans to build any new ports for commercial shipping operations. In addition, the international ports comply with relevant international and International Maritime Organisation (IMO) operating requirements. Although the port system meets basic needs for coverage, capacity, and compliance, the standard of infrastructure has suffered from a lack of investment in core infrastructure and facilities; and insufficient emphasis on maintenance of outer-island ports and channels.

Recent investments in the maritime sector include Government-funded minor works at all ports necessary for the operation of the new inter-island ferry; upgrading of navigational aids and other port upgrades under the TSCP; and investments by Ports Authority Tonga (PAT) from its own resources in upgrading ship and cargo handling facilities and equipment at Queen Salote Wharf (forklifts, fenders, pavements). The cruise ship terminal at Vuna Wharf (Nuku'alofa) has also been completed and commenced operation in December 2012. Responsibility for implementing these projects is split between the PAT which is responsible for Queen Salote International and Domestic Wharves at Nuku'alofa, and the MOI which is responsible for all other ports.

For the medium-longer term, investment planning for the port sector is less well developed. The sector does not have a current development roadmap, but studies supported under the TSCP are providing greater certainty regarding investment needs for outer-island ports. The PAT is also reviewing its long-term plans for development of Queen Salote International and Domestic wharves at Nuku'alofa. It is important that an integrated approach is applied that enhances the overall safety, efficiency, and resilience of the port system as a whole.

Challenges

Safety is Government's key priority for the maritime sector. Responding to this challenge will require investment in people, systems, and infrastructure. In particular, the arrival of the new inter-island ferry MV *'Otuanga'ofa* has given this service a boost in terms of quality and comfort, but the port infrastructure and shore facilities for passengers and freight are not of the same standard. Maritime training facilities have also suffered from a lack of investment, there is a need to upgrade safety standards and awareness, and rebuild capability in maritime safety oversight. Some of these issues are being addressed as part of the TSCP and other programs, but more needs to be done urgently.

The other major challenge driving the need for investment in the ports sector is building resilience to the impacts of climate change and natural disasters. With sea levels predicted to rise by up to 0.6 metres by 2090 and cyclones expected to become more intense, ports are especially at risk (see CCA/DRM risk assessment in Annex D). Ensuring that ports can withstand these impacts and securing continuity of shipping services are high priorities for Government. This is especially important considering the role of shipping in outer islands economies and the critical role played by shipping in post-disaster recovery. It is important to start factoring CCA/DRM into port planning as soon as possible.

Priority initiatives

Government's highest priority for the Maritime sector is increasing the safety and resilience of all maritime activities, especially in relation to inter-island shipping. This will require investments in infrastructure and complementary initiatives to improve capabilities, facilities, and systems. Because an integrated approach is required, the various needs have been packaged into a single high priority investment program:

- Maritime Sector Safety and Resilience (P9: preliminary estimate of T$20 million, but specific components could be split out as part of an integrated sector program)

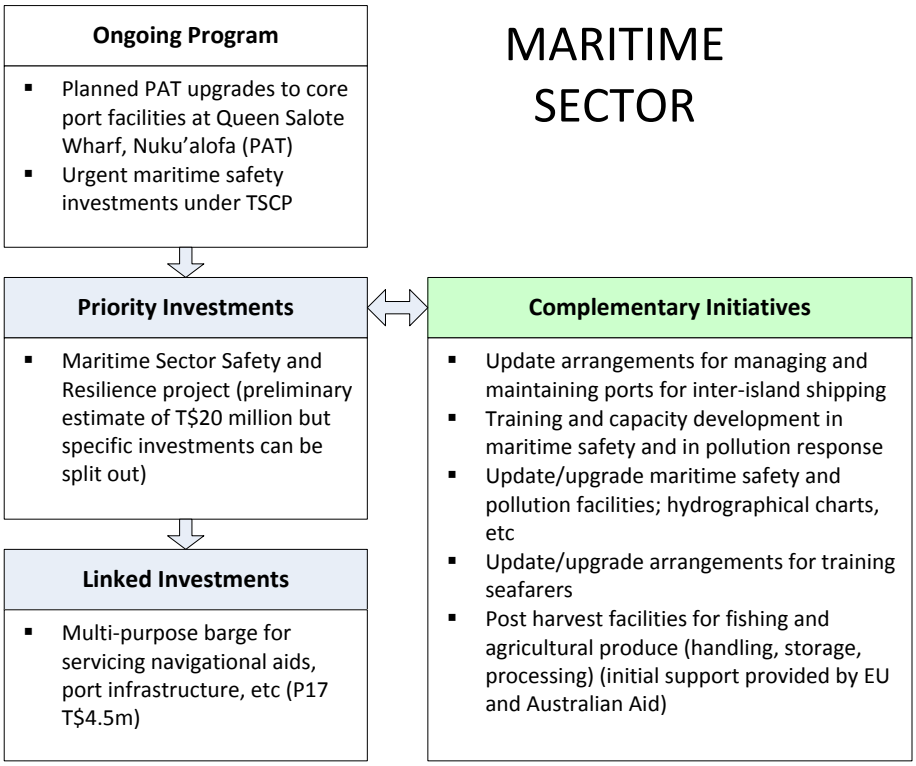
The *Maritime Needs Safety Assessment* 2012 prepared under the TSCP provides a starting point, but more work needs to be done to fully define the components of this program. It is expected that investment will be required in the following areas:

- upgrading berths and related shore facilities to be more resilient to climate change and natural disasters, as well as improving safety and facilities for passengers and cargo;
- upgrading navigational aids and channel/mooring markers, and updating hydrographical charts;
- dredging channels and berths to increase safety in all weathers;
- building local capacity and systems for enhanced maritime safety oversight; and
- revitalising local training programs for seafarers and the associated facilities.

The other major priority for the Maritime sector is to update institutional arrangements for managing, maintaining, and financing the outer island ports. As noted above, responsibility for outer islands port operations is with the MOI, but this is inconsistent with the MOI's regulatory role in the maritime sector. The need for improved mechanisms for financing sustainable maintenance of outer-island ports is also a catalyst for reviewing current arrangements. Government is examining a range of options for the institutional structure of the ports system as part of the overall Government Structural Reform process.

In summary, the priority program for the Maritime sector is shown in Figure 3.7.

Figure 3.7: Priority program for the maritime sector



AIRPORTS

Current situation

Aviation also plays a vital role in connecting the Tongan economy and community in terms of tourism; inter-island and international commerce; and travel for social, educational and medical needs. The existing commercial airports provide sufficient coverage to all island groups, and at this stage, there are no plans to build any additional airports. The airports have sufficient capacity for expected growth in passenger demand, but the length and current condition of runways place limits on the operation of larger aircraft and much of the infrastructure is either nearing the end of its useful life or requires upgrade to continue to meet international and national safety and security standards. Tonga already meets required service standards and complies with International Civil Aviation Organisation (ICAO) requirements, or has been granted a temporary exemption from some requirements during a transition period. All commercial airports in Tonga are managed by TAL.

A significant investment program is already underway in the airport sector, with a focus on meeting safety and security compliance requirements in terms of fire and rescue capability, security screening, navigational aids, and runway condition. This includes resurfacing of runways at Fua'amotu and Vava'u, which were priority projects under the first NIIP. The investments are being managed by TAL, with support under the WB-funded TSCP and PAIP programs.

Challenges

Safety, security, and continuity of service are the key imperatives driving investment and reform in the aviation sector. In the medium-longer term, additional investments will be required to maintain compliance with increasingly stringent industry safety and security requirements; to ensure that current aircraft types and new international and domestic aircraft likely to be used on Tonga services can operate safely and without weight restrictions; and to keep Tonga competitive as an exporter and international travel destination.

The other major challenge in the aviation sector is to ensure that a supportive policy and institutional environment is in place for competitive and stable international and domestic air services; and to ensure that the necessary skills and qualifications for effective oversight of international safety and security standards are available in Tonga. This will

require ongoing capacity building to keep pace with aviation market developments; high industry standards; and rapid technology change. Aviation safety and maintaining vital air service connections is a high priority for Government.

Priority initiatives

In conjunction with initiatives already underway and committed, Government's highest priority investments proposed for the Aviation sector are:

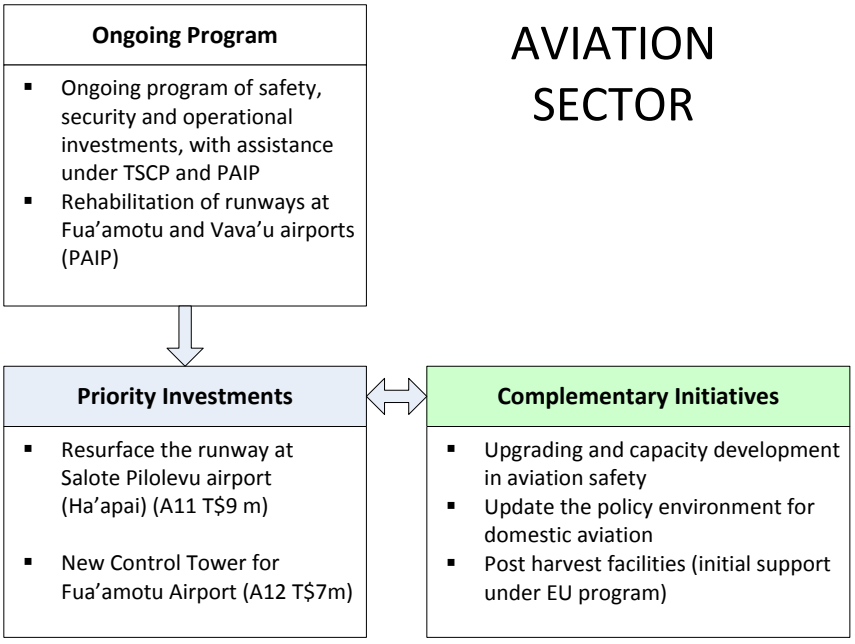
- construction of a new Control Tower at Fua'amotu International Airport (T$7.0 millionm).
- resurfacing Ha'apai runway, apron, and taxiway (T$9.0 millionm); and

The runway and associated aprons and taxiways at Ha'apai will require resurfacing within the next five years to ensure safe ongoing operations for aircraft types/sizes likely to operate to Ha'apai and for compliance with ICAO requirements. If not resurfaced soon, the continuing deterioration in runway condition will result in operations restricted to small, light aircraft, and eventually closure of the airport. The control tower at Fua'amotu is also in poor condition. It is poorly located relative to the runway and taxiways and lacks up-to-date equipment for communications and aviation traffic management. Construction of a new Control Tower in a new location is a high priority for the next three to five years. These priority investments will complement recent and planned investments in airports and aviation safety by TAL and under the TSCP and PAIP projects. In the longer term, expanding the airport apron and adding new taxiways at Fua'amotu will increase airport capacity and enhance the safety and efficiency of aircraft movements on the ground.

There are several high priority complementary initiatives that support the imperatives of safety and connectivity. Foremost is the need for upgrading and capacity development in aviation safety oversight. It is also important to update the policy environment, especially for the domestic aviation market. Over recent years, inter-island air services have been unreliable and the market unstable with several operators entering and leaving the market. This has adversely affected tourism and access to markets for the outer islands' producers. Specialist advice supported under the TSCP has developed recommendations on issues such as market entry and regulation. Government will consider these recommendations with the aim of creating a market environment in which stable and reliable inter-island air transport can be assured. The third complementary initiative is to further develop post-harvest facilities (handling, storage, and processing) so that fishing and agricultural produce can be processed and stored for export markets.

In summary, the priority program for the Aviation sector is shown in Figure 3.8.

Figure 3.8: Priority program for the aviation sector



MULTI-SECTOR

Current situation

Multi-sector projects generally fall into two broad categories. The first involves complex construction projects with the need for coordination across several sectors, such as electricity, telecommunications, roads, and water. The Nuku'alofa CBD redevelopment is an example is this type of multi-sector project. It involved upgrading basic infrastructure in the CBD area, including roads, underground power and additional High Voltage supply, drainage, grey water collection system, footpaths, and street lighting. Another example is restoration of basic infrastructure on Niuatoputapu following the tsunami in 2009. Complex multi-sector projects expected in the next five to 10 years include preparation for the Pacific Games 2019 and the planned Government Ministerial Complex.

The second category involves cross-cutting issues, especially CCA and DRM. Government is committed to working with development partners to better manage CCA/DRM risks, and initiatives are already underway to strengthen Government capability in this area and ensure that adequate consideration is given to CCA/DRM issues in infrastructure development. The *Joint Action Plan on Climate Change Adaptation and Disaster Risk Management 2010-2015* (JNAP) has been prepared with assistance from the Global Environment Facility (GEF), Applied Geoscience and Technology Division of the Secretariat of the Pacific Community (SPC-SOPAC), and United Nations Development Program (UNDP), and implementation is underway. In addition, a *Strategic Program for Climate Resilience for the Kingdom of Tonga* has been prepared under the Pilot Program for Climate Resilience (PPCR) process. These documents provide a framework for developing and implementing infrastructure responses to CCA/DRM.

Challenges

Tonga is especially vulnerable to CCA/DRM impacts. Best available scientific advice[15] indicates that Tonga's climate is changing and is expected to continue to change. The greatest risks to infrastructure result from the increase in extremes: more very hot days, increased rainfall intensity, and more powerful cyclones. Coupled with sea level rise and storm surge, this creates significant challenges for the future of infrastructure development. In addition, Tonga is at risk from earthquake and tsunami, and in places, volcanic eruption. The overall challenge is firstly to ensure that potential CCA/DRM impacts are considered in all aspects of infrastructure planning, design, construction, and management; and secondly that Tonga is well-prepared to respond quickly and effectively to disasters when they happen.

Another key multi-sector challenge is coordination of infrastructure construction and delivery of services. As noted above, major infrastructure projects generally have implications for a range of infrastructure services (electricity, water, sanitation, roads, telecommunications), as well as possible environmental impacts. The Nuku'alofa CBD redevelopment is a recent example, and as Tonga develops, infrastructure projects are getting larger and more complex. Even smaller projects such as road rehabilitation can affect electricity and water supply lines and drainage. To avoid delays and inefficiency, Government and Public Enterprises must be ready to respond to these opportunities quickly and in a coordinated way. The challenge also encompasses coordination of infrastructure development with broader spatial planning and urban development. The recent adoption of the *National Spatial Planning and Management Act 2012* is a major Government initiative towards a more systematic and integrated approach.

The third challenge is asset management, and especially maintenance. Even though maintenance is less 'visible', it is more likely to have a greater positive influence on economic output than new investment. Some Public Enterprises have effective maintenance programs in place, but overall, there has been under-investment and insufficient attention to maintenance in the infrastructure sector. The challenge is to look after existing and new infrastructure better through improved maintenance; and to develop a more systematic and effective approach to asset management across the infrastructure sector as a whole.

Priority initiatives

From a capital investment perspective, Government's highest Multi-sector priorities are in building greater resilience to climate change and natural disasters:

- Coastal Protection for Eastern Tongatapu (M2 T$15 million); and
- Infrastructure to enhance Disaster Response & Evacuation (M4 T$12 million).

[15] Pacific Climate Change Science Program, *Current and future climate of Tonga* (2011), www.pacificclimatechangescience.org.

The first of the priority investment projects involves rehabilitation and construction of foreshore protection structures along approximately 8km of the north-eastern coast of Tongatapu between Nukuleka and Manuka. It will provide greater resilience against sea level rise, cyclone impacts, storm surges, and tsunamis for six villages with housing and road infrastructure located in close proximity to the shoreline. This location was rated as a very high priority because of its existing high degree of vulnerability to wave action and sea level rise; the proximity of development to the coastline; and the extent of erosion already taking place and degraded state of existing coastal protection. The second project involves a range of infrastructure to support disaster response coordination and capacity and to support community evacuation prior to natural disaster events. It would provide better and more resilient facilities for the National Emergency Management Office (NEMO) and Tonga Meteorological Office (TMO); construction of joint, climate-proof disaster command centres; improved communications through connection of this facility to the underground fibre optic cable that is currently being developed throughout Nuku'alofa; and the infrastructure required to support implementation of the Tongatapu Tsunami Evacuation Plan that is currently in preparation.

There are also a range of priority complementary initiatives designed to improve the performance of the economic infrastructure sector as a whole. These include:

- **Institutional reform to clarify and simplify responsibilities across all sectors.** This is part of the Government's Structural Reform process designed to streamline delivery of Government services, with the aim to reduce costs while improving efficiency. It also has implications for improved arrangements for the coordination of major projects with multi-sector implications. Government intends to strengthen the role of the MOI and the National Spatial Planning Authority as focal points for coordinating the planning and delivery of multi-sector infrastructure projects. Another aspect of this priority is improved monitoring and enforcement of existing standards and requirements. This includes strengthening the EIA system and capacity, and ensuring that legislated environmental management standards are applied to all major infrastructure projects.

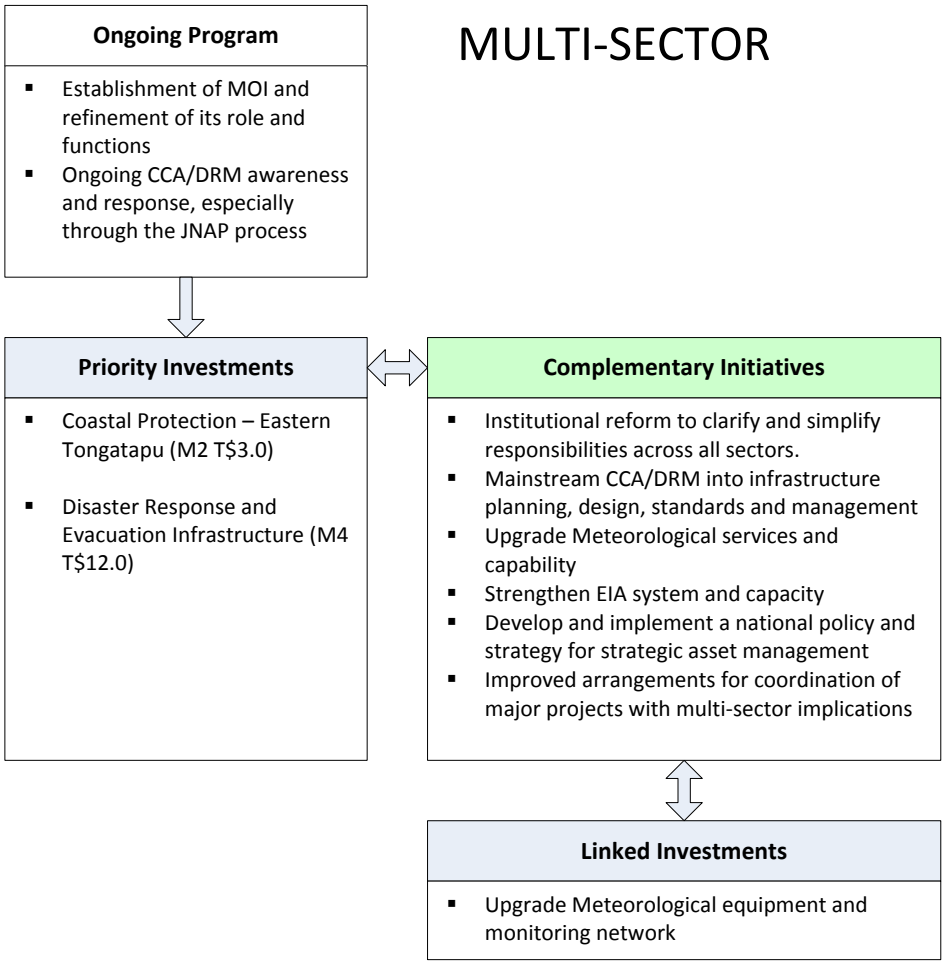
- **Mainstreaming CCA/DRM into infrastructure planning, design, standards, and management.** This priority builds on and enhances initiatives under the JNAP process. An important foundation for this process is the availability of good quality and timely weather and climate data and predictions. Therefore, upgrading Meteorological services and capability is also an important part of this complementary activity. Annex D provides more detail on mainstreaming CCA/DRM into infrastructure development.

- **Developing and implementing a national policy and strategy for strategic asset management.** The NIIP is an important step towards establishing asset management as a core function of Government and infrastructure managers; instilling a greater emphasis on maintenance; and incorporating a life-cycle approach to infrastructure management. An important step in this process is the NUDSP project, which will work with the Water and Solid Waste sectors to develop and implement asset management and maintenance systems appropriate for Tonga.

These and other multi-sector priorities are discussed further in the next Chapter in context of discussions about building the foundation of sustainability, safety, and resilience for the infrastructure sector.

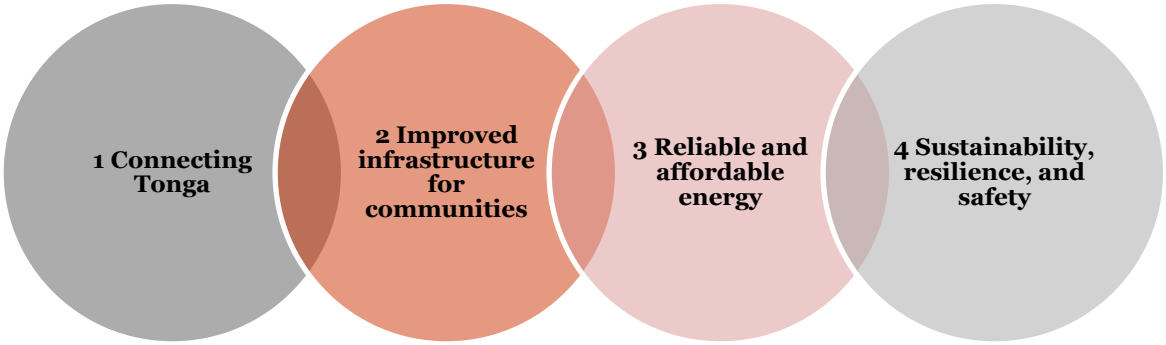
In summary, the priority program for the Multi-sector cluster is shown in Figure 3.9.

Figure 3.9: Multi-sector priority program



3.4 Priorities by strategic theme

Each of the priority investments and complementary initiatives contributes to achieving the goals of the TSDF and the NIIP strategic framework. Table 3.3 shows the key NIIP priorities in terms of their alignment with the NIIP's four strategic themes:



It highlights that NIIP is an integrated response to the infrastructure challenges facing Tonga, with a balance of initiatives targeted at achieving Government's key outcome objectives for the infrastructure sector.

Table 3.3: Priorities by strategic theme

Theme	Sector	Priority Investment Projects	Complementary Initiatives
Connecting Tonga	Telecoms	▪ T9 - Undersea fibre-optic cable linking Ha'apai and Vava'u with international networks (T$30m)[16] ▪ T10 - Communications for Early Warning and Disaster Recovery (T$6.0m)	▪ Update the access/regulatory regime for telecoms sector ▪ Private sector and Government initiatives (e-Government) that take advantage of opportunities emerging from improved internet access
	Roads	▪ R10 - Outer Islands Roads Upgrading Program (T$10m)	▪ Develop private sector capacity for road maintenance (TSCP)
	Ports	▪ See Sustainability, Safety and Resilience theme.	▪ Post-harvest facilities for fishing and agricultural produce (handling, storage, processing) (initial support provided by EU and Australian Aid)
	Airports	▪ A11 - Resurface the runway at Salote Pilolevu airport (Ha'apai) (T$9 m) ▪ A12 - New Control Tower for Fua'amotu Airport (T$7m)	▪ Update the policy environment for domestic aviation ▪ Post-harvest facilities (initial support under EU program)
Infrastructure for Communities	Water	▪ W3 - Outer islands water supply system improvements (Vava'u, Ha'apai, 'Eua) (T$15.0m) ▪ W4 - Expand Nuku'alofa system to new growth areas. (T$11.4m)	▪ Prepare a roadmap for the Water Sector that examines the full water cycle, including waste water and drainage. Roadmap should - clarify and simplify institutional responsibilities for water and waste water - explore DSM and other non-infrastructure initiatives - prepare a Drainage Plan for Nuku'alofa - prepare an investment plan for the next 10 years
	Solid Waste	▪ S6 - Improved Solid Waste disposal arrangements for Ha'apai (T$4m)	▪ Prepare a sector roadmap that addresses the institutional, financial and operational model for the sector and provides a 5-10 year investment plan.
Reliable and Affordable Energy	Energy	▪ Additional on-grid solar electricity generation - E11 - 1-2 MW on Tongatapu (T$24m) - E16 - Outer islands Vava'u, Ha'apai, 'Eua (T$9m)	▪ Non-Infrastructure aspects of the Energy Roadmap - Policy, legal, regulatory reform supporting the Energy Roadmap - Research and feasibility studies of alternative energy sources (wind, wave, coconut oil, etc.) - Improved fuel supply chain logistics - Other non-infrastructure aspects of the Energy Roadmap (DSM, etc)
Sustainability, Safety, Resilience	Sustainability		▪ Institutional reform to clarify/simplify responsibilities across all sectors ▪ Develop and implement a national policy and strategy for strategic asset management ▪ Design and implement new arrangements for sustainable road maintenance funding and delivery (TSCP) ▪ Update arrangements for managing and maintaining ports for inter-island shipping
	Safety	▪ Maritime Sector Safety and Resilience project (preliminary estimate of T$20 million but specific investments can be split out)	▪ Strengthen EIA system and capacity ▪ Upgrading and capacity development in maritime safety and pollution response ▪ Update/upgrade maritime safety and pollution facilities; hydrographical charts, etc ▪ Upgrading and capacity development in aviation safety
	Resilience	▪ M2 - Coastal Protection – Eastern Tongatapu (T$3.0) ▪ M4 - Disaster Response and Evacuation Infrastructure (T$12.0)	▪ Mainstream CCA/DRM into infrastructure planning, design, standards and management ▪ Upgrade Meteorological services and capability ▪ Improved arrangements for coordination of major projects with multi-sector implications

[16] Linked to a proposed extension of the international fibre-optic cable from Tonga to Samoa.

4 Building the foundation of sustainability, safety, and resilience

The Government's strategic framework for the infrastructure sector sits on a foundation of sustainability, safety, and resilience that underpins all infrastructure in Tonga:

- *Financial sustainability* means that the infrastructure is affordable on a full life-cycle cost basis. This is a challenge in countries like Tonga with a relatively small population dispersed over many islands and located at a large distance from markets. As most infrastructure in Tonga is managed by Public Enterprises, the financial performance and management capacity of these organisations is key to the sustainable operation and maintenance of their assets. Any investment proposal will need rigorous economic and financial analysis, based on the whole of life costs of proposed projects. The capacity of Ministries and state-owned enterprises (SOEs) to carry out such analysis needs to be strengthened.

- *Operational sustainability* means making the best possible use of existing infrastructure and ensuring that the assets are properly managed and maintained by applying strategic asset management. The concept of strategic asset management encompasses a life cycle approach and provides a framework for guiding the process of "acquisition, use, and disposal of assets to make the most of their service delivery potential and manage the related risks and costs over their entire life".[17]

- *Environmental sustainability* means that impacts of infrastructure development on the local and global environment are minimised. It is one of the key pillars of the TSDF. The policy and legislative framework for the treatment of environmental issues in the development and operation of infrastructure projects is already in place. Compliance with the environmental sustainability objectives of the TSDF is assessed during the process of obtaining development consent under the *National Spatial Planning and Management Act 2012* and, in many cases, as part of environmental approval under the *Environmental Impact Assessment Act 2003*. Sustainability during the construction and operation phases is managed through the application of the *Environmental Management Act 2010* which sets out processes for the environmental monitoring of projects and penalties for any environmental damage caused by projects.

- *Institutional sustainability* involves having in place adequate institutional frameworks and capabilities to support the development and operation of infrastructure. Significant progress has already been made through the Government's Structural Reform Process, which includes the creation of the MOI as the focal point for policy, planning, regulation, and multi-sector coordination in the infrastructure sector. It also involves developing the technical and management capacity within Ministries and SOEs to plan and manage infrastructure. Finally, it involves providing clear direction on infrastructure priorities by preparing this NIIP and by ensuring that Ministries and SOEs take into account the priority directions and initiatives of the NIIP when framing their Corporate and Annual Management Plans.

- *Safety* for users and operators is paramount in any infrastructure development. The Government has a lead role in developing appropriate national safety standards, and monitoring and enforcing compliance with national and international standards. In the past, insufficient emphasis has been placed on safety in some areas, and in some cases, complacency and inadequate maintenance has led to declining safety standards.
- *Resilience* means that infrastructure is planned, designed and constructed in a way that is adapted to expected climate change over the lifetime of the asset, and on the other hand, that infrastructure is there to help withstand the impact of natural disasters (cyclones, tsunamis, etc).

These aspects of infrastructure development are not optional extras, but are an essential part of any infrastructure development. Government is committed to improving performance in all of these areas. The next section will explain

[17] Department of Treasury and Finance, *Developing Strategic Asset Management Plans, Department of Treasury and Finance* (Government of Tasmania: 2004).

Government's plans and actions to achieve sustainability. Section 4.3 provides more detail on the role of infrastructure in enhancing the resilience of Tonga against climate change and natural disasters.

4.1 Measures for enhancing the sustainability of infrastructure

Infrastructure investment, sustainability, safety, and resilience go hand in hand as parts of an integrated response to improved performance in the economic infrastructure sector. Government can facilitate better outcomes from the infrastructure sector and intends to strengthen its role in coordinating infrastructure management and place a greater emphasis on sustainability, safety and resilience. In particular, the preparation of the NIIP has highlighted a range of specific measures that the Government can take and is taking to achieve better outcomes. These measures include:

National infrastructure planning

- Using the NIIP to provide clear direction and information about Government's infrastructure development priorities, and making sure that it is widely available, both in electronic and printed forms, within Government and to the broader community.

Financial sustainability

- Working with Ministries and Public Enterprises to strengthen their capacity in financial planning; evaluation of the feasibility of proposed infrastructure investments; and preparation of a business case for Government or Board, with full consideration of life-cycle costs. This is part of ongoing initiatives by Government, with assistance from development partners, to strengthen the Corporate Planning process and implement the MTBF.
- Working with Ministries and Public Enterprises to further strengthen financial and cost recovery performance to help ensure that there are adequate financial resources for the sustainable management of infrastructure. Wherever possible, Government considers that infrastructure services should be delivered through a commercial model that fully recovers the cost of operation. The improved financial performance of Public Enterprises and approved implementation of a Road Fund are examples of progress in this area, but striving for improvement in financial performance is an ongoing process. Government, with assistance from development partners, will continue to work with Ministries and Public Enterprises to further strengthen financial performance.
- Retaining a clear commercial focus of Public Enterprises. This includes transparent identification of community service obligations and their funding; careful consideration of Board appointments; and continued monitoring and reporting of financial performance by the Ministry of Public Enterprises.

Operational sustainability

- Promoting the principles of strategic asset management as a framework for an improved approach to infrastructure management by Ministries and Public Enterprises, and facilitating a 'maintenance culture' within organisations that is driven at the Board and CEO level. The NUDSP will be a focus for broader progress in this area. In addition, the Government intends to formalise the imperative for improved asset management by incorporating asset management as a performance indicator for Ministries and Public Enterprises.
- Placing a greater emphasis on reducing the demand for new assets by making better use of existing infrastructure, through measures such as demand management techniques, improved efficiency of service delivery, and consideration of alternative service delivery options. In the long term, this can reduce or delay the need for major infrastructure investment. Strong progress has already been made on improved efficiency of service delivery in the electricity and water sectors, but more needs to be done. The Government will continue to work with Public Enterprises and development partners on further initiatives aimed at making better use of existing infrastructure.

Environmental sustainability

- Ensuring that EIA and environmental management planning is undertaken for major infrastructure projects, and strengthening environmental monitoring and enforcement of legislative requirements. In particular, Government intends to put in place procedures for systematic follow-up on the environmental performance of approved projects, and apply legislated penalties where appropriate. This will encourage greater compliance with environmental management requirements. Consideration will also be given to the future development of national environmental pollution standards that can be applied to infrastructure development.
- Harmonising environmental legislation and the role of institutions in operational terms to avoid duplication and inconsistencies, and simplify processes. In particular, the Government will introduce administrative

measures to clarify responsibilities and harmonise the *Environmental Impact Assessment Act 2003*, *Environmental Impact Assessment Regulation 2010,* and *National Spatial Planning and Management Act 2012* in operational terms and to avoid duplication and inconsistencies.

Institutional sustainability

- Setting the ground rules appropriately because infrastructure relies on having effective public policies, institutions, and legislation. The establishment and strengthening of the MOI is a key Government initiative towards improved governance in the infrastructure sector.
- Continuing initiatives under the Government Structural Reform process to clarify and simplify institutional responsibilities and streamline Government procedures, so that lines of responsibility are clearly drawn and there is a single coordinating agency for each sub-sector. The Change Management process currently underway in the MOI with assistance under the TSCP will help to clarify and streamline Government involvement in the infrastructure sector.
- Working with development partners to build technical and management capacity in Ministries and Public Enterprises for infrastructure planning, management, operation, and regulatory oversight (as appropriate). Government will continue to maintain an emphasis on technical and management capacity building as an integral part of development assistance projects.

Safety

- Taking a leading role, with MOI as the lead agency, in developing appropriate national safety standards, and effective monitoring and enforcement of compliance with national and international standards. Government's highest priority is maritime safety. Progress is being made with maritime safety, as well as aviation and road safety, under the TSCP and PAIP programs but more needs to be done urgently. The Government is committed to working closely with development partners to improve safety, especially in the transport sector.

Resilience

- Mainstreaming CCA/DRM into infrastructure planning, design, standards, and management; upgrading the enabling environment through better decision support information and tools; updating planning processes, policy, and legislation to better reflect the priority that Government places on infrastructure resilience and broader CCA/DRM issues; and building institutional frameworks and capacity to support these initiatives. Initiatives are already underway and progress on mainstreaming CCA/DRM issues has been made under the JNAP process. Further progress is expected as part of implementation of the *Strategic Program for Climate Resilience for the Kingdom of Tonga* that has been prepared under the PPCR process.

4.2 Resilience

Resilience is about protecting infrastructure assets, people, and the economy against climate change and natural disasters, and the ability to recover quickly and effectively when disasters happen. Tonga is particularly vulnerable to natural disasters, and to the effects of climate variability and long-term climate change (see Annex D for details). Tonga averages T$30 million per year in losses from cyclones and earthquakes, has a 50 per cent chance of experiencing a loss exceeding T$300 million, and casualties exceeding 440 people in the next 50 years.[18] Much of the economic loss from natural disasters results either directly or indirectly from damage to infrastructure. In addition, infrastructure can have a very long operational life, up to and exceeding 100 years for some types. Therefore, it makes sense to now start planning, designing, building, and operating infrastructure with a view to resilience to long term climate change and natural disasters. This is recognised in the TSDF which includes "… disaster risk management and climate change adaptation, integrated into all planning and implementation of programmes ..." as part of the headline Outcome Objectives.

Mainstreaming CCA/DRM into infrastructure processes

The Government has adopted the *Joint National Action Plan on DRM and CCA for 2010 to 2015* as a guiding document for initiatives in CCA/DRM, and is working with development partners to mainstream CCA/DRM into infrastructure planning, design, standards, and management. A key objective of this NIIP is to incorporate consideration of DRM and CCA issues into the infrastructure planning process. To achieve this in a systematic and participatory manner, a framework for the integration of DRM and CCA aspects, including a vision and a series of principles, was developed and discussed with stakeholders. The following vision statement was agreed upon:

[18] Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), 2011. Country Risk Profile for Tonga.

"Infrastructure projects contained in the NIIP have optimal levels of climate resilience[19], and where relevant have been developed to maximise their climate change adaptation and/or DRM function."

The following principles were developed to allow realisation of this vision:

1. Mainstreaming of DRM and CCA issues: DRM and CCA are mainstreamed throughout all stages of NIIP2 development; this includes consideration of CCA/DRM issues in project identification and prioritisation, project development and costing, and monitoring and evaluation.

2. Short-term and long-term climate risks: Consideration is given both to existing and short-term future climate risks, and, as relevant to the lifespan of infrastructure included in the NIIP2, future changes in the frequency and/or intensity of extreme events and long term changes in average climate.

3. Integration throughout infrastructure life-cycle: DRM and CCA issues are considered throughout the life cycle of planned investments; i.e. throughout planning, design, construction, operation, maintenance, costing, and budgeting.

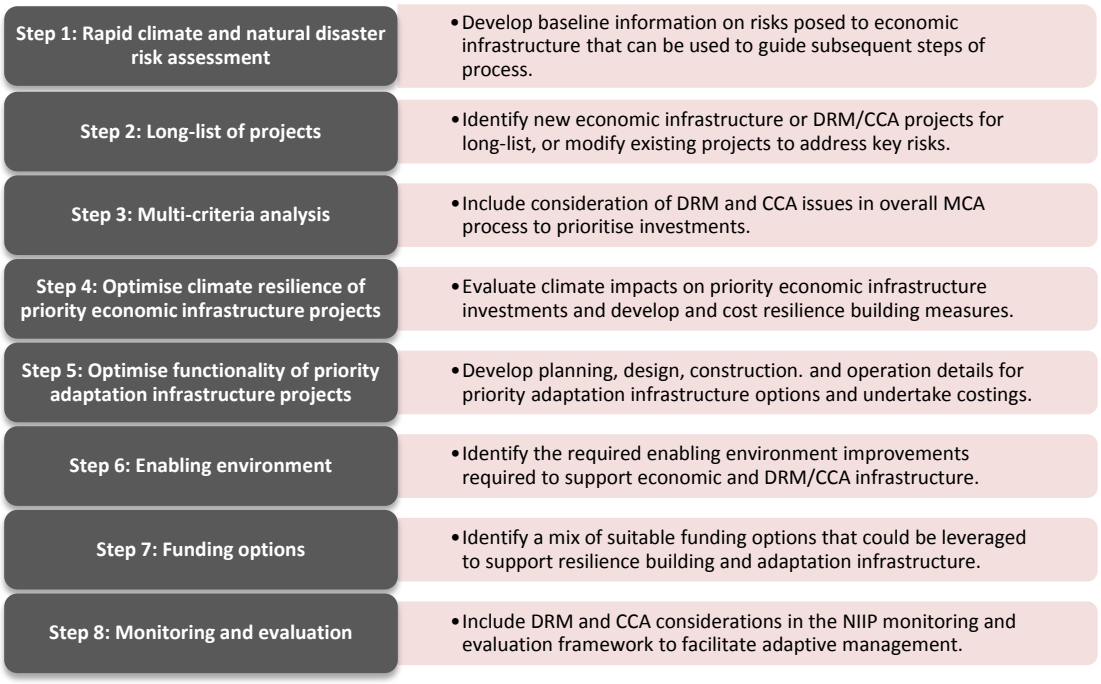
4. DRM and CCA enabling environment: Actions to enhance the enabling environment for DRM and CCA are considered in line with infrastructure investments to ensure that the necessary 'software' is in place to maximise the effectiveness of investments.

5. Cost-effectiveness of actions: Actions relating to DRM and CCA issues are based on a 'no-regrets' and 'low-regrets' approach to project identification to optimise the cost effectiveness of future investments.

6. Adaptive management approach: Integration of DRM and CCA issues will be viewed as a flexible and ongoing process that is subject to adaptive management principles; the results of monitoring and evaluation will allow future review and refinement of the consideration of DRM and CCA issues in the future iterations of the NIIP.

The steps that were followed in applying these principles are illustrated in Figure 4.1.

Figure 4.1: Actions to integrate DRM and CCA issues in the NIIP



[19] Climate resilience is defined as the ability of assets, networks and systems to anticipate, absorb, adapt to and / or rapidly recover from a disruptive climate event.

Climate proofing measures in priority projects are discussed in Section 3 and in Annex A. To build resilience for infrastructure, improvements will also be required to strengthen the CCA/DRM enabling environment, including decision support tools; planning, policy and legislation; and institutions and capacity building. This will require an integrated program of investment in technical resources and capacity building. Further progress on mainstreaming CCA/DRM issues is expected as part of the implementation of the Strategic Program for Climate Resilience for the Kingdom Of Tonga, prepared under the PPCR process.

Priorities for strengthening the enabling environment and mainstreaming CCA/DRM into infrastructure planning, design, standards and management, are outlined in Table 4.1. More detail on each of these priorities is provided in Annex D.

Table 4.1: Priorities for strengthening the CCA/DRM enabling environment

Key areas	Priorities
Decision Support Tools	▪ Reinforcement of the Hydro-Meteorological Monitoring Network by the installation of additional monitoring equipment, including weather radar stations, oceanic parameter monitoring equipment (e.g. sea surface temperature and tidal gauges), and upgraded monitoring stations on outer islands. ▪ Risk Modelling and Mapping for tsunami and storm surge. ▪ Climate Projections at a level of detail required to feed into the revision of Building Code and Road Design Standard Revision. ▪ Groundwater Capacity Analysis, because there is currently little information on groundwater capacity on outer islands yet groundwater resources are already subject to saline intrusion as a result of sea level rise and storm surge.
Planning, Policy and Legislation	▪ Revision of National Building Code and Road Design Standard to take into account predicted future climate change. This is one of the highest overall priorities for enabling environment improvement. ▪ National and Sub-National Climate and Natural Disaster Risk Plan Preparation, based on the results of risk mapping. ▪ DRM/CCA Checklist for Infrastructure Planning, to help ensure systematic consideration of DRM and CCA issues in the early stages of planning. ▪ Infrastructure Post-Disaster Response Planning, that includes adoption of a *Build Back Better* policy that requires adoption of climate resilient design standards for post-disaster rehabilitation or upgrading works so that climate resilience of the infrastructure stock is progressively increased. ▪ Planning for Climate Resilient Infrastructure Monitoring and Maintenance, including development of a manual that addresses standard requirements for pre- and post-wet season and pre- and post-cyclone event monitoring and maintenance. ▪ Revision of Legal Framework, with priority actions for integration of CCA/DRM issues into legislation that regulates environmental approvals for infrastructure development (*i.e. the Environmental Assessment Act 2003, Environmental Impact Assessment Regulations 2010* and the *Spatial Planning and Management Act 2012*). ▪ Guidelines on Coastal Protection and Resilient Water Supply, including development of user-friendly, non-technical guidelines on the development of foreshore protection and climate resilient rural water supply schemes.
Institutions and Capacity Building	▪ Strengthening of CCA and DRM Focal Points, by targeted capacity building for personnel in the MLECCNR, JNAP Secretariat, Tonga Meteorological Service (TMS) and NEMO in relation to climate change projections, climate and natural disaster risk analysis for infrastructure, and disaster response planning. ▪ Strengthening of the Coordination Role of JNAP, and establishing arrangements for continuity of the functions of the JNAP Secretariat. ▪ Capacity Building within Line Ministries, especially the MLECCNR and the National Spatial Planning Authority to ensure adequate technical resources and capacity in relation to CCA/DRM issues. ▪ Technical Training related to Revised Building Code and Road Design Standard. ▪ Ongoing and regular capacity building for personnel and community leaders on outer islands, and broad community awareness raising on climate and natural disaster risks and response planning, and disaster response drills.

5 Funding strategy

The function of the NIIP is to set out Government's priorities in terms of infrastructure investments; strengthening the foundation of sustainability, safety, and resilience; and also to set the scene in terms of delivery mechanisms. This part of the NIIP looks at the overall demand for infrastructure financing, potential financing options, and develops an overall funding strategy for how the infrastructure priorities will be delivered.

5.1 Demand for infrastructure finance

Demand for infrastructure finance comes from three sources: capital investment in new or upgraded infrastructure; complementary initiatives that support the operation and management of the infrastructure sector; and ongoing maintenance of the infrastructure.

Capital investment

Capital expenditure on infrastructure projects over the period 2013/14 to 2017/18 will come from four sources:

- Projects that that were identified in NIIP2010 and whose implementation is currently underway and will continue during the NIIP2013 timeframe. As shown in Table 3.2, this component is estimated at T$100 million over the period 2013/14 to 2017/18;
- Projects that that were identified in NIIP2010, have committed funding, and will commence implementation during the NIIP2013 five-year timeframe at an estimated cost of T$73 million (see Table 3.2);
- High priority additional projects identified in this NIIP (see Chapter 3). If all of the high priority projects forge ahead as planned, this will involve an estimated T$173 million in additional infrastructure investment; and
- Other smaller investments (mostly by Public Enterprises) that are part of their own investments programs but are not major projects captured by the NIIP process. Based on current expenditure patterns (Annex E), this is estimated to total around T$8 million per year.

If all of these investments go ahead as planned, demand for capital investment over the period 2013/14 to 2017/18 is estimated at total T$385 million. Phasing of expected capital expenditure over the period 2013/14 to 2017/18 is shown in Table 5.2 and reveals high levels of investment in 2013/14 and 2014/15, after which levels will decline.

To put these investments in perspective, the peak level of investment in 2013/14 is equivalent to almost 15 per cent of GDP, while the average annual level of investment over the period 2013/14 to 2017/18 is equivalent to eight per cent of GDP. These levels of investment in infrastructure are high, particularly in the first two years of the plan period. In part, this is a result of several large projects that are already underway or committed and being scheduled for implementation over the 2013/14-2014/15 period. This includes laying of the undersea fibre-optic communications cable to Fiji and resurfacing of the Fua'amotu and Vava'u airport runways. These three projects have some T$90 million of committed expenditure. This tends to distort the expected expenditure profile. However, it should also be recognised that the peak level of T$110-120 million in the first two years of this Plan is lower than recent peaks in infrastructure investment (T$140 million in 2010/11 on projects covered by NIIP2010); and the overall average level of investment of eight per cent over the five-year plan period is consistent with international norms for developing countries, though at the upper end of the scale.[20]

Complementary initiatives

Chapter 3 set out the full range of complementary activities required to support implementation of the NIIP. Table F.2 in Annex F provides a breakdown of estimated costs of these complementary initiatives. At this stage, it is not possible to precisely estimate the cost of each individual activity, but in total it is anticipated that all the complementary activities, which mostly involve consulting services, may amount to T$15 million over the five-year priority period covered by this NIIP.

[20] According to the World Bank's World Development Report for 1994, *Infrastructure for Development*, public investment in infrastructure in developing countries ranges from two per cent to eight per cent (and averages four per cent) of GDP.

Maintenance

Turning to maintenance, Table 5.1 shows the annual maintenance expenditure requirements for NIIP projects (underway, committed high priority proposed) at the end of the first five years of this NIIP (2017/18), with a breakdown by project status and responsibility. These maintenance requirements are separate from the capital expenditure requirements set out above. Estimated forward maintenance costs were calculated using rules of thumb for maintenance requirements of different types of infrastructure. Infrastructure was classified as fixed or mobile, and as having a short, medium, or long lifespan, and maintenance rates were specified accordingly. It is assumed that mobile infrastructure with a short lifespan requires the highest level of maintenance (3.5 per cent of capital cost per annum), while fixed infrastructure with a long lifespan requires the lowest level of maintenance (two per cent of capital cost per annum, or lower in some cases).

Table 5.1: Annual maintenance expenditure requirements at the end of 2017/18 (T$ million)

	Government	Public Enterprises	Total
NIIP2010 investments (underway, committed)	0.9	4.8	5.7
NIIP2013 high priority proposed investments	1.2	2.1	3.3

Around 35 per cent of the estimated total annual requirement of T$9.0 million relates to high priority proposed projects; most (75 per cent) accrues to Public Enterprises; and almost all of the Government component relates to road maintenance. However most of this is not 'new' maintenance. Many NIIP projects upgrade/repair/rehabilitate existing infrastructure and so do not produce 'new' maintenance liabilities and in some cases may lead to a reduction in required maintenance spending. Therefore to avoid double-counting, it is necessary to consider demand for maintenance spending from three sources:

- maintenance of existing infrastructure, including investments from the NIIP2010 program that were already operational in 2011/12. This is estimated to total some T$10.5 million per year, including T$6.8 million on road maintenance (sustainable maintenance level from calculations conducted for establishment of the Road Fund), around T$0.3 million on maintenance of outer islands ports (see Annex E), and around T$3.4 million by Public Enterprises with maintenance spending at an average of two per cent of asset value (Annex E);
- new maintenance requirements from NIIP2010 projects that are underway and committed. This figure will be lower than the T$5.7 million shown in Table 5.1 because about half of the required maintenance spending relates to the upgrade/repair/rehabilitation of existing infrastructure assets; and
- new maintenance requirements from high priority projects proposed by this NIIP (Annex E).

Table 5.2 shows the estimated annual maintenance expenditure requirement for the first five years of this NIIP for each of these components.

Total demand for infrastructure finance

Table 5.2 combines the requirements for capital expenditure on infrastructure over the period 2013/14 to 2017/18 with requirements for expenditure on complementary initiatives and the maintenance of infrastructure (including pre-existing assets) to provide a picture of the total demand for infrastructure finance over this period.

Table 5.2: Total demand for infrastructure finance (T$ million)

	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Capital Investment						
NIIP2010 underway and committed	104	49	7	8	5	173
NIIP2013 high priority	16	62	60	24	10	172
Other smaller items of capital expenditure	8	8	8	8	8	40
Complementary initiatives						
NIIP2013	3	3	3	3	3	15
Maintenance						
Pre-existing assets [1]	10.5	10.5	10.5	10.5	10.5	52.5
NIIP2010 underway and committed	0.5	2.5	2.5	2.5	2.5	10.4
NIIP2013 high priority	0.3	0.8	1.5	2.0	2.1	6.7
Total	142	136	92	58	41	470

Notes: [1] Including NIIP2010 assets operational in 2011/12

5.2 Overview of the infrastructure financing environment

Traditional sources of finance for investment in infrastructure in Tonga have been:

- grants from development partners;
- concessional loans from international financial institutions;
- self-financing by Public Enterprises; and
- limited financing by Government from consolidated revenues.

In recent years, additional sources of finance for investment in infrastructure have emerged which include:

- grants and concessional loans from non-traditional development partners (mirroring an international trend for non-Organisation for Economic Co-operation and Development (OECD) nations to play a more significant role in development cooperation);
- grants, rather than the traditional concessional loans, from international financial institutions (though this form of assistance may be considered a temporary response to difficult economic conditions);
- regional development assistance programs, which have begun to combine south-south cooperation together with the financing of some quite major infrastructure (commitment to finance investments in airports in Tonga under the PAIP being an important example);
- private sector involvement in the provision of infrastructure, in particular the opening of the telecommunications market to competition and the entry of Digicel; and
- dedicated funding for adaptation to climate change, disaster risk management, and more general environmental management.

Not all of these developments in relation to sources of funding, and notably, the availability of funding for airport redevelopment under the PAIP were foreseen at the time NIIP2010 was prepared.

In relation to the financing of this NIIP, the tight fiscal situation facing Government will restrict the options available to finance the investment priorities. In particular, the Government is unlikely to be in a position to finance major infrastructure from domestic revenues, and an announced interim 'no new loans policy'[21] will remove additional concessional borrowing as an option at least in the early years of the plan period. Most economic infrastructure in Tonga is now managed and operated by Public Enterprises,[22] so the Government will be looking to work closely with Public Enterprises and also with the private sector and development partners to make the infrastructure development in this NIIP a reality.

5.3 Assessment of financing options

As noted above, a range of options are available for the financing of capital and ongoing expenditure. The following sections describe possible funding sources and their suitability for financing investment in infrastructure under this NIIP. More details are available in Annex F.

[21] See summary of fiscal policy in Government of Tonga Budget Statement for the year ending 30 June 2013, page 8

[22] Government retains direct responsibility only for the road network and outer island ports, but remains involved in the planning and financing of major infrastructure owned and operated by Public Enterprises

Government finance

Tonga is emerging from a period of high budget deficits resulting from imbalance between domestic revenues and expenditures, and a high level of capital expenditure (with a high proportion financed from concessional borrowing). The fiscal deficit was equivalent to roughly six per cent of GDP in 2009/10 and 2010/11, and a projected 2.7 per cent of GDP in 2011/12. However, this is expected to turn around in the short-medium term. Government has budgeted for a small surplus in 2012/13, and surpluses in the order of one per cent of GDP are projected in the next three financial years. This has been achieved through fiscal tightening, access to budget support funding from development partners, and a reduction in capital expenditure. Although more Public Enterprises are paying dividends to Government (total around T$1.7 million in 2011/12), dividends are not significant in the infrastructure financing context nor are they likely to be so in the medium term.

Overall, this means that the Government has very limited capacity for financing economic infrastructure investment either from its Budget or through borrowing. At the end of 2011/12, the Government carried T$350 million of indebtedness by way of direct borrowings and loan guarantees (see Annex E for details), and the most recent Debt Sustainability Assessment (DSA) undertaken jointly by the International Monetary Fund (IMF) and WB in early 2012 concluded that Tonga remains at a high risk of debt distress. As a result, the Government has adopted an interim 'no new loans policy'. On the other hand, with the improving Budget position and establishment of a Road Fund, Government funding of maintenance of infrastructure is in a position to increase, as discussed below.

If the proposed extension of the fibre-optic cable from Tonga to Samoa materialises, part of the costs of the high priority project T9 (Undersea cable linking Ha'apai and Vava'u) would be covered by linking into this international connection. If the international cable project is not pursued, further analysis will be necessary to establish the preferred least cost technological option of connecting the northern island groups.

Public Enterprise finance

With the exception of roads and outer island ports, Public Enterprises manage all economic infrastructure in Tonga. There has been improvement in the financial performance of Public Enterprises since NIIP2010, with more recording profits and more paying dividends to Government (despite the continuing fragility of the economy and difficult business environment). Table 5.3 summarises the results of an analysis (Annex E) of the capacity of Public Enterprises to self-fund infrastructure maintenance and renewal.

In terms of financial performance, Public Enterprises can be classified as *large and strong* (TPL and TCC), *medium and capable* (PAT, TAL and TWB), and *small and marginal* (TBC and WAL). The stronger Public Enterprises can self-finance operations, maintenance, and all but major capital expenditures; others can self-finance operations, maintenance, and small capital expenditures, while the WAL requires a level of Government subsidy to cover the costs of operation. Only TPL, TCC, and PAT can support commercial borrowing on any significant scale.

The high priority proposed projects included in NIIP2013 tend to be large projects of national significance, which are beyond the capacity of Public Enterprises to self-finance (the control tower at Fua'amotu International Airport and the expansion of the Nuku'alofa water system are two projects that could involve at least partial self-financing by the Public Enterprise responsible). However, Public Enterprises currently finance a significant amount of capital expenditure from their own resources. This has averaged around T$15 million per year over recent years (Annex F, Table F.6), but can be expected to increase in line with the general trend of improved financial performance. Over the five-year period 2013/14 to 2017/18, roughly half of this capital investment by Public Enterprises is expected to go towards NIIP2010 projects underway or committed, and half to smaller investments which are nonetheless critical to the overall performance of infrastructure. Public Enterprises also spend an estimated T$4.0 million per annum on infrastructure maintenance, and with the exception of the WAL, have the financial capacity to fund maintenance of new investments.

Table 5.3: Analysis of capacity for self-funding infrastructure costs

Sector	Agency	Operations	Maintenance	Small CAPEX	Medium CAPEX	Large CAPEX
Energy	Tonga Power Ltd	High	High	High	High	Medium
Telecommunications	Tonga Communications Corp	High	High	High	High	Medium
	Tonga Broadcasting Corp	High	Medium	Medium	Low	Low
Water	Tonga Water Board	High	High	Medium	Low	Low
Waste	Waste Authority Ltd	Medium	Low	Low	Low	Low
Transport	Ports Authority of Tonga	High	High	High	High	Low
	Tonga Airports Ltd	High	High	High	High	Low

Development partner finance

Over recent years, development partners have been very supportive in assisting Tonga with investments in the infrastructure sector. As outlined in Annex F, this has involved some T$380 million in recent and planned support from development partners in the financing of investments in economic infrastructure. Government expects that support will continue to be available, provided infrastructure investments are demonstrably well managed and maintained. Beyond current commitments, development partners do not have specific forward allocations dedicated to infrastructure. One opportunity that may emerge is a possible regional maritime initiative, which could fund improvements in maritime safety and port infrastructure.

Domestic financial institutions

Domestic financial institutions with a current or potential interest in financing economic infrastructure include the private commercial banks and the Tonga Development Bank. These institutions already have dealings with some Public Enterprises, and are open to lending for infrastructure projects. However, they are only interested in lending for projects which can establish commercial viability. An indicative analysis of the borrowing capacity of Public Enterprises (Annex F) has concluded that only TPL, the TCC, and PAT have the capacity to fund investments through commercial finance. None of the high priority proposed projects included in this NIIP appear to lend themselves to direct commercial borrowing by Public Enterprises.

Pension funds including the newly formed Tonga National Retirement Benefits Fund are also potential investors in economic infrastructure. Again, interest would be confined to projects which are commercially viable.

Funding for climate change adaptation and disaster risk management

Due to the high levels of climate and natural disaster vulnerability of Pacific countries, the region has been a focus of CCA and DRM support for many donors. In recent years the funding available for CCA and DRM activities has increased. Traditional donors are paying greater attention to mainstreaming climate issues in their operations and are providing enhanced support for targeted CCA and DRM activities. A number of new sources of funding that focus on CCA related interventions have also been created both at the national and international level. These opportunities are considered in detail in Annexes D and F. In particular, a *Strategic Program for Climate Resilience for the Kingdom of Tonga* has been prepared and assistance with implementation funding is expected under the PPCR program.

Maintenance funding

Government policy is that the cost of operations and maintenance of economic infrastructure should be funded from user charges wherever possible. Public Enterprises (with the exception of WAL) have the capacity to self-finance a reasonable level of expenditure on maintenance, but some are neglecting maintenance and most would benefit from greater attention to improvements in asset management. Public Enterprises currently spend around T$4 million per annum on maintenance (see Annex E for details), which in aggregate is above basic maintenance requirements (around two percent of asset value on average). The main sectors which appear to have a significant gap in maintenance expenditures are water and aviation. In the aviation sector, this can be at least partly explained by the

major infrastructure renewal program underway and the high asset value. Asset management in WAL and the TWB is being addressed under the NUDSP with the intention that the principles developed under this project will be adopted more broadly.

In recent years, Government spending on the maintenance and rehabilitation of roads and outer island ports has been patchy and below sustainable levels. As noted above, Government has approved the establishment of a Road Fund that will provide dedicated financing of routine and periodic maintenance of the road network at a long term sustainable level, with most work contracted out to the private sector. The next step is to update the institutional arrangements for managing and maintaining outer islands ports. This is identified in this NIIP as a priority initiative for the ports sector.

Private sector involvement

Inputs in the provision of infrastructure can range from *design* to *construction* to *operation* to *financing* to *ownership*. Private sector involvement in the implementation of this NIIP is likely to focus on design and construction which will be undertaken by local and international contractors. There is also scope for increased outsourcing of some aspects of the operations of Public Enterprises to the private sector, including some aspects of service delivery and asset maintenance. In particular, road maintenance and construction is increasingly being contracted out to the private sector, and more opportunities will emerge from increased funding under the Road Fund. The private sector is also active in service provision in the telecommunications sector, and in providing specialist technical services across all sectors. More complex arrangements covering the operation and ownership of infrastructure are unlikely to be realistic prospects during the term of this NIIP, but have potential for the future. In summary, the private sector is not expected to contribute significantly to capital investment in infrastructure in the short-medium term, but will play a critical and increasing role as a service provider in terms of design, construction, operations, maintenance, and specialist technical services.

5.4 Overall funding strategy

If all of the ongoing, committed, and proposed high priority investment projects and complementary initiatives go ahead as planned, it will involve around T$385 million in new investments (underway, committed, additional high priority), T$15 million in complementary initiatives, and around T$70 million in the maintenance of new and existing assets over the first five-year period of this NIIP (Table 5.2).

Maintenance of existing and new infrastructure is a high priority. As noted above, Government policy is that the cost of operations and maintenance of economic infrastructure should be funded from user charges wherever possible. Government intends to work closely with Public Enterprises, the private sector, and development partners to lift the overall performance of the infrastructure sector, and as a minimum, achieve self-funding of operations and sustainable maintenance by Government and Public Enterprises. In particular, appropriate maintenance expenditure levels need to be established, which means having effective asset management plans in place and ensuring that service prices include provision for maintenance. Progress has already been made towards improved cost recovery, maintenance, and asset management, and further progress is expected with assistance under the NUDSP program.

However, the capacity to self-fund major capital investment in infrastructure is limited. **Tonga does not currently have the capacity to finance substantially more infrastructure assets without assistance from development partners**, even if those investments are high priorities. As already noted:

- the Government is facing very tight fiscal constraints in relation to funding investment from domestic revenues or concessional borrowing, and as an interim measure has adopted a ‘no new loans policy’;
- the capacity of Public Enterprises to finance infrastructure from internal sources is improving, but generally is insufficient to replace/rehabilitate major infrastructure items, or introduce significant new innovations to transform the sector; and
- in the short-medium term, the private sector is unlikely to be a significant source of investment in additional major economic infrastructure.

Overall, Tonga will need to adopt a partnership approach to infrastructure delivery with Government, Public Enterprises, and the private sector working closely together with the support of development partners. In particular, **support from Development Partners in the form of grants will be needed to help finance the high priority investment projects and technical assistance for complementary initiatives identified in this NIIP**.

Taking these factors and the above analysis of potential funding sources into account, the key aspects of the funding strategy for infrastructure development and asset management over the next five-years are:

- Improving Budget conditions are expected to enable Government to make a small contribution to infrastructure investment (average around T$1 million per year) and to increase spending on maintenance of outer islands ports to sustainable levels, either through direct Budget allocation and/or improved cost recovery. Development and implementation of improved mechanisms for management and financing of outer islands ports is an important planned complementary initiative of this NIIP.

- The Road Fund recently established by Government will transform financing of road maintenance. The Fund will be phased in over several years and when fully operational will provide more than T$6 million each year for routine and periodic maintenance.

- Public Enterprises are expected to continue their strengthening their financial performance, and cover required maintenance and make infrastructure investment from their own resources. Based on current levels of expenditure (Annex E) and assuming some strengthening in financial resources, it is expected that Public Enterprises will lift spending on infrastructure, and contribute around T$35 million of spending on required maintenance; and around T$80 million to financing capital expenditure in infrastructure over the five-year period. This includes contributions to NIIP2013 high priority projects, to major investment projects already underway or committed, and to planned smaller investments that are part of the Public Enterprises' own investment program. The proposed new control tower at Fua'amotu and the expansion of the Nuku'alofa water system are two NIIP priority projects that could involve at least partial self-financing by the Public Enterprise responsible, in this case by TAL and the TWB respectively.

- Development partners are expected to continue to provide support for economic infrastructure and associated technical assistance and capacity building, but the mix of sources may change. As noted above, major development partners have committed some T$380 million in assistance for recent and planned infrastructure projects. With the Government's 'no new loans' policy in place, it is expected that the balance of sources will change, with an increase in grant finance to make up for lower utilisation of concessional loan finance, and a greater contribution from new sources, including regional and global funds, such as growing support for CCA/DRM activities. Government will take a lead role in facilitating CCA/DRM investments, a key emerging priority in the NIIP process.

- It is not expected that the private sector will contribute significantly to capital investment in infrastructure in the short-medium term, but as noted above, will play a critical and increasing role as a service provider in terms of design, construction, operations, and specialist technical services.

The funding strategy as explained above is summarised in Table 5.4 below with the indicative breakdown of funding sources for the NIIP.

Table 5.4: Indicative Infrastructure Budget for 2013/14 - 2017/18 (T$ million)

		Funding Source		
	Demand for Funding	**Government**	**Public Enterprises**	**Development Partners**
Capital Investment	$385	$5	$80	$300
Complementary Activities	$15	-	-	$15
Maintenance	$70	$35	$35	-
Total	$470	$40	$115	$315

Government will continue to invest in the economic infrastructure sector, but as outlined above, its capacity to fund additional infrastructure, beyond what is already committed, is extremely limited. A key role that Government will continue to play is to facilitate a partnership approach to infrastructure delivery by brokering arrangements for funding infrastructure and working with key stakeholders in the infrastructure sector to improve the environment for infrastructure financing. This will involve:

- identifying and building awareness of traditional, new and innovative financing sources and mechanisms (such as new opportunities emerging for funding CCA/DRM initiatives from regional and global programs);

- helping to coordinate the dialogue between sources of funding and infrastructure managers;
- working with infrastructure managers to design and implement financing packages for major projects. This may involve a combination of one or more sources such as Public Enterprise resources, development partner grants, commercial loans, and in some cases, Government budget and private equity. Development of the Tonga-Fiji undersea communications cable is an example of a project with a more complex package of funding modalities. The MFNP has a key role to play in this area and the Government is strengthening its capability to coordinate infrastructure financing;
- working with infrastructure managers (with support from development partners) on complementary initiatives aimed at improving the financial and operational performance of infrastructure management, improving asset management and maintenance, and thereby creating an improved environment for infrastructure development and financing; and
- engaging further with the private sector with a view to it taking on more significant roles in infrastructure in the future.

6 Monitoring and updating the Plan

6.1 Monitoring progress

The NIIP is a high-level strategic Plan with an ongoing role in guiding the development of the infrastructure sector. Priority projects will vary from one NIIP to the next update, but the underlying key outcome objectives and enabling themes will stay the same. Accordingly, the monitoring and evaluation (M&E) framework for NIIP focuses on a relatively small number of high-level indicators that are linked to NIIP's outcome objectives of Connecting Tonga; Infrastructure for Communities; Reliable and Affordable Energy; and the foundation of Sustainability, Safety and Resilience. The framework also includes a number of performance indicators for each of the sub-sectors to measure access to and the quality, affordability, and efficiency of service delivery.

The monitoring framework for NIIP draws on the approach adopted for the TSDF to maintain consistency and practicality. As with the TSDF, the focus is on indicators that are specific and measureable, and targets that are achievable, realistic, and timely. The M&E indicators for NIIP, along with targets and M&E responsibilities, are listed in Appendix 2. Benchmark levels and targets for the indicators will be confirmed as part of the first NIIP Monitoring Report.

Progress against the NIIP M&E framework will be reported on an annual basis. Each year, the MFNP in collaboration with the MOI will prepare a brief NIIP Monitoring Report that will provide an update on the status of funding and implementation of all projects in the NIIP portfolio, especially the high priority planned projects; and on the M&E indicators listed in Appendix 2. The Monitoring Report will also note major and outstanding issues in the infrastructure sector to determine if the current NIIP needs adjusting. The Report will be presented to Cabinet and after that will be publicly available to enable interested stakeholders to follow progress with the implementation of this NIIP. As the implementation and funding of the NIIP will to a large extent depend on external support, the Government intends to discuss the NIIP Monitoring Report in annual meetings with development partners.

6.2 Updating the Plan

The NIIP is an integral part of the Government's national planning and budgeting process. With many infrastructure projects and reforms already underway and more in the NIIP priority pipeline, it will be important to keep the NIIP updated so it stays relevant to emerging challenges and opportunities. The Government intends to update the NIIP on a regular basis to reflect latest planning and budget priorities, and track progress on implementation. The MFNP, with support from the MOI and other agencies, will be responsible for managing the NIIP update process as part of its national planning role.

The update cycle will align with the MTBF process that is being introduced by Government from 2013 and with updates to the TSDF:

- Every two to three years, a NIIP Update will be prepared. This will be a brief report containing an update of the list of high priority projects and complementary initiatives; highlight emerging challenges; and note any major changes to overall Government policies and priorities for the infrastructure sector. The exact timing will be decided by the Government taking into account changing needs and guided by the annual NIIP Monitoring Report.
- Every four to five years a full update of the NIIP priorities and NIIP document will be prepared. Since the focus of each NIIP is on a detailed priority program for the next five years, it is essential that the NIIP has a full update at intervals of no more than five years so it remains current and relevant. The exact timing of this update will be guided by the release of a new TSDF to ensure the NIIP reflects latest Government thinking on priorities and goals for national development.

In years when there is a partial or full update of the NIIP, this will replace the annual NIIP Monitoring Report.

Appendix 1: NIIP summary matrix

Sector	Major Ongoing Projects	T$ m	Additional Priorities (next five years)	T$ m	Preferred Timing FY2014 - 2018	Preferred Timing FY19-23	Responsible Agency
ENERGY							
	E1 TPL Distribution Network Upgrade Program	$5			■	⇔	TPL
	E2-5 TPL Diesel Generators Upgrade Program	$30			■	⇔	TPL
	E6 Village Networks (electricity pole replacement)	$14			■		TPL
	E7 Outer-island Off-Grid power (solar)	$5			■		TPL
	E14 Solar Generation (Vava'u)	$10			■		TPL/TERM
			E11 Additional 1-2MW of Solar PV on Tongatapu	$24	■		TPL
			E16 Outer Islands On-Grid Renewable Energy	$9	■		TPL
TELECOMMUNICATIONS							
	T1,2 TCC Fixed line and Mobile Upgrade Program	conf.			■		TCC
	T4 Outreach – Expanding Services to small islands	$2			■		MCI
	T6 International Fibre-Optic Cable to Fiji	$53			■		TCL
	T7 Local Reticulation of High Speed Internet	$8			■		TCC/TCL
			T10 Comms for Early Warning & Disaster Recovery	$6	■		TBC
			T9 Fibre-Optic Cable to Ha'apai and Vava'u[23]	$30	■		TCL
WATER							
	W2 Rehabilitate the Nuku'alofa water system	$7			■		
			W3 Outer Islands water supply improvements	$15	■		TWB
			W4 Expand Nuku'alofa system to growth areas	$11	■		TWB
WASTE							
	S5 Sustainable Solid Waste Services in Nuku'alofa				■		WAL
			S6 New Landfill or Transfer Station on Ha'apai	$4	■		MLECCNR
ROADS							
	R2 Integrated Urban Development Sector Program	$12			■		MOI
	R3 Transport Sector Consolidation Project (Roads)	$12			■		MOI
	R4 Vaipua Bridge (Vava'u)	$8			■		MOI
			R10 Outer Islands Roads Upgrading Program	$10		■	MOI

[23] Linked to proposed extension of the international fiber-optic cable between Tonga and Samoa

Sector	Major Ongoing Projects	T$ m	Additional Priorities (next five years)	T$ m	Preferred Timing FY2014 - 2018	Preferred Timing FY19-23	Responsible Agency
MARITIME							
	P6 Replace Fender at QSW International Wharf	$1			■		PAT
	P3 Reseal Queen Salote Wharf (Int. and Dom.)	$11			■ ■ ■		PAT
			P9 Maritime Sector Safety and Resilience	$20	■ ■ ■ ■		MOI
AIRPORTS							
	A6 Upgrade International Arrivals (Fua'amotu)	$2			■		TAL
	A8 Resurface Fua'amotu runway, apron, taxiway	$38			■		TAL
	A10 Resurface Vava'u runway, apron, taxiway	$11			■		TAL
			A11 Resurface Ha'apai runway, apron, taxiway	$9	■		TAL
			A12 New Control Tower at Fua'amotu Airport	$7	■		TAL
MULTI							
			M2 Coastal Protection - Eastern Tongatapu	$15	■ ■ ■		MLECCNR, MOI
			M4 Disaster Response & Evacuation Infrastructure	$12	■ ■		MOI, MLECCNR

Appendix 2: Monitoring and evaluation framework

The following Table describes the Monitoring and Evaluation (M&E) framework for the NIIP. It lists key indicators that measure the impact of NIIP in terms of outcome objectives of the TSDF and NIIP. The Table is structured in line with the NIIP Strategic Framework described in Chapter 2 and includes the following information for each M&E indicator:

Indicator:	a brief description of the indicator in terms of what it aims to achieve
Target:	the desired outcome (benchmark levels and targets to be confirmed as part of the first NIIP Monitoring Report)
Source/ Responsibility	the agency(s) that are responsible for monitoring progress and providing data
Linkages:	links to other key strategic and monitoring documents, especially TSDF and MDGs

Indicator	Target	Source/ Responsibility	Linkages
NIIP AWARNESS, IMPACT AND MANAGEMENT			
NIIP is widely available in electronic form	Available on GoT/MFNP/MOI websites	MFNP, MOI	
NIIP is widely available in printed form	Brochure version of NIIP prepared and distributed	MFNP, MOI	
Percentage of projects in NIIP with identified funding within 3 years	More than 50%	MFNP, MOI	
NIIP has an incremental update every 2-3 years	Completed	MFNP, MOI	
NIIP has a full update every 3-4 years	Completed	MFNP, MOI	
Institutional arrangements in place for monitoring and updating the NIIP	Completed and adopted	MFNP, MOI	
CONNECTING TONGA			
Speed of internet services available to all parts of the Kingdom	Increased	MCI	TSDF; MDG 8.F
Cost of internet and mobile phone services to all parts of the Kingdom	Decreased [in real terms from 2012 level]	MCI	TSDF
Percentage of road network rated in good/fair condition	Increased [consistent with TSCP targets]	MOI	TSCP
Number of airports meeting relevant international safety and security requirements	All	TAL, MOI	TSDF
Number of sea ports meeting relevant international safety and security requirements	All	PAT, MOI	TSDF
INFRASTRUCTURE FOR COMMUNITIES			
Proportion of population with access to basic services (electricity, water, improved sanitation)	Maintained and Improved	TPL, TWB, MOI, MLECCNR	TSDF, MDGs
RELIABLE AND AFFORDABLE ENERGY			
Proportion of Tonga's energy needs met by renewable energy	Increased [target 50%]	TERM	TSDF
Percentage of villages/towns with 24 hour energy supply	Increased	TPL	TSDF
Cost of electricity	Stable or reduced [in real terms from 2012 level]	TPL	
SUSTAINABILITY, SAFETY, RESILIENCE			
National asset management policy developed and adopted	Completed	MOI	
Review of Government functions in the infrastructure sector to streamline processes and address gas/overlaps	Completed and Implemented	MOI, MFNP	
EIA conducted for major infrastructure projects	100%	MLECCNR	TSDF

Indicator	Target	Source/ Responsibility	Linkages
Arrangements for sustainable funding and maintenance of roads	Implemented	MOI	
Arrangements for sustainable funding and maintenance of outer islands ports	Implemented	MOI	
Number of fatal accidents on roads	Reduced (target 50% reduction from 2012 level)	MOI, Police	
CCA/DRM issues integrated into legislation that regulates environmental approvals for infrastructure development (Environmental Assessment Act 2003; Environmental Impact Assessment Regulations 2010; Spatial Planning and Management Act 2012)	Completed and adopted	MLECCNR	TSDF
Revised Building Code and national Road Design Standard that take into account latest information on CCA/DRM risks	Completed and adopted	MOI	
CCA/DRM Checklist for Infrastructure Planning	Completed and adopted	MOI, MLECCNR	

Key Performance Indicators per sub sector

Subsector	Indicators
Energy	▪ *Access:* Access to Electricity | Electricity Production (Capacity and Actual) ▪ *Affordability:* Electricity Tariffs (Commercial and Residential) ▪ *Energy Use:* Total Fuel Imports | TOE per capita | Renewable Energy Share | Clean Energy Contribution ▪ *Efficiency:* Distribution Losses
ICT/ Telecommunications	▪ *Access:* Fixed Line, Mobile Subscriptions and Internet Users per 100 People | Total Teledensity | Fixed Broadband Subscribers per 100 People ▪ *Affordability:* Telecommunications Service Price as % of Average Monthly Income (Fixed Line, Mobile and Internet) | Number of Service Providers (Fixed Line, Mobile and Internet) ▪ *Quality:* International Internet Bandwidth per Person | Secure Internet Servers per 1 Million People
Solid Waste Management	▪ *Access:* Access to Regular Waste Collection (Urban) | Frequency of Household Waste Collection ▪ *Sustainability:* Recycling Services and Waste Sorting ▪ *Quality:* Environmental Standards of Landfills ▪ *Efficiency:* Cost Recovery
Transport	**ROADS** ▪ *Access:* Total Road Network | Paved Roads | Unpaved Roads | Paved Roads as % of Total Road Network | Road Density | Population Density | Private Motor Vehicle Registrations ▪ *Quality:* Paved Roads ▪ *Affordability*: Vehicle Registration Tariffs **AVIATION** ▪ *Access*: Number of Operational Airports (Paved/Unpaved) | Scheduled Take-Off and Landing by Airport | Average Passenger Numbers | National (and other) Airline Carriers | Inbound Flights per Week | Inbound Seats per Week | Domestic Air Services in PICs ▪ *Affordability*: Air Travel Costs | International Air Freight Rates | ▪ *Efficiency*: Average Waiting Time for Services | Institutional Arrangements for Pacific Airports **MARITIME** ▪ *Access:* Frequency of International Shipping Services per Month | Shipping Traffic in Ports (Vessels per Year) | Number of Main Ports ▪ *Affordability*: Stevedoring Charges *Efficiency/Productivity*: Cargo Handling Equipment and Facilities in Major Ports | Vessel Turn-Around Times | Port Administration
Water and Sanitation	▪ *Access:* Access to Improved Water Source (Urban and Rural)| Access to Improved Sanitation (Urban and Rural)| Incidence of Water Borne Diseases ▪ *Quality:* Availability of Water Supply in Piped Water Supply Systems ▪ *Efficiency*: Estimated Non-Revenue Water| Metered Connections| Employees per 1000 Connections| Cost Recovery ▪ *Affordability:* Average Tariff (Water and Sewerage Services)

Annexes

Annex A	Project details
Annex B	Infrastructure sector status and plans
Annex C	Project prioritisation
Annex D	Climate change adaptation and disaster risk management issues
Annex E	Analysis of life-cycle costing issues
Annex F	Funding issues and strategy
Annex G	Review of outcomes and impact of NIIP2010

Annex A: Project details

This Annex provides a more detailed account of the infrastructure investment projects. It is presented in two parts:

- Part 1 provides a summary description of all of the major projects (underway, committed, and proposed) that form the long list of projects considered in the National Infrastructure Investment Plan (NIIP) planning process. To provide ongoing tracking of NIIP projects, it also includes projects that were included in the NIIP2010 that are now operational.
- Part 2 offers a more detailed description of each of the NIIP2013 priority projects in the form of a one-page project sheet that includes details of project description, benefits and financing.

PART 1: Summary description of all projects

The following Tables provide a summary description of all infrastructure investment projects considered in the NIIP planning process. The following information is provided for each of the projects:

NIIP Reference	A unique code number that is used to identify and track specific projects.
Project Name	A short descriptive title for the project.
Responsible Agency	The Government agency or Public Enterprise that is most responsible for delivering the project.
Project Cost	Estimated cost in T$ million. For most projects, this is an estimate for planning purposes and is not a firm cost based on detailed design/specification.
Start	The year that the project is expected to start.
Finish	The year that the project is expected to be completed and operational.
Status	The stage that the project has reached, classified as: ▪ *Operational:* work on implementation is completed and the infrastructure is operational; ▪ *Underway*: work has already started on implementation; ▪ *Committed*: funding has already been identified for the investment and there is a high probability that it will proceed, but the timing may change; or ▪ *Proposed*: these are planned investments for which funding has not been confirmed and timing is not certain. Some are at an early stage of planning and development without fully defined components.
Funding Source	The expected source of funding for the project, and if it involves development partners (DP), which partner and the status of the funding commitment (*confirmed* or *under discussion*). For many projects, the need has been identified and preliminary planning undertaken, but the source of funding is unknown at this stage.
Description	A more detailed description of the project components and rationale.

ENERGY SECTOR

NIIP Reference	E1	E2	E3	E4	E5
Project Name	**Distribution Network Improvements (multi-year)**	**Additional/Replacement Generators (Tongatapu)**	**Additional/Replacement Generators (Vava'u)**	**Additional/Replacement Generators (Ha'apai)**	**Additional/Replacement Generators ('Eua)**
Responsible Agency	TPL	TPL	TPL	TPL	TPL
Project Cost (T$ million)	18.0	28.6	2.0	4.0	3.5
Start	Ongoing	Ongoing	Ongoing	Ongoing	Ongoing
Finish					
Status	Underway	Underway	Committed	Committed	Committed
Funding Source	Self (TPL)	Self (TPL)	Self (TPL)	Self (TPL)	Self (TPL)
if DP, who					
if DP, status					
Description	Ongoing program to refurbish the distribution network (poles, cables, etc) for improved efficiency and safety.	Ongoing program to replace/ upgrade existing generators and add additional capacity.	Ongoing program to replace/ upgrade existing generators and add additional capacity.	Ongoing program to replace/ upgrade existing generators and add additional capacity.	Ongoing program to replace/ upgrade existing generators and add additional capacity.

NIIP Reference	E6	E7	E8	E9	E10
Project Name	**Village Networks (electricity pole replacement)**	**Outer-island Off-Grid power (solar)**	**Improved Street Lighting**	**Upgrade Bulk Fuel Logistics (Tank Farm, Bunkering)**	**Solar generation (Tongatapu - Meridien)**
Responsible Agency	TPL	TPL	TPL / GoT	TERM/TPL	TPL / TERM
Project Cost (T$ million)	27.0	12.0	2.0	30.0	14.0
Start	2010	2010	2010	Unknown	2011
Finish	2015	2014	2015		2012
Status	Underway	Underway	Underway	Proposed	Operational
Funding Source	DP Grant	DP Grant	Government	Unknown	Private/DG
if DP, who	NZAID/EU/WB	JICA			NZAID
if DP, status	Confirmed	Confirmed			Confirmed
Description	Ongoing program to replace existing "stick" poles to improve the safety and reliability of the distribution system.	Installation of solar photovoltaic cells in off-grid areas.	Ongoing program to improve street lighting in Nuku'alofa	Expand the capacity of the existing tank farm and associated facilities to enable bulk buying of fuel on the international market.	Installation of 1,500 MWh of solar generation capacity. Financed by Meridian Energy with assistance from NZ Government. Ownership transfers to TPL in 2017.

ENERGY SECTOR

NIIP Reference	E11	E12	E13	E14	E15
Project Name	**Solar generation (Tongatapu – Additional 1-2 MW)**	**Renewable energy pilots (biofuel, wind, tidal, etc)**	**Energy Roadmap TGIF Projects**	**Solar Generation (Vava'u, 500 KW)**	**Biomass Generation ('Eua)**
Responsible Agency	TPL / TERM	TERM/TPL	TERM	TPL/TERM	TPL
Project Cost (T$ million)	24.0	3.0	-	10.0	10.0
Start	2013	2013	2014/15	2013	2013
Finish	2015	2014	beyond 2017	2013	2014
Status	Proposed	Proposed	Proposed	Underway	Proposed
Funding Source	DP Grant	DP Grant	Unknown	DP Grant	
if DP, who	Unconfirmed	Unconfirmed		Abu Dhabi Future Energy Company	
if DP, status	Under discussion	Under discussion			
Description	Installation of 1-2 MW of solar generation and storage capacity. Possible financing by JICA.	Based on the outcomes of research and feasibility studies, construct pilot plants to test the viability of wind power, tidal power, producing bio-fuel from coconuts, etc.	Program to implement the recommendations of the Tonga Energy Roadmap, based on the results of pilot plants and research.	Installation of 500 KW of solar generation capacity.	Generation of electricity from Biomass (wood chips and forestry waste) on 'Eua.

NIIP Reference	E16	E17	E18	E19
Project Name	**Outer Islands On-Grid Renewable Energy Project**	**Relocation of Tongatapu Power Station and Tank Farm**	**Undergrounding of Key Sections of Electricity Distribution on Tongatapu**	**Upgrade of Nuku'alofa Electricity Distribution Network**
Responsible Agency	TPL / TERM	TPL/TERM	TPL	TPL
Project Cost (T$ million)	4.0	Unknown	Unknown	26.0
Start	2014	beyond 2017	beyond 2017	2014
Finish	2016			2019
Status	Proposed	Proposed	Proposed	Proposed
Funding Source	DP Grant			
if DP, who	ADB			
if DP, status	Under preparation	Unknown	Unknown	Unknown
Description	Construct grid-connected PV solar plants on outer islands ('Eua, Ha'apai, Vava'u).	Move the power station and tank farm to a location outside of the tsunami and storm surge risk zone.	Overhead power lines are amongst the most vulnerable infrastructure to cyclone, storm surge, earthquakes and tsunami. Involves undergrounding key sections of electricity supply on Tongatapu, such as electricity supply to the hospital.	Accelerate the process of renewing and upgrading of the reticulation network and customer service connections in the greater Nuku'alofa urban region.

TELECOMMUNICATIONS SECTOR

NIIP Reference	T1	T2	T3	T4	T5
Project Name	**Upgrade Fixed line services and cabling**	**Mobile phone Next Generation Network (NGN)**	**Relocation of TCC Transmission Towers (Nuku'alofa)**	**Outreach – Expanding Services to small islands**	**Upgrading of TBC Radio Towers**
Responsible Agency	TCC	TCC	TCC	MIC	TBC
Project Cost (T$ million)	4.5	3.0	1.0	4.0	1.0
Start	Ongoing	Ongoing	2011	2009/10	2011
Finish			2011	2015	2011
Status	Underway	Underway	Operational	Underway	Operational
Funding Source	Self (TCC)	Self (TCC)	Self (TCC)	DP Grant	DP Grant
if DP, who				ITU/JICA/SPC	ICU/Korea
if DP, status				Confirmed	Confirmed
Description	Ongoing program of upgrading of landline services and cabling, including fibre-optic cabling where appropriate.	Upgrade the mobile phone network to enable mobile internet access and value-added services. Current 2.75G technology; next step to move to 3G or 4G.	Relocation of communications towers from existing location in Nuku'alofa.	Infrastructure for improved telecoms to non-commercial remote communities of Niuas and Ha'apai (GSM, FM community radio station, etc). Managed by TCC.	Replace main AM transmission tower on Tongatapu

NIIP Reference	T6	T7	T8	T9	T10
Project Name	**International Fibre-Optic Cable**	**Reticulation of High Speed Internet on Tongatapu**	**E-Government**	**Fibre-Optic Cable to Ha'apai, Vava'u etc**	**Communications for Early Warning and Disaster Recovery**
Responsible Agency	TCL	TCC/TCL	MIC	TCL	TBC
Project Cost (T$ million)	53.0	8.0	20.0	30.0	6.0
Start	2012	2011	2013	2014	2013
Finish	2013	2014	2017	2016	2014
Status	Underway	Underway	Proposed	Proposed	Proposed
Funding Source	DP Grant/Commercial Equity	Self (TCC/TCL)	DP Grant	DP Grant	Unknown
if DP, who	ADB/WB			ADB/WB	
if DP, status	Committed		Under discussion	Under Discussion	
Description	Undersea cable for high speed, high bandwidth internet and other voice and data communications. Link with global communications network.	Upgrading of TCC backbone distribution network on Tongatapu to fibre-optic. Aim for Fibre-to-Cabinet covering Tongatapu.	Enhanced information sharing, Government portal website and website presence for all agencies and Government services.	Extend the proposed international undersea fibre-optic communications cable to Ha'apai and Vava'u. Planning has commenced and initial discussions have taken place with ADB/WB. This project is linked to the proposed extension of the fibre-optic cable between Tonga and Samoa.	Install new AM radio mast on Vava'u, to (a) improve signal on the Niuas and north-facing areas of the Vava'u group; and (b) provide a backup to Tongatapu mast in case of disaster/ failure. Relocate TBC studios at Tongatapu to climate proof TBC operations. Upgrade/relocate studios at Vava'u to improve services and provide a backup in case of disaster/failure at Tongatapu.

WATER SECTOR

NIIP Reference	W1	W2	W3	W4	W5
Project Name	**Upgrade village water supplies**	**Upgrade Nuku'alofa water system (wells, storage, distribution)**	**Outer Islands water supply improvements (Vava'u, Ha'apai, 'Eua, Niuafo'ou)**	**Expand Nuku'alofa system to growth areas**	**Development of a new Tongatapu well-field**
Responsible Agency	TWB	TWB	TWB	TWB	TWB
Project Cost (T$ million)	5.0	8.0	15.0	11.4	10.0
Start	2010	2012	2014	2016	beyond 2017
Finish	2012	2015	2016	2018	
Status	Completed	Committed	Proposed	Proposed	Proposed
Funding Source	DP Grant	DP Grant	Unknown	Unknown	Unknown
if DP, who	AusAID	ADB/AusAID			
if DP, status	Confirmed	Confirmed (NUSDP)			
Description	Upgrade of 5 village water supply systems.	Program of Nuku'alofa water supply improvements to reduce losses and lower costs. Includes upgrade of well field (pipes, pumps, etc), reservoirs, access roads, etc.	Rehabilitation and expansion of outer islands water systems (wells, filtration, storage, distribution); and improved water supply for schools. Possible funding for some components under the JICA Outer Islands Water Supply Improvement Project.	Extension of piped water supply to growth areas of Nuku'alofa.	New well field to cater for projected increase in demand for water.

NIIP Reference	W6	W7
Project Name	**Water Softening for Nuku'alofa System**	**New Well Field for Neiafu, Vava'u**
Responsible Agency	TWB	TWB
Project Cost (T$ million)	8.0	12.0
Start	2013	Beyond 2017
Finish	2015	
Status	Proposed	Proposed
Funding Source	Unknown	Unknown
if DP, who		
if DP, status		
Description	Facilities to treat water to reduce the mineral content and "hardness" of the Nuku'alofa water supply.	New source of water to cater for growing demand in Neiafu.

SOLID WASTE MANAGEMENT

NIIP Reference	S1	S2	S3	S4	S5
Project Name	**Additional capacity for septage treatment**	**Waste Management Equipment Renewal Program**	**New Semi-Aerobic Landfill on Vava'u**	**Upgrade Vava'u Landfill Facility**	**Sustainable Solid Waste Services in Nuku'alofa**
Responsible Agency	WAL/Health	WAL	Environment	Environment	WAL
Project Cost (T$ million)	3.0	2.0	5.0	3.0	3.5
Start	2012	2012	2015	2011	2012
Finish	2014	2013	2016	2013	2015
Status	Proposed	Proposed	Proposed	Underway	Underway
Funding Source	Unknown	Unknown	Unknown	Part funding from DP Grant	DP Grant
if DP, who				JICA (partly)	ADB (NUDSP)
if DP, status				Committed	Confirmed
Description	Refurbish/expand existing facilities to increase capacity to treat septic tank waste (septage) at the existing Tapuhia facility	Replacement/upgrade of equipment (septage trucks x2, compactor, etc) and install a weighbridge at the Tapuhia facility	Construction of a fully engineered sanitary waste management facility at Vava'u at a new location away from the vulnerable and environmentally sensitive coastal zone.	Upgrading of the existing waste management facility at Vava'u to improve its environmental performance.	Improvements to the Tapuhia landfill facility; equipment (loader, collection trucks, etc); and upgrading of WAL financial and management systems under the NUDSP

NIIP Reference	S6
Project Name	**New Landfill or Transfer Station on Ha'apai**
Responsible Agency	Environment
Project Cost (T$ million)	4.0
Start	Urgent/ 2013
Finish	2015
Status	Proposed
Funding Source	Unknown
if DP, who	
if DP, status	
Description	Implementation of improved solid waste disposal arrangements for Ha'apai. First step is a feasibility of study of options; either landfill on Ha'apai or transfer station and disposal on Tongatapu. Then implement the preferred option.

ROADS SECTOR

NIIP Reference	R1	R2	R3	R4	R5
Project Name	**National Roads Improvement Project**	**Integrated Urban Development Sector Program (Roads)**	**Transport Sector Consolidation Project (Roads)**	**Vaipua Bridge (Vava'u)**	**Foa Causeway (Ha'apai)**
Responsible Agency	MOI	MOI	MOI	MOI	MOI
Project Cost (T$ million)	83.0	12.0	11.6	7.8	3.2
Start	2010	2011	2010	2011	2012
Finish	2012	2013	2013	2012	2013
Status	Operational	Underway	Underway	Underway	Committed
Funding Source	DP Loan	DP Loan	DP Grant	DP Grant	DP Grant
if DP, who	China	ADB	WB	China	Germany
if DP, status	Confirmed	Confirmed	Confirmed	Confirmed	Confirmed
Description	Upgrading and sealing of existing roads on Tongatapu, Vavu'a, Ha'apai, 'Eua	Upgrading of main access roads into Nuku'alofa and associated drainage.	Develop domestic private sector capacity for initial rehabilitation and thereafter routine and periodic maintenance of roads	Rehabilitation/replacement of Vaipua Bridge	Rehabilitation of causeway linking Foa island.

NIIP Reference	R6	R7	R8	R9	R10
Project Name	**Agricultural Road Program**	**Upgrading of Toula Causeway (Vava'u)**	**New Fanga'uta Lagoon road link**	**Resealing of Airport Road on Tongatapu**	**Outer Islands Roads Upgrading Program**
Responsible Agency	MAFF	MOI	MOI	MOI	MOI
Project Cost (T$ million)	-	20.0	50.0	11.6	10.0
Start	2010	beyond 2017	beyond 2017	2014	2016
Finish	2013			2015	2018
Status	Deleted	Proposed	Proposed	Proposed	Proposed
Funding Source	DP Grant	Unknown	Unknown	Unknown	Unknown
if DP, who					
if DP, status					
Description	Program of upgrade of roads serving plantations and markets. IMPLEMENTATION HAS NOT PROCEEDED.	Causeway rehabilitation. Increase bridge section to improve water flow.	New road link to southern side of Fanga'uta Lagoon. Options include a new causeway along the western edge of the lagoon, or a bridge across the Lagoon, south from Nuku'alofa	Repair and resealing of the road from Nuku'alofa to Fua'amotu Airport.	Rehabilitation and resealing of around 60km of roads on Vava'u, Ha'apai, 'Eua and Niuaofou.

ROADS SECTOR

NIIP Reference	R11
Project Name	**Tongatapu Trunk Roads Program**
Responsible Agency	MOI
Project Cost (T$ million)	16.0
Start	2014
Finish	2017
Status	Proposed
Funding Source	
if DP, who	
if DP, status	Unknown
Description	Rehabilitation of around 95kms of trunk and agricultural roads on Tongatapu

PORTS AND SHIPPING

NIIP Reference	P1	P2	P3	P4	P5
Project Name	**Replacement inter-island ferry**	**Reconfigure inter-island ports for new ferry (QSW, Vava'u, Ha'apai, Niuas)**	**Reseal Queen Salote Wharf (domestic and int.)**	**Refurbish Slipway at QSW**	**Upgrade Container Handling (Forklift) for QSW**
Responsible Agency	Transport	Transport	PAT	PAT	PAT
Project Cost (T$ million)	25.0	2.1	11.3	0.5	2.0
Start	2010	2010	2012	2011	2011
Finish	2010	2010	2015	2012	2012
Status	Operational	Operational	Underway	Underway	Operational
Funding Source	DP Grant	Government	Self (PAT)	Self (PAT)	Commercial Loan
if DP, who	JICA				
if DP, status	Confirmed				
Description	New inter-island ferry to replace the Olovaha.	Reconfigure existing wharves/channels to accommodate the new inter-island ferry. Basic works required to enable operation of the ferry.	Program of resealing the international and domestic wharves, storage areas and other cargo handling areas (5 Stage project) to improve accessibility, safety and drainage.	Refurbish the existing slipway at Queen Salote Wharf (QSW) to 300 tonne capacity.	Procure 1 new or 2 second-hand 40 tonne capacity forklifts, to improve cargo handling capability and reduce maintenance costs.

NIIP Reference	P6	P7	P8	P9	P10
Project Name	**Replace Fender at QSW International Wharf**	**Vuna Wharf Development (Stage 1 Cruise ship wharf)**	**New Pilot Boat for QSW**	**Maritime Sector Safety and Resilience**	**Vuna Wharf Development (Stage 2 Marina)**
Responsible Agency	PAT	PAT, NDC	PAT	MOI, PAT	PAT, NDC
Project Cost (T$ million)	1.0	33.0	1.5	20.0	23.4
Start	2012	2010	2012/13	2013	2014
Finish	2014	2012	2013	2016	2015
Status	Committed	Operational	Committed	Proposed	Proposed
Funding Source	Self (PAT)	DP Loan	Self (PAT)	Unknown	Unknown
if DP, who		China			
if DP, status		Confirmed			
Description	Replace fenders to improve ship safety and wharf protection, for cargo and cruise ships.	Complete the construction of a cruise ship terminal at Vuna Wharf and upgrade the access causeway with improved roads, market area, etc	New pilot boat to increase safety of ship navigation and compliance with IMO requirements.	Improve safety and resilience to climate change and disasters in the maritime sector, with a focus on outer island ports. Including navigational aids, port upgrades, dredging, etc.	Complete the yacht marina at Vuna Wharf and associated works. PAT has committed $3.4 m to the project.

PORTS AND SHIPPING

NIIP Reference	P11	P12	P13	P14	P15
Project Name	**Upgrade the Queen Salote Domestic Wharf**	**Yellow Pier Upgrade**	**Slipway at QSW**	**Barge for Deep Water Dredging**	**Upgrade of Vava'u port**
Responsible Agency	PAT	PAT	PAT	PAT	MOI
Project Cost (T$ million)	9.0	7.5	3.0	1.0	25.0
Start	2016	2016	beyond 2017	beyond 2017	beyond 2017
Finish	2018	2017			
Status	Proposed	Proposed	Proposed	Proposed	Proposed
Funding Source	Unknown	Unknown	Unknown	Unknown (Possible Self (PAT))	Unknown
if DP, who					
if DP, status					
Description	Construct a new Domestic Wharf to separate the domestic and international wharf areas and relieve congestion in the current location.	Refurbish Yellow Pier. Consider swimming zone links to Vuna Marina.	New slipway at QSW capable of handling 2,000 tonne ships, associated workshops and facilities.	Construction of a barge capable of deeper water dredging, and suitable for services and maintenance to the outer islands.	Relocation of international wharf, upgrade of domestic wharf, and improved terminal facilities at Vava'u.

NIIP Reference	P16	P17
Project Name	**Upgrade port of Nafanua ('Eua)**	**Multi-purpose Barge**
Responsible Agency	MOI	MOI
Project Cost (T$ million)	3.0	4.5
Start	2014	
Finish	2015	
Status	Proposed	Proposed
Funding Source	DP Grant	
if DP, who	JICA	
if DP, status	Under Discussion	Unknown
Description	Upgrade port infrastructure to allow operation of the new inter-island ferry to 'Eua	Multi-purpose barge for disaster recovery, installation and maintenance of navigational aids; marine oil spills; and general maintenance works.

AIRPORTS AND AVIATION

NIIP Reference	A1	A2	A3	A4	A5
Project Name	**Additional Fire Tender (Fua'amotu)**	**Upgrade Navigations Aids (Fua'amotu DVOR)**	**Upgrade 'Eua runway**	**Upgraded Departure area (Fua'amotu International)**	**New fire station at Fua'amotu airport**
Responsible Agency	TAL	TAL	TAL	TAL	TAL
Project Cost (T$ million)	1.8	2.0	4.2	1.0	1.5
Start	2010	2010	2011	2012	2012
Finish	2010	2010	2012	2013	2013
Status	Operational	Operational	Operational	Underway	Underway
Funding Source	DP Grant	Self (TAL)	DP Grant	DP Grant	DP Grant
if DP, who	World Bank/TSCP		NZAID	World Bank/TSCP	World Bank/TSCP
if DP, status	Confirmed		Confirmed	Confirmed	Confirmed
Description	Additional Fire Tender to improve safety and fire response at Fua'amotu. Provide Category 8 fire fighting capability.	New navigational aid (DVOR/DME = Doppler VHF Omnidirectional Range + Distance Measuring Equipment) to replace existing out-dated and unreliable equipment.	Resealing, widening and lengthening of 'Eua runway to improve safety and accommodate larger aircraft.	Extend the departures area of the Terminal to provide space for separate screening of transit passenger and new toilets.	Replace the existing fire station with a new and larger station with better (quicker) access to the runway.

NIIP Reference	A6	A7	A8	A9	A10
Project Name	**Upgraded Arrivals area (Fua'amotu)**	**Additional Fire Tender (Vava'u)**	**Resurfacing of Fua'amotu runway, apron, taxiway**	**Expand apron and new taxiways Fua'amotu**	**Resurfacing of Vava'u runway, apron, taxiway**
Responsible Agency	TAL	TAL	TAL	TAL	TAL
Project Cost (T$ million)	1.5	2.0	38.0	25.0	11.0
Start	2013	2014	2014	2015	2014
Finish	2013	2014	2014	2015	2014
Status	Committed	Proposed	Committed	Proposed	Committed
Funding Source	DP Grant	Unknown	DP Grant	Unknown	DP Grant
if DP, who	World Bank/PAIP		World Bank/PAIP		World Bank/PAIP
if DP, status	Confirmed		Confirmed		Confirmed
Description	Reconfigure the terminal arrivals area to provide better utilisation of available space; improved baggage collection; an area to manage health warnings (e.g. swine flu); new toilets; and an increased number of immigration processing desks.	Additional Fire Tender to improve safety and fire response at Vava'u Provide Category 5 fire fighting capability, and to provide extra capability and flexibility in TAL's overall fire fighting capability.	Resurface the runway to ensure safe ongoing operations and compliance with ICAO requirements; enable continued operation of aircraft at full loads; and enable future services by heavier aircraft.	Expand the runway apron and construct additional taxiways to cater for larger aircraft; reduce congestion; provide more flexibility in aircraft operations; and provide additional parking space for aircraft.	Resurface the runway to ensure safe ongoing operations and compliance with ICAO requirements.

AIRPORTS AND AVIATION

NIIP Reference	A11	A12	A13
Project Name	**Resurfacing Ha'apai runway, apron, taxiway**	**New Control Tower at Fua'amotu**	**New Aircraft Hanger at Fua'amotu**
Responsible Agency	TAL	TAL	TAL
Project Cost (T$ million)	9.0	7.0	2.0
Start	2014	2015	2015
Finish	2015	2016	2015
Status	Proposed	Proposed	Proposed
Funding Source	Unknown	Unknown	Unknown
if DP, who			
if DP, status			
Description	Resurface the runway to ensure safe ongoing operations for aircraft types/sizes likely to operate to Ha'apai and for compliance with ICAO requirements. If not resurfaced soon will result in operations restricted to small, light aircraft and eventually closure.	Construct new control in position central to runway and with updated technology. Existing tower is old and out-dated; and its location is not ideal and technically non-compliant with regulations.	New common user hanger for maintenance and safety checks of domestic and visiting aircraft..

MULTI-SECTOR PROJECTS

NIIP Reference	M1	M2	M3	M4
Project Name	**Nuku'alofa Development (Multi-sector)**	**Coastal Protection - Eastern Tongatapu**	**Western Tongatapu Infrastructure Resilience**	**Disaster Response & Evacuation Infrastructure**
Responsible Agency	Nuku'alofa Development Corporation	MLECCNR	MLECCNR	NEMO, MLECCNR
Project Cost (T$ million)	20.0	15.0	20.0	12.0
Start	2010	2013	2015	2014
Finish	2010	2015	2017	2016
Status	Underway	Proposed	Proposed	Proposed
Funding Source	DP Loan	Unknown	Unknown	Unknown
if DP, who	China			
if DP, status	Confirmed			
Description	Upgrade of basic infrastructure in the CBD area, including roads, underground power and additional High Voltage supply, drainage, grey water collection system, footpaths, street lighting, etc.	Engineering, design and construction of seawalls from Nukuleka to Manuka to provide protection from climate change and tsunami.	Includes engineering, design and construction of seawalls from Ha'lafu to Puke and protection of groundwater resources.	Construction of cyclone and flood proof meteorological office, central disaster response control centre, related communications links, and district level emergency response offices on Eua, Ha'apai, Vava'u, and Niuas. Upgrading of evacuation tracks (i.e. Popua access road), construction of multi-purpose shelters and signage.

NIIP Reference	M5	M6	M7
Project Name	**Ha'apai Infrastructure Resilience**	**Government Ministerial Complex**	**Pacific Games 2019**
Responsible Agency	MLECCNR, TWB	MOI	PMO, MOI
Project Cost (T$ million)	12.0	To be defined	To be defined
Start	2013	To be defined	before 2019
Finish	2015		
Status	Proposed	Proposed	Proposed
Funding Source	Unknown	Unknown	Unknown
if DP, who			
if DP, status			
Description	Includes strengthening of foreshore protection and groundwater infrastructure resilience; and relocation of key community facilities away from the most vulnerable coastal zone.	Provision of services/utilities supporting the Government Ministerial Complex project. Total project is around $30m including construction and services.	New and upgraded fixed infrastructure (roads, services, etc) to support holding the Pacific Games in Tonga in 2019. Does not include sporting venues and associated buildings.

PART 2: Project sheets for NIIP priority projects

The following project sheets provide a 1-page description of all NIIP priority projects listed in Chapter 3 of the main report. The following information is provided for each of the projects:

Project Name	A short descriptive title for the project.
Responsible Agency	The Government agency or Public Enterprise that is most responsible for delivering the project.
Project Description/Purpose	A brief description of the project background and objectives, highlighting the problem that the proposed project addresses; project components; implications for social and economic development; and climate change adaptation and disaster risk management aspects.
Project Benefits	The key benefits that the project is expected to deliver.
CCA/DRM Issues	A brief description of the Disaster Risk Management (DRM) and/or Climate Change Adaptation (CCA) function of the project (where relevant); and of the resilience of the project to climate change and natural disasters, including resilience building measures integrated in project design.
Alignment with National/Corporate Strategic Objectives	The linkage to national outcome objectives of the TSDF; corporate plans; and international standards.
Project Type	Whether the project is: ▪ new infrastructure (provides additional capacity or access to services that did not exist before); ▪ an upgrade or replacement of existing infrastructure (newer technology/design, or adds new service features); or ▪ refurbishes existing infrastructure (repair or replacement on a largely like-for-like basis).
Project Stage	Where the project is in the project development pipeline (concept stage; planning and design stage; or ready to start).
Capital Cost Estimate	Estimated cost in TOP/T$ million and USD. For most projects, this is an estimate for planning purposes and is not a firm cost based on detailed design/specification.
Estimated Annual Maintenance Cost	An estimate derived from feasibility/planning studies (where available), or based on the type of infrastructure and typical maintenance costs as discussed in Annex E.
Planned Timing of Implementation	The year that the project is planned to start and the implementation period.
Potential Source of Financing	For both the capital cost and operations and maintenance (O&M) components of life cycle costs.

E11: Solar generation (Tongatapu – additional 1-2MW)

PROJECT DESCRIPTION

Sector:	Energy
Responsible Agency:	Tonga Power
Description/Purpose:	This project involves installation of an additional 1-2 MW of on-grid solar generation capacity on Tongatapu. The feasibility and benefits of solar photovoltaic generation in Tonga have already confirmed (*Tonga Energy Road Map*) and demonstrated by the 1.3MW of solar generation facility that commenced operation on Tongatapu in 2012. As well as providing additional generating capacity from a renewable source, this project will provide technology transfer and experience with managing large scale on-grid solar generation.
Project Benefits:	The project will deliver benefits in terms of experience with additional solar generation and early displacement of diesel as an energy source, but will not be so large that it excludes the possibility of alternatives (such as wind) should these prove viable and more cost-effective. The proposed additional capacity would generate sufficient electricity to displace approximately 4-8% of projected diesel usage for electricity generation; and associated carbon emissions. In addition to the environmental benefits, this reduces reliance on imported diesel and exposure to fluctuations in energy prices.
Climate Change Adaptation/ Disaster Risk Management Issues	Resilience of the project will depend on site selection. If a new site is chosen, resilience will be maximised by locating the facility at a higher elevation, less exposed site with reduced risk from cyclones, storm surge and tsunamis; and by adopting appropriate design standards for wind loads and flooding. However if the project is located at the current solar power farm site, this may negatively effect on the cost-effectiveness of the project due to the need to establish ancillary infrastructure to protect it from storm surge, tsunami or cyclone risk.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 11: Maintaining and where possible expanding the provision of reliable and cost efficient power supplies, using traditional and renewable options, to all communities. b. Government target to supply 50% of electricity generation through renewable resources c. Component of the Implementation Plan of the *Tonga Energy Road Map 2010-2020*
Project Type:	☒ New Infrastructure ☐ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☐ Concept ☐ Planning & Design ☒ Ready to Start Next major milestone in project preparation: Finalize financing package

PROJECT FINANCING

Capital Cost Estimate:	T$24.0 million (USD13.8 million) (Source: TERM)
Est. Annual Maintenance Cost:	T$0.72 million per year
Planned Timing of Implementation:	2013 – 2015
Potential Source of Financing:	Capital: Grant from bilateral development partners O&M: Tonga Power

E16: Outer Islands on-grid renewable energy project

PROJECT DESCRIPTION

Sector:	Energy
Responsible Agency:	Tonga Power
Description/Purpose:	This project would construct around 0.75MW of grid-connected PV solar plants on outer islands ('Eua, Ha'apai, Vava'u). The Project will also will quantify the available solar resource; facilitate the integration of intermittent renewable energy with the conventional diesel grid; build the capacity of Tonga Power in the operation and maintenance of renewable technologies; and develop community awareness regarding the importance of energy conservation.
Project Benefits:	The project will deliver benefits in terms of in terms of experience with grid-connected solar generation on outer islands; early displacement of diesel as an energy source; and cost savings that may be passed on to poor households. It will also reduce carbon emissions from electricity generation with climate change mitigation benefits; and reduce reliance on imported diesel and exposure to fluctuations in energy prices.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 11: Maintaining and where possible expanding the provision of reliable and cost efficient power supplies, using traditional and renewable options, to all communities. b. Government target to supply 50% of electricity generation through renewable resources c. Component of the Implementation Plan of the *Tonga Energy Road Map 2010-2020*
Climate Change Adaptation/ Disaster Risk Management Issues	Solar panels and overhead transmission lines typically have low resilience to climate and natural disasters, particularly wind damage from storms and cyclones. These elements should be structurally reinforced to the extent possible, but a degree of residual vulnerability will remain and emphasis should be placed on operational procedures that facilitate a rapid switch to alternative sources of energy supply in the event of a natural disaster. Resilience will also be maximised by locating the project components to the extent possible on higher elevation, less exposed sites with reduced risk from cyclones, storm surge and tsunamis; and by adopting appropriate design standards for wind loads and flooding.
Project Type:	☒ New Infrastructure ☐ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☒ Concept ☐ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Finalize project design and financing package. Project preparation studies are expected to take place in 2013, with support from ADB.

PROJECT FINANCING

Capital Cost Estimate:	T$9.0 million (USD5.2 million) (Source: ADB estimate)
Est. Annual Maintenance Cost:	T$0.23 million per year
Planned Timing of Implementation:	2014 – 2016
Potential Source of Financing:	Capital: Grant from bilateral development partners O&M: Tonga Power

T9: Fibre-optic cable to Ha'apai and Vava'u

PROJECT DESCRIPTION

Sector:	Telecommunications
Responsible Agency:	Ministry of Information and Communications; Tonga Cable Ltd
Description/Purpose:	This project builds on the installation of an undersea fibre-optic cable linking Tongatapu with international communications networks, planned for 2013. The link to Tongatapu will provide high speed, high bandwidth international communications and lift the constraints resulting from current satellite-based communications. However outer islands will continue to rely on lower speed and bandwidth (mostly microwave) connections to Tongatapu, which constrains the development of new internet-based business opportunities and community applications; and also limits development of internet-based Government services. This project will provide an undersea fibre-optic connection to Ha'apai and Vava'u to link with the international cable at Tongatapu; and extend the benefits of increased speed and bandwidth to outer-islands. Based on current plans, the project would be part of a larger project that further extends the undersea cable network from Tongataupu to Samoa as part of a regional connectivity program. This would also improve the commercial viability of the project and if it does not take place additional feasibility analysis will be needed to establish the least cost technical solution for this project.
Project Benefits:	This project has potential to redefine telecommunications in the northern island groups of Tonga; offset some of their geographical disadvantage; and create new economic and social opportunities. In particular, the project will deliver increased internet speed and bandwidth, and reduced prices to residents and businesses.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 10: Improving the performance of the information and communications sector, with quality service delivery, free and fair availability of information, geographical coverage, service affordability and access to new service applications. b. TSDF Outcome Objective 2. Dynamic public and private sector partnership as the engine of growth - Strategy 5 (vii) Fostering technological development c. MDG Goal 8.F
Climate Change Adaptation/ Disaster Risk Management Issues	This project would significantly improve the resilience of communications links to the outer islands thereby increasing, amongst other things, access to information on climate and weather conditions, including extreme events. It would facilitate pre-disaster planning and alerts, and post-disaster response efforts. In terms of CCA/DRM resilience, the main issues concern the location and design of the landing station, which would require incorporation of design measures to ensure its resistance to flooding and cyclone impacts, such as measures similar to those incorporated in the Tongatapu landing station.
Project Type:	☒ New Infrastructure ☐ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☐ Concept ☒ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Finalize design and financing package. Survey of the planned route to Ha'apai and Vava'u has already been completed by TCL.

PROJECT FINANCING

Capital Cost Estimate:	T$30 million (USD17.3 million) (Source: TCL)
Est. Annual Maintenance Cost:	T$0.15 million (operations and maintenance)
Planned Timing of Implementation:	2014 – 2016
Potential Source of Financing:	Capital: Combination of grants from development partners; and local investment The investment costs may partly be covered by the proposed extension of the international fibre optic cable from Tonga to Samoa. O&M: Self-funded by Tonga Cable Ltd from commercial operation of the cable

T10: Communications for early warning and disaster recovery

PROJECT DESCRIPTION

Sector:	Telecommunications
Responsible Agency:	Tonga Broadcasting Corporation (TBC)
Description/Purpose:	Telecommunications has a vital role during natural disasters and other emergency situations. In particular, AM Radio continues to play an important role in sending messages to outer island communities, especially for poorer households on remote islands, and is a vital lifeline during times of natural disasters. The installation of a new AM transmission tower on Tongatapu has addressed some deficiencies in the AM coverage, but problems remain with reception in northern island groups and with the CCA/DRM resilience of transmission facilities. This project will (a) install a new AM radio mast on Vava'u, to improve signal on the Niuas and north-facing areas of the Vava'u group and provide a backup to the Tongatapu mast in case of disaster/ failure; (b) relocate TBC studios at Tongatapu to climate proof TBC operations; and (c) upgrade/relocate studios at Vava'u to improve services and provide a backup in case of disaster/failure at Tongatapu.
Project Benefits:	This project will enhance the capacity and resilience of radio broadcasting, especially in its role during periods of natural disasters when broadcast radio becomes the main source of information for the majority of households. In particular, it will relocate and climate proof TBC studios on Tongatapu and Vava'u; improve reception in northern islands groups; and add resilience by providing back-ups for vital transmission towers and facilities. The main beneficiaries will be poorer households in outer islands for whom radio continues to be the principal information source.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 7: Cultural awareness, environmental sustainability, disaster risk management and climate change adaptation, integrated into all planning and implementation of programmes - Strategy 23: Implementing the *JNAP-CCADRM* to reduce vulnerability & risks; and to enhance resilience to the impacts of climate change & natural hazards
Climate Change Adaptation/ Disaster Risk Management Issues	As described above, this project would enhance the resilience of radio broadcasting during periods of natural disasters, by "climate proofing" facilities and providing back-up infrastructure. In particular, the new AM radio tower on Vava'u should be constructed to withstand projected wind loads during future cyclone events.
Project Type:	☐ New Infrastructure ☒ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☒ Concept ☐ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Planning and design of project components

PROJECT FINANCING

Capital Cost Estimate:	T$6.0 million (USD3.5 million) (Source: TBC estimate)
Est. Annual Maintenance Cost:	T$0.12 million (operations and maintenance)
Planned Timing of Implementation:	2013 – 2014
Potential Source of Financing:	Capital: Grant from development partner or global/regional fund O&M: Self-funded by TBC

W3: Outer Islands water supply improvements

PROJECT DESCRIPTION

Sector:	Water
Responsible Agency:	Tonga Water Board (TWB)
Description/Purpose:	All Tongans have access to clean water but problems currently exist in the efficiency and quality of water supply. This program involves an integrated program of rehabilitation and expansion of outer islands water systems (Vava'u, Ha'apai, 'Eua, Niuafo'ou). In particular, it will accelerate programs to replace pipes to reduce losses and lower costs; upgrade water treatment and storage facilities; replace diesel with solar pumps on well fields; extend the reticulation network to additional villages; and improve water supplies for around 24 schools and colleges. Where feasible, measures will also be put in place to improve to resilience of the water supplies to climate change and natural disasters. The projects will also include training and capacity building for TWB outer island branches.
Project Benefits:	This project will provide benefits to consumers, business and schools in terms of improved water supply quality and reliability, and reduce the cost of water production. In the longer term it will reduce the pressure on existing underground resources and delay the need for additional wells and other new investment.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 13: Maintaining and expanding access to safe water and sanitation for all communities. b. MDG Goal 7.C: Sustainable access to safe drinking water and basic sanitation
Climate Change Adaptation/ Disaster Risk Management Issues	Groundwater supplies, especially on Ha'apai, are already being affected by rising sea levels and storm surge. Increased security and quality of supply will be provided for outer islands communities, through climate proofing measures that may include relocation of water storages outside storm surge and sea level rise zones, replacement of household and village concrete water tanks damaged by earthquakes with more resilient models to foster use of rainwater harvesting as a secondary water source, and relocation where possible of corroded pipes or pipes located in saline intrusion areas or replacement with suitable anti-corrosive materials. Further analysis of the future evolution of groundwater capacity and quality under different climate change scenarios would support project development.
Project Type:	☒ New Infrastructure ☒ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☐ Concept ☒ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Finalize work program and financing package

PROJECT FINANCING

Capital Cost Estimate:	T$15.0 million (USD8.7 million) (Source: TWB)
Est. Annual Maintenance Cost:	T$0.38 million per year
Planned Timing of Implementation:	2014 – 2016
Potential Source of Financing:	Capital: Combination of grant from development partners, and inputs by TWB O&M: Self-funded by TWB

W4: Expand Nuku'alofa system to growth areas

PROJECT DESCRIPTION

Sector:	Water
Responsible Agency:	Tonga Water Board (TWB)
Description/Purpose:	Nuku'alofa is growing rapidly, especially in urban fringe areas where population growth is averaging 2.5% per year. This creates a significant challenge for TWB to keep pace with demand for system coverage and water quality in the Nuku'alofa system, while at the same time monitoring and safeguarding water sources. This project involves a staged program of expanding the Nuku'alofa water supply system to peri-urban growth areas of Nuku'alofa, where reticulated water supply is currently not available. It goes hand -in-hand with the program of upgrades to the existing system (wells, storage, distribution) already underway under the Nuku'alofa Urban Development Sector Project; and with spatial planning initiatives aimed at better management of urban growth.
Project Benefits:	This project will provide benefits to households and business in terms of improved access to safe and reliable water supply. In particular, it will benefit poorer households in urban fringe areas with a more secure supply.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 13: Maintaining and expanding access to safe water and sanitation for all communities. b. MDG Goal 7.C: Sustainable access to safe drinking water and basic sanitation
Climate Change Adaptation/ Disaster Risk Management Issues	The resilience of the project to climate and natural disasters is high and does not require integration of specific resilience building measures. Most of the expansion areas are located in relatively elevated areas of Tongatapu and the undergrounded infrastructure will not be at risk of storm surge, sea level rise or cyclones.
Project Type:	☒ New Infrastructure ☐ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☐ Concept ☒ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Finalize planning, design and work program

PROJECT FINANCING

Capital Cost Estimate:	T$11.0 million (USD6.3 million) (Source: TWB and the ADB-funded *Urban Planning and Management System* project)
Est. Annual Maintenance Cost:	T$0.29 million per year
Planned Timing of Implementation:	2016 – 2018
Potential Source of Financing:	Capital: Combination of grant from development partners, and inputs by TWB O&M: Self-funded by TWB

S5: New landfill or transfer station on Ha'apai

PROJECT DESCRIPTION

Sector:	Solid Waste
Responsible Agency:	Waste Authority Ltd
Description/Purpose:	There is currently no managed facility on the Ha'apai group for disposal of solid waste (including sludge from septic tanks), or regular waste collection service for households. This project involves developing a solid waste management strategy for Ha'apai and then implementing the recommended improved disposal arrangements. The first step is a feasibility of study of options, which may include development of a sanitary landfill on Ha'apai; or development of a transfer station on Ha'apai, with waste transported to Tongatapu for disposal at the existing Tapuhia landfill; or other arrangements.
Project Benefits:	This project will deliver benefits in terms of improved solid waste management, with flow-on environmental and health-related benefits. As well as improving the image of Ha'apai and its attractiveness as a tourist destination, improved waste management would reduce pollution of ground water, waterways and the coastal marine environment. The development of a landfill or transfer facility will also support the possible establishment of waste collection services on Ha'apai.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 12: Improving and where possible expanding the safe collection, disposal and recycling of solid and liquid waste to protect people's health and the environment.
Climate Change Adaptation/ Disaster Risk Management Issues	The project would reduce additional stresses on climate-affected groundwater supplies and coastal ecosystems by improving environmental management of solid waste. If the option for a new landfill on Ha'apai is selected, then careful attention will need to be given to site selection, and the ability to develop the project outside of tsunami, storm surge, or sea level rise risk zones. Climate risk mapping that is proposed to be carried out for Lifuka will be an invaluable tool in this regard. The landfill drainage and runoff systems will need to be designed to cater for future projected rainfall intensity.
Project Type:	☒ New Infrastructure ☐ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☒ Concept ☐ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Feasibility study that identifies the best approach to introducing improved solid waste management on Ha'apai.

PROJECT FINANCING

Capital Cost Estimate:	T$4.0 million (USD2.3 million) (Source: MLECCNR estimate)
Est. Annual Maintenance Cost:	T$0.12 million per year
Planned Timing of Implementation:	As soon as possible
Potential Source of Financing:	Capital: Grant from development partners O&M: Budget allocation

R10: Outer Islands roads upgrading program

PROJECT DESCRIPTION

Sector:	Roads
Responsible Agency:	Ministry of Infrastructure
Description/Purpose:	The outer islands road network is generally in poor condition. Maintenance has generally not kept pace with deterioration and apart from isolated section of rehabilitation and upgrading, the last major road program in the outer-island roads was completed more than 10 years ago. This is constraining access to markets and tourism facilities and impacting negatively on potential economic development of the outer islands, and the day-to-day quality of life of residents. A Road Fund is being introduced by the Tonga Government as a mechanisms for funding log-term sustainable maintenance of the road network, but in the short-medium term, there are sections of the outer islands road network that need urgent attention. This project involves rehabilitation, resealing and (where feasible) "climate proofing" of around 60km of roads on Vava'u, Ha'apai, 'Eua and Niuaofou. Priority will be given to roads based on their function in supporting social and economic development (especially agriculture, fisheries and tourism) and linking to transport facilities (ports, airports); and to roads that could act as evacuation routes in times of natural disaster, or be developed to incorporate a coastal protection function.
Project Benefits:	This project will provide substantial benefits to outer-islands in terms of better, safer and more reliable access to markets and social, education, health activities; and could be a catalyst for economic development in areas such as tourism, agriculture and fisheries. Under the TSDF and other Government strategies, revitalisation of agriculture and fisheries exports and further development of tourism are high priorities.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 7: Ensuring safe and reliable transport infrastructure (roads, ports, airports), with the necessary institutional arrangements in place to manage and fund effective development and maintenance of these facilities throughout the Kingdom.
Climate Change Adaptation/ Disaster Risk Management Issues	As well as providing improved accessibility for vulnerable outer island communities, this project potentially has a high to very high CCA/DRM function since some roads could act as evacuation routes in times of natural disaster, or could be developed to incorporate a coastal protection function. Priority could be given to upgrading of links of the road network that could fulfil these functions. A high degree of resilience could be integrated into the project through the adoption of climate-proofing measures at the design, construction and operation stages of the infrastructure. Design of road cross-sections and drainage structures should cater for projected future rainfall, projected sea levels and coastal erosion rates, flood and storm surge, and to allow egress of floodwaters thus avoiding ponding of water. The choice of pavement materials should be suitable for expected maximum air temperatures. Maintenance regimes should be adapted as necessary to include pre-wet season clearing and rehabilitation of drains, regular post-cyclone or storm monitoring, and procedures for rapid post-cyclone or storm emergency rehabilitation works.
Project Type:	☐ New Infrastructure ☒ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☒ Concept ☐ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Feasibility study that identifies/designs the program of road upgrades.

PROJECT FINANCING

Capital Cost Estimate:	T$10 million (USD5.8 million) (Source: MOI estimate)
Est. Annual Maintenance Cost:	T$0.20 per year
Planned Timing of Implementation:	2016 – 2018
Potential Source of Financing:	Capital: Grant from development partners O&M: Government of Tonga, via the Road Fund.

P9: Maritime sector safety and resilience

PROJECT DESCRIPTION

Sector:	Maritime
Responsible Agency:	Ministry of Infrastructure
Description/Purpose:	The last major upgrading of outer-island ports was completed in 2000 and there has been limited further investment. Small scale works and improvements works have been undertaken with Government funding to reconfigure the ports for operation of the new inter-island ferry; and to replace some navigational aids and provide other equipment under the TSCP program. However many safety and operational deficiencies remain to be address. This project is part of a broader Government priority to revitalise inter-island shipping and address urgent safety concerns, operational problems, and vulnerabilities to climate change and natural disasters. More work needs to be done to fully define the components of this program, but investment will be required in the following areas: upgrading berths and related shore facilities to be more resilient to climate change and natural disasters, as well as improving safety and facilities for passengers and cargo; upgrading navigational aids and channel/mooring markers, and updating hydrographical charts; improving channels and berths to increase safety in all weathers; building local capacity and systems for enhanced maritime safety oversight; and revitalising local training programs for seafarers and the associated facilities.
Project Benefits:	This project will provide substantial benefits to outer-islands in terms of better, safer and more reliable access by sea to markets and social, education, health activities; and could be a catalyst for economic development in areas such as tourism, agriculture and fisheries. Under the TSDF and other Government strategies, revitalisation of agriculture and fisheries exports and further development of tourism are high priorities. The project will also increase the resilience of outer islands ports to the effects of climate change and natural disasters.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 7: Ensuring safe and reliable transport infrastructure (roads, ports, airports) - Strategy 9: Strengthening regulatory compliance and safety oversight of transport sector to ensure compliance with international safety standards. b. TSDF Outcome Objective 7: Cultural awareness, environmental sustainability, disaster risk management and climate change adaptation, integrated into all planning and implementation of programmes - Strategy 23: Implementing the JNAP-CCADRM to reduce vulnerability & risks; and to enhance resilience to the impacts of climate change & natural hazards
Climate Change Adaptation/ Disaster Risk Management Issues	As noted this project this project has a high DRM and climate change adaptation function as it would increase the climate resilience of important transport infrastructure, and allow transport of goods and persons in the aftermath of an extreme event. Resilience building measures incorporated in the project could include elevation of wharves, strengthening and reinforcement of structures, investigation of the need to reconfigure structures to prevent or reduce downstream coastal erosion and encourage sand replenishment, and treatment of underwater structures to minimise physical and chemical corrosion.
Project Type:	☐ New Infrastructure ☒ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☒ Concept ☐ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Feasibility study that identifies/designs the program of port/safety upgrades.

PROJECT FINANCING

Capital Cost Estimate:	T$20 million (USD11.5 million) (Source: MOI preliminary estimate)
Est. Annual Maintenance Cost:	T$0.40 per year
Planned Timing of Implementation:	2013 – 2016
Potential Source of Financing:	Capital: Grant from development partners O&M: Government of Tonga

A11: Resurfacing of Ha'apai Airport runway, taxiway, and apron

PROJECT DESCRIPTION

Sector:	Airports
Responsible Agency:	Tonga Airports Ltd (TAL)
Description/Purpose:	Along with airports on Tongatapu and Vava'u, Salote Pilolevu Airport on Ha'apai is a vital part of the domestic aviation network serving outer islands. The condition of the runway was inspected by Beca Infrastructure consultants in July 2009 and it was found that the runway will require resurfacing within the next five years to ensure safe and unrestricted operation. If resurfacing works are not undertaken in the near future then there is a risk that limits will be placed on airport operations which will constrain air access to Ha'apai with negative flow-on effects to economic development and the community. This project involves resurfacing the runway and associated taxiways and apron, to rehabilitate runway condition and provide around another 15 years of operations before the next resurfacing is required.
Project Benefits:	The project will deliver improved safety and reliability of airline services to the Ha'apai group; and compliance with ICAO requirements. It will ensure continued access to air transport linkages to other island groups for business, social, educational and health-related activities; and connections to international services for tourism and export opportunities (agriculture, fisheries) via Tongatapu. The airport also has an important role for urgent freight and passenger movements for example, in the event of a natural disaster, or access during times when ocean movements are not possible. Direct beneficiaries will be domestic air travellers and air freight movements, but the flow-on effects will benefit all aspects of social interaction, tourism and business in Ha'apai.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 7: Ensuring safe and reliable transport infrastructure (roads, ports, airports), with the necessary institutional arrangements in place to manage and fund effective development and maintenance of these facilities throughout the Kingdom. - Strategy 9: Strengthening regulatory compliance and safety oversight of transport sector to ensure compliance with international safety standards. b. Requirement to maintain compliance with ICAO standards
Climate Change Adaptation/ Disaster Risk Management Issues	Salote Pilolevu Airport is located at 9m AMSL and more than 100m from the shoreline. The main CCA/DRM risk to the project would arise from a relatively low likelihood, but high consequence tsunami or earthquake event. Resilience building measures can be built into this project through the choice of suitable pavement materials to cater to prevailing temperatures, and adequately sized drainage to cater to projected future rainfall intensity.
Project Type:	☐ New Infrastructure ☐ Upgrade/Replace Existing ☒ Refurbish Existing
Project Stage:	☐ Concept ☐ Planning & Design ☒ Ready to Start Next major milestone in project preparation: Development of a financing package.

PROJECT FINANCING

Capital Cost Estimate:	T$9 million (USD5.2 million) (Source: TAL)
Est. Annual Maintenance Cost:	T$0.09 million per year (covering all routine maintenance of runway)
Planned Timing of Implementation:	As soon as possible
Potential Source of Financing:	Capital: Combination of grants from development partners, and inputs by TAL O&M: Self-funded by TAL

A12: New Control Tower at Fua'amotu International Airport

PROJECT DESCRIPTION

Sector:	Airports
Responsible Agency:	Tonga Airports Ltd (TAL)
Description/Purpose:	The existing control tower at Fua'amotu International Airport is old and in poor condition; the technology is out-dated and unreliable; and its location is not ideal and technically non-compliant with regulations. The current structure is also potentially at risk from cyclone wind damage, which would lead to closure or reduced operation of the airport. This project will construct a new control in a position central to the runway and with updated technology that fully meets current requirements and is compatible with emerging technologies and international regulations. At the same time, climate resilience will be built into the control tower design and construction through the adoption of suitable wind design loads.
Project Benefits:	The project will deliver improved safety and reliability of international and domestic airline services to Fua'amotu International Airport; and compliance with ICAO requirements. It will ensure continued access to air transport linkages to Tonga for business, social, educational and health-related activities; and connections to international services for tourism and export opportunities (agriculture, fisheries). Direct beneficiaries will be air travellers, but the flow-on effects will benefit all aspects of social interaction, tourism and business.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 3: Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business - Strategy 7: Ensuring safe and reliable transport infrastructure (roads, ports, airports) - Strategy 9: Strengthening regulatory compliance and safety oversight of transport sector to ensure compliance with international safety standards. b. Requirement to maintain compliance with ICAO standards
Climate Change Adaptation/ Disaster Risk Management Issues	The CCA/DRM function of this project is medium and is related to the incremental improvement in aircraft safety and capacity that would occur during a disaster relief operation. The airport is located on relatively elevated ground in the southeast of Tongatapu and is not within a tsunami risk zone. Cyclone wind damage poses the most substantial potential risk to this project and resilience will be built into this project through the adoption of suitable wind design loads.
Project Type:	☐ New Infrastructure ☒ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☒ Concept ☐ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Detailed planning and design of the control tower.

PROJECT FINANCING

Capital Cost Estimate:	T$7 million (USD4.1 million) (Source: TAL)
Est. Annual Maintenance Cost:	T$0.18 million per year
Planned Timing of Implementation:	2015 – 2016
Potential Source of Financing:	Capital: Combination of grants from development partners, and inputs by TAL O&M: Self-funded by TAL

M2: Coastal protection – Eastern Tongatapu

PROJECT DESCRIPTION

Sector:	Multi-Sector
Responsible Agency:	MLECCNR
Description/Purpose:	This project involves the rehabilitation and construction of foreshore protection structures along an approximately 8km section of the north-eastern coast of Tongatapu between Nukuleka and Manuka. This area is highly exposed to wave action, storm surge and tsunami. It contains six coastal villages with housing and road infrastructure located in very close proximity to the shoreline. Extensive coastal erosion from rising sea level and storm surge is occurring along the entire coastline and is threatening to undermine houses and road infrastructure. In some sections seawalls had previously been constructed, but lack of maintenance or poor design and construction have resulted in their deterioration after storm events and due to ongoing sea level encroachment. This is a location where the effect of climatic factors is already evident and urgent attention is required to provide resilience to further erosion and limit damage to infrastructure, houses and property; and fishing and small-scale aquaculture activities.
Project Benefits:	The project will protect the coastline from further erosion and inundation, and improve resilience to climate change and natural disasters. As described above, the affected villages will directly benefit from reduced damage to infrastructure, houses and property; and improved access during and after extreme weather events and natural disasters. There will also be broader economic benefits from enhanced opportunities to maintain and develop tourism, fishing and small-scale aquaculture activities along the coastline.
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 7: Cultural awareness, environmental sustainability, disaster risk management and climate change adaptation, integrated into all planning and implementation of programmes - Strategy 23: Implementing the *JNAP-CCADRM* to reduce vulnerability & risks; and to enhance resilience to the impacts of climate change & natural hazards
Climate Change Adaptation/ Disaster Risk Management Issues	As described above, the CCA/DRM function of this project is very high. Resilience of the project, and thus optimisation of its DRM and adaptation functions, will be achieved through the use of appropriate foreshore design that is based on hydrological analyses. It will be necessary to ensure that adverse effects on coastline adjacent to foreshore protection (i.e. through a displacement of wave energy from seawalls to unprotected sections of coastline) are avoided.
Project Type:	☒ New Infrastructure ☒ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☐ Concept ☒ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Development of a financing package, followed by detailed planning and scheduling of works.

PROJECT FINANCING

Capital Cost Estimate:	T$15 million (USD 8.7 million) (Source: JNAP Secretariat)
Est. Annual Maintenance Cost:	T$0.30 million per year (covering routine maintenance of seawalls)
Planned Timing of Implementation:	2013 – 2015
Potential Source of Financing:	Capital: Grant from development partners and global/regional funds O&M: Government of Tonga

M4: Disaster response and evacuation infrastructure

PROJECT DESCRIPTION

Sector:	Multi-Sector
Responsible Agency:	NEMO, MLECCNR
Description/Purpose:	This project involves a range of infrastructure to support disaster response coordination and capacity and to support community evacuation prior to natural disaster events. It would provide better and more resilient facilities for the National Emergency Management Office (NEMO) and Tonga Meteorological Office; construction of a joint, climate and flood proof disaster command centre in Nuku'alofa; improved communications through connection of this facility to the underground fibre optic cable that is currently being developed throughout Nuku'alofa; and district level emergency response offices on Eua, Ha'api, Vava'u, and Niuas. The project would also provide infrastructure required to support implementation of the Tongatapu Tsunami Evacuation Plan that is currently in preparation. This may include road upgrading to allow rapid egress from high-risk zones, especially in the Popua area; installation of signage and sirens; and construction of evacuation shelters. In addition, project would examine the feasibility of longer term options for Nuku'alofa evacuation routes (such as the construction of a crossing of the Funga'uta Lagoon).
Project Benefits:	The project will deliver enhance resilience of disaster response infrastructure
Alignment with National/Corporate Strategic Objectives:	a. TSDF Outcome Objective 7: Cultural awareness, environmental sustainability, disaster risk management and climate change adaptation, integrated into all planning and implementation of programmes - Strategy 23: Implementing the *JNAP-CCADRM* to reduce vulnerability & risks; and to enhance resilience to the impacts of climate change & natural hazards
Climate Change Adaptation/ Disaster Risk Management Issues	This project will address a range of DRM vulnerabilities and issues that have been identified through recent risk modelling and mapping, and reviews of DRM capability. In particular, the NEMO disaster response command centre and disaster response equipment storage is currently located within an identified tsunami risk zone. Also the Tonga Meteorological Services offices are of poor quality and communication between these agencies is via mobile telephone and HF radio; both of which are subject to disruption during major natural disasters. As described above, this project will address these issues through construction of a joint, climate-proof disaster command centre, and improved communications. It will also support implementation of the Tongatapu Tsunami Evacuation Plan that is currently in preparation based on latest risk mapping.
Project Type:	☒ New Infrastructure ☒ Upgrade/Replace Existing ☐ Refurbish Existing
Project Stage:	☐ Concept ☒ Planning & Design ☐ Ready to Start Next major milestone in project preparation: Development of a financing package, followed by detailed planning and scheduling of works.

PROJECT FINANCING

Capital Cost Estimate:	T$12 million (USD6.9 million) (Source: from MOI, JNAP Secretariat estimates)
Est. Annual Maintenance Cost:	T$0.24 million per year (covering routine maintenance)
Planned Timing of Implementation:	2014 – 2016
Potential Source of Financing:	Capital: Grant from development partners and global/regional funds O&M: Government of Tonga

Annex B: Infrastructure sector status and plans

This Annex provides background information to help understand the current status of the economic infrastructure sector, and the development and framing of the NIIP. In particular, it provides a snapshot of the infrastructure sector in Tonga as at late 2012, including:

- a brief profile of Tonga in terms of key demographic and economic indicators;
- an overview of the economic infrastructure sector (dimensions and key parameters, institutional structure, etc) and factors affecting demand for infrastructure in each sub-sector;
- the role of the NIIP in the context of the overall infrastructure planning process; and
- a summary of recent developments and current investment plans for each sub-sector.

B1: Tonga key indicators

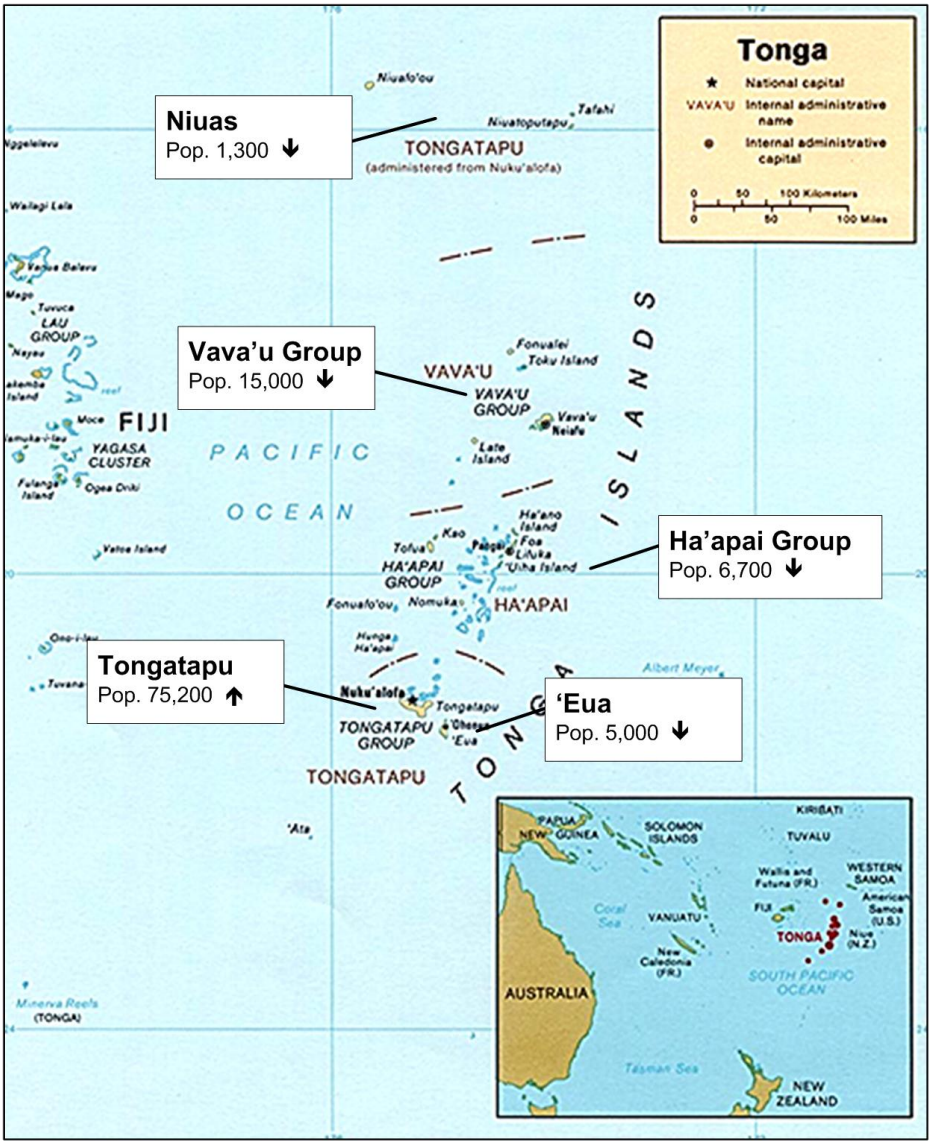
As background to the following discussion of the economic infrastructure sector, Table B.1 provides a snapshot of key demographic, economic, and sector indicators; Figure B.1 contains a map of Tonga showing the island groups, and population distribution and trends.

Table B.1: Tonga at a glance

Indicator		
Demographic		
Population (2011)	103,040 persons	
Average growth rate (5 years to 2011)	0.2%	
Distribution of population	See Figure B.1	
No. of Households (2011)	18,160	
Average Household Size	5.7 persons	
Economic		
GDP (2010-11)	T$ 782 million (USD 453 million)	
GDP per capita (2010-11)	T$ 7,600 (USD 4,400)	
Growth in GDP (real terms)	0.8% (2011/12r); 2.9% (10/11r); 3.3% (09/10); 3.2% (08/09)	
Government Budget Surplus/Deficit (%GDP)	0.1% (2012/13e); -3.0% (11/12e); -7.3% (10/11p); -5.3% (09/10)	
Growth in Consumer Prices	6.1% (2010/11); 1.7% (2009/10); 5.5% (2008/09)	
Exchange Rate:	0.545 (USD/T$: 2010/11 average)	
Sector Contributions		
Key Components of GDP 2010-11	Agriculture, forests and fisheries -	17%
	Commerce, restaurants and hotels -	13%
	Government Services -	12%
	Construction -	11%
Key Components of Exports 2010-11	Live Animals, Animal Products -	50%
	Vegetable Products -	41%

Sources: Tonga Census 2011; Tonga National Accounts Statistics (Tonga Statistics Department, June 2012 and February 2013); Government of Tonga Budget Statement for year ending 30th June 2013

Figure B.1: Map of Tonga, population distribution, and trends



B.2: Overview of the infrastructure sector

The NIIP focuses on the basic infrastructure facilities and systems that support everyday life and business activity. In particular, it covers energy, telecommunications, water, solid waste management, and transportation.

The current state of economic infrastructure

Tonga is generally well-placed regarding access to basic infrastructure and associated services, and the coverage and capacity of those services. A snapshot of the current state of the sector is shown in Table B.2.

The overall picture is that basic services and service coverage are good, with full national coverage of basic telecommunications and improving; a high level of access to reticulated power and water, and off-grid arrangements in place elsewhere; one of the highest levels of road density in the region; and a strategically located network of ports and airports throughout the country. This provides a good platform on which to continue to sustain and improve economic infrastructure and delivery of services.

Table B.2: Overview of the economic infrastructure sector

Sector	Notes
Energy	15.5 MW total installed capacity (Tongatapu, Vava'u, Ha'apai, 'Eua) 1,300 km of distribution network (total of overhead, underground, submarine and low voltage cables) 16,500 domestic, 4,000 commercial customers 60% capacity factor (ratio of average power demand to installed capacity) 85% of population on-grid 14% line losses
Telecommunications	Telephone access available throughout the country (fixed line or mobile) 15,000 landline subscribers (estimated 70% of households) 53,000 mobile customers (TCC, Digicel) 3,000 internet connections (1,200 TCC & 1597 TCC GSM Mobile Internet)
Water and sanitation	100% of population have access to safe drinking water (reticulated supply, rainwater tanks, wells, etc) 85% of households have piped water 4 x reticulated water supply schemes (Nuku'alofa, Nieafu, Pangai-Hihifo, 'Eua) 15-39% Total losses (Nuku'alofa 39%) No central sewage collection and treatment system (septic tanks)
Solid Waste	1 x sanitary landfill (Tapuhia, Tongatapu) Household collection of solid waste on Tongatapu only No regular system for collection of recyclables
Transport	
Airports	1 x International/Domestic airport (Fua'amotu 2,671m asphalt runway) 2 x Domestic airport – bitumen runway (Ha'apai, Vava'u) 1 x Domestic airport – chip seal runway ('Eua) 2 x Domestic airport – grass runway (Niuafo'ou, Niuatoputapu) 80,000 international and 50,000 domestic departures per year 14 international flights per week (4 international destinations)
Roads	880 km (including community roads) 40% sealed 15,500 vehicles
Sea Ports	2 x International/Domestic ports (Nuku'alofa – 3 international, 2 inter-island berths; Vava'u – 1 international, 1 inter-island berth) 5 x domestic ports ('Eua, Ha'afeva, Pangai, Niuafo'ou, Niuatoputapu) 8,500 international container movements per year (full TEU) (90% imports) 149 international ship calls at Nuku'alofa (General Cargo, Cruise, Tanker, Other)

Sources: Infrastructure managers (TPB, TWB, TCC, PAT, TAL, Ministries); Tonga Census; various feasibility and benchmarking studies; Pacific Power Association; Pacific Water and Waste Association

Institutional structure of the sector

As well as the key parameters of the sector, it is important to understand its institutional structure since it impacts on all aspects of infrastructure development. The overall structure is shown in Table B.3. For each sector or sub-sector, Table B.3 lists the agencies responsible for infrastructure/service delivery; regulating/monitoring the performance of the sector; and developing policy for the sector. Since NIIP2010 agencies and Ministerial responsibilities have been restructured, but the Table continues to highlight several features of the sector structure, in particular, the large number of entities involved in the sector, the lack of clarity in the institutional structure of the sector, and the overlaps and gaps:

- Responsibility for infrastructure/service delivery is split between Government Ministries, Public Enterprises, and the private sector (telecommunications only); and in some sectors, Ministries and Public Enterprises are both involved. Note that the Table shows primary responsibility only and not outsourcing and sub-contracting to the private sector, which occurs in some sectors.

- In some sectors, there are different agencies responsible for infrastructure/service delivery at different geographic/administrative levels, so that for example, responsibility for delivery of water, power, and ports varies depending on whether it is an urban, regional, or remote location.

- There are gaps in infrastructure/service delivery. It is unclear which agency and whether there is an agency responsible for infrastructure/services in the liquid waste/sanitation sector and for drainage. There are

several agencies responsible for monitoring and standards (Environment & Climate Change; Health; Works), but liquid waste and run-off appear to be gaps in terms of responsibility for infrastructure.

- There are multiple agencies regulating different aspects of some sectors, for instance in the water sector, the MLECCNR has a role in protecting water supply catchments and groundwater; the Ministry of Health in testing water quality/contamination; and the MAFF in some areas of resource management. This situation is not unusual, but does create potential for inefficient overlaps and delays.

- In the ports sector, responsibility for infrastructure/service delivery is split between a Ministry and Public Enterprise. In addition, the MOI is both operator and regulator which is contrary to general principles of good governance.

This lack of institutional clarity in the sector and the associated overlaps and gaps can lead to ineffective coordination of planning and management, inefficient delivery of infrastructure and services, and wasteful duplication; especially where projects intersect or overlap, and for linked investments. There is a potential for wasted investment when related projects are planned and delivered in isolation from each other.

Table B.3: Institutional structure of the economic infrastructure sector

Sector	Scope of Services	Infrastructure/ Service Delivery	Regulation/ Monitoring	Planning/ Policy
Power	National	Tonga Power Ltd	Electricity Commission	TERM MLECCNR
	Off-grid Outer Islands	MLECCNR/ Community		
Telecoms	National	TCC/ Digicel	PMO/MIC	PMO/MIC
Water	National		MLECCNR MOH MAFF	MLECCNR MOH
	Urban Areas	Tonga Water Board (TWB)	TWB MPE	TWB MPE
	Villages / Outer Islands	Village Committees Tonga Water	MOH MLECCNR	MOH MLECCNR
Sanitation	National	Private Sector/ Community	MLECCNR MOH	MOH
	Urban Areas			
	Villages			
Solid Waste	National		MLECCNR MOH	MLECCNR MOH
	Nuku'alofa	Waste Authority Ltd/ Private sector		
	Rural Tongatapu	Waste Authority Ltd		
	Other Islands	Community	MLECCNR	MLECCNR
Drainage	National	MOI	MOI	MOI
Roads	National	MOI	MOI	MOI
Ports	Nuku'alofa	Ports Authority Tonga	MOI	MOI
	Outer Islands	MOI	MOI	MOI
Airports	National	Tonga Airports Ltd	MOI	MOI

Legend: MLECCNR (Ministry of Lands, Environment, Climate Change and Natural Resources); MOH (Ministry of Health); MOI (Ministry of Infrastructure); MOI (Ministry of Infrastructure); TCC (Tonga Communications Corporation); MIC (Ministry of Information & Communication); MPE (Ministry of Public Enterprises); WAL (Waste Authority Ltd)

Factors affecting demand for infrastructure in each sub-sector

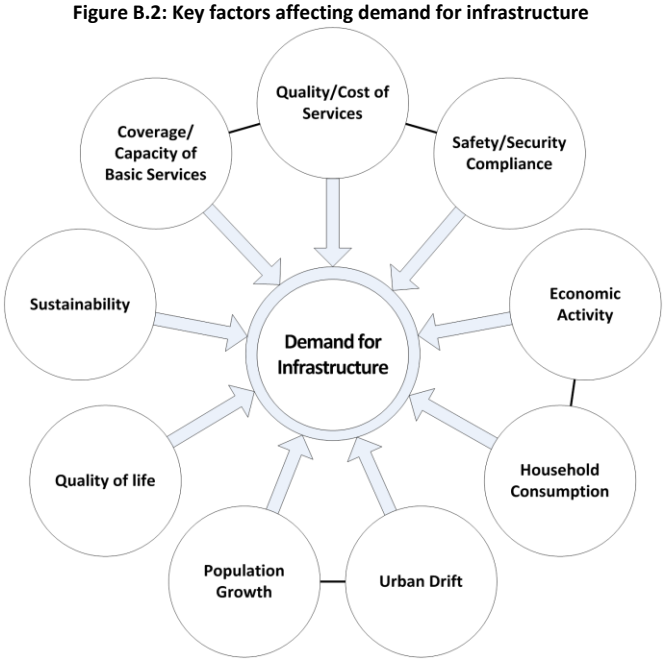
Although Tonga is generally well-placed regarding access to basic infrastructure and associated services (Table B.1), there is ongoing pressure to improve the management of existing infrastructure and to invest wisely in infrastructure improvements. In particular, there is pressure to:

- keep pace with growth in demand for infrastructure services;
- address a range of specific issues and deficiencies with existing infrastructure so that the infrastructure system functions more effectively; and

- improve the coverage, quality, safety, reliability, and resilience of economic infrastructure. As well as ensuring access to basic services, there are growing community expectations regarding the quality of the services provided.

In this respect, Tonga has essentially the same drivers for infrastructure development as all other countries, but there are some differences that need to be taken into account. The following diagram (Figure B.2) identifies the key drivers for demand for infrastructure investment. It shows that in addition to economic growth and national goals, the factors that are expected to strongly influence infrastructure demand in Tonga include quality and cost of services; access to new technologies; safety and security compliance; urban drift as more people move to urban areas, especially Nuku'alofa; quality of life; and sustainability.

Figure B.2: Key factors affecting demand for infrastructure



All of these factors will apply pressure for infrastructure development, but they are not equally strong. Table B.4 provides an overview of indicators of the strength of key demand drivers. The Table shows that:

- Over the last 10 years, average rates of population and economic growth have been low with an average population growth of only 0.2-0.4 per cent, and mixed annual growth in real GDP, ranging from -4.1 per cent in 2006/07 to a preliminary figure of 4.7 per cent in 2010/11. The combined effect[1] is that overall growth in underlying demand for infrastructure over the last decade has averaged less than two per cent per year and is expected to drop to below one per cent over the next three years on the basis of Budget forecasts of GDP growth.
- Urban drift is a much stronger factor, with population growth in some fringe areas of Nuku'alofa averaging 2.5 per cent growth per year over the last five years.
- Access to basic services is generally not a strong driver for infrastructure investment because of high existing levels of access (Table B.2).
- Social and business connectivity through transport and telecommunications is increasingly important to economic development and quality of life.
- Compliance with relevant international and national standards (health and environmental, safety and security) can be a critical factor driving investment in infrastructure, especially for the international aviation and maritime sub-sectors where lack of compliance with relevant international standards can threaten connectivity between Tonga and international markets.
- Climate change and disaster risk management are powerful long-term factors for infrastructure investment to mitigate risks and improve resilience.

[1] Assuming an elasticity of demand for infrastructure with respect to real GDP of 1-1.2.

The situation is further complicated by differences in the characteristics of infrastructure sub-sectors and the relative strength of the demand drivers. Table B.5 provides an indication of the relative strength of the key demand drivers for each sub-sector. For instance, it shows that:

- access to basic services is not a key factor, except in the solid waste sector where infrastructure and services are limited outside Tongatapu;
- urban drift is a strong factor driving the need for investment in water, solid waste, and roads sectors;
- safety and maintaining compliance with international regulations is extremely important for the aviation and maritime sectors;
- reducing the cost and improving the quality of services is a strong driving force in the energy and telecommunications sectors; and
- enhancing resilience in terms of CCA/DRM is important for all sectors, especially in terms of protecting water supplies, ensuring resilience of ports and shipping services, and generally protecting community infrastructure.

Table B.4: Drivers of demand for infrastructure and key indicators

Driver	Indicators
National Goals for Infrastructure (TSDF)	"Improve the everyday lives of people" "reduce the cost of doing business" Renewable energy target of 50%
Population Growth	National: 0.2% average annual growth
Urban Drift	Tongatapu : 0.8% average annual growth Nuku'alofa urban fringe: up to 2.5% average annual growth Other islands: negative growth
Economic activity	Real GDP: Around 1-3% average annual growth over the last 5-6 years Forecast average growth of around 0.5% to 2014 (MFNP)
Household expenditure	Average household income per capita: No real growth since 2001 (TSDF) Remittances: downward trend since 2005
Access to Basic Services	High to very high level of access to basic services across all modes, see Annex B.
Cost of Services	Varies by sector from low to high.
Quality of Services	Varies by sector from medium to high.
Compliance with relevant standards (Health and Environmental; Safety and Security)	Compliance with international regulations: Aviation (ICAO), Maritime (IMO) Compliance with national legislative standards
Social/Business Connectivity	More than 60% of Tonga population receive at least one mobile phone call on any day. More than 53,000 mobile customers Internet: Around 1 in 10 homes have an internet connection, but expected to rise to more than 1 in 4 after completion of the undersea fibre-optic cable link High level of reliance on international/domestic aviation and maritime links
Climate Change	Latest forecasts indicate: - increase in average air temperature and sea surface temperature of 0.3-1.1°C by 2030 - increase in the number of extreme hot days and warm nights and a decline in cooler weather. - decrease in dry season rainfall and an increase in wet season rainfall - extreme rainfall days are likely to occur more often - increase in cyclone intensity - sea level of 3-17 cm by 2030
Disaster Risk	Tonga averages T$30m per year in losses from cyclones and earthquakes (PCRAFI) Tonga has a 50% chance of experiencing a loss exceeding T$300m in the next 50 years

Sources: TSDF, Tonga Census, Tonga Budget, Tonga 2nd MDG Report, Infrastructure managers (TPB, TWB, TCC, PAT, TAL).

Table B.5: Current significance of demand drivers in Tonga by sector

Driver	Energy	Telecoms	Water	Solid Waste	Roads	Maritime	Aviation	Multi
National Goals for Infrastructure	4	4	4	4	4	4	4	4
Population Growth	1	1	1	1	1	1	1	0
Urban Drift	0	0	4	4	4	0	0	0
Economic activity	2	2	2	2	2	1	2	1
Household expenditure	1	4	2	4	1	1	1	0
Access to Basic Services	1	1	1	4	1	1	1	1
Cost of Services to consumers	4	4	2	2	2	0	0	0
Quality of Services	2	4	4	4	2	2	2	0
Compliance with relevant standards	1	1	2	2	2	4	4	1
Social/Business Connectivity	0	4	0	0	4	4	4	1
Climate Change	4	2	4	1	2	4	2	4
Disaster Risk	2	2	4	0	2	4	2	4

B.3: NIIP and the planning process

Responding to these factors driving pressure for investment in infrastructure is the role of the planning process. The NIIP has an important part in this process, but it sits within a broader national and corporate planning framework in Tonga. Therefore, it is important to understand where the NIIP fits within the context of the broader planning process.

Overview of the planning process

Within Government and Public Enterprises, the planning process for the development and funding of infrastructure takes many forms, but the basic elements are shown in Figure B.3 and in more detail in Figure B.4. These diagrams also demonstrate how the NIIP fits into this process now, and in the future, as the Medium-Term Budget Framework (MTBF) is implemented. In particular, it shows the relationship between the *Tonga Strategic Development Framework 2011-2014* (TSDF), NIIP, MTBF, and annual Budget.

Figure B.3: High level structure of the planning process

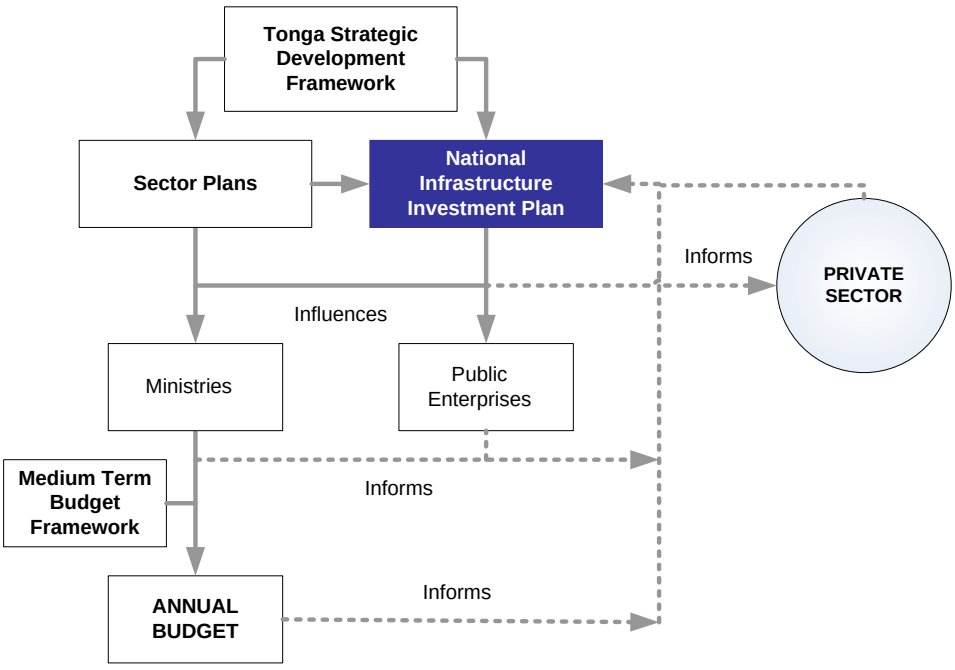
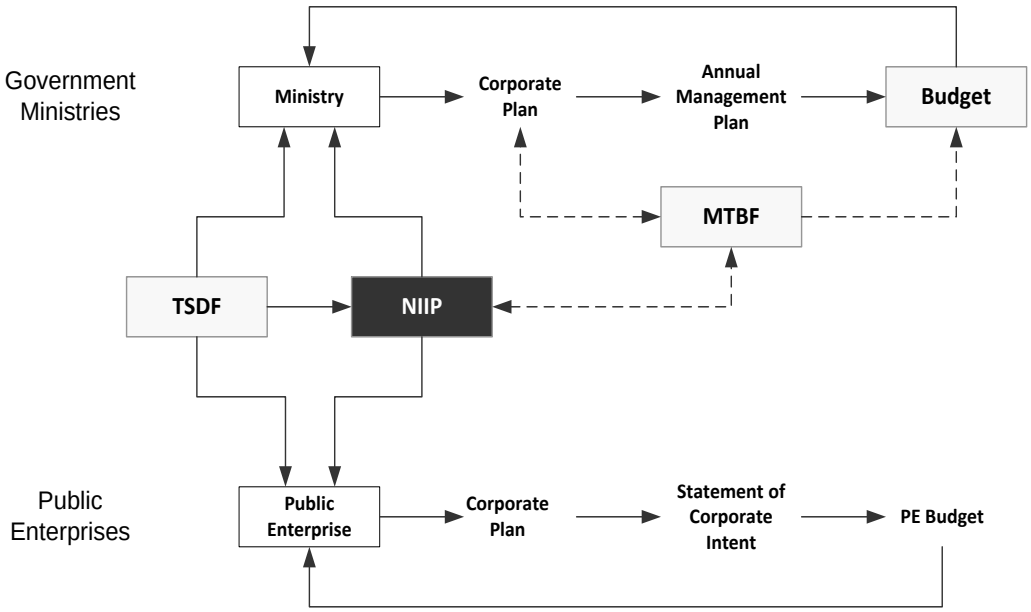


Figure B.4: Link between NIIP and corporate planning



The overall direction and priorities of national infrastructure planning and the NIIP are shaped by the TSDF. The TSDF is the Kingdom's principal document for setting economic and social development objectives. It sets the following development vision for the Kingdom:

> "To develop and promote a just, equitable and progressive society in which the people of Tonga enjoy good health, peace, harmony and prosperity, in meeting their aspirations in life".

Infrastructure and the NIIP play a major part in meeting the TSDF goals. In particular, TSDF Outcome Objective 3 specifies the need for:

> "Appropriate, well planned and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business by the adequate funding and implementation of the National Infrastructure Investment Plan (NIIP)".

As well as being influenced by the TSDF, the NIIP is also shaped by sector development strategies/roadmaps. Together the TSDF, NIIP, and sector plans then influence Ministries and Public Enterprises in their corporate and investment planning. The Corporate Plans and the Annual Management Plans of Ministries set out a three-year strategic plan for the Ministry, and a one-year management plan for allocation of resources. This aligns closely with the annual budgeting process of Government and the planned MTBF which incorporates forward projections of aggregate expenditure and revenue. Since NIIP2010, work has progressed on enhancing the corporate planning leading to the full implementation of MTBF, which is expected to be operational for the 2013/14 Budget.

A similar process occurs in Public Enterprises where Statements of Corporate Intent play an equivalent role in forward planning and budgeting by outlining the development plans and forecast financial performance of the Public Enterprise over the next 12 months. The NIIP also provides important information on planned future investments that can be used by the private sector in its planning and decision-making. Finally, each update of the NIIP is informed by national and corporate investment plans and budgets (Figure B.3) plus the priorities of the private sector, and the planning loop is completed.

Sector strategic planning

From the NIIP perspective, a key aspect of the planning process is the development and maintenance of sector strategic plans, which provide a roadmap for sector development and a key input to the NIIP process. The current status of high level strategic planning in each of the economic infrastructure sectors is shown in Table B.6. Since NIIP2010, the situation has improved but remains mixed. The energy sector has a current roadmap and Tonga Power has a 10-year investment plan, but for most other sectors, long-term infrastructure strategies are either still incomplete or not up-to-date.

This situation is also reflected in the short-medium investment planning in the infrastructure sector. Most sectors/agencies have well-defined investment plans for the next three years; for three to five years the picture is less certain; and beyond five years, only the major Public Enterprises have well-developed investment plans.

Table B.6: Status of sector strategic and master planning

Sector	Master Plan/ Roadmap	Notes
Energy	Yes	*Tonga Energy Road Map 2010-2020*, June 2010; Tonga Power 10 year investment plan
Telecommunications	Partial	Elements (TCC corporate plan, Undersea Cable proposal, *National IT Policy* 2009) but no sector roadmap
Water and sanitation	Out-dated	Latest Masterplan for Water Supply 1991. Expected to be updated as part of the NUSDP.
Solid Waste	Draft	*(Draft) National Integrated Waste Management Strategy for Tonga*, July 2010, but no roadmap for how to implement the strategy
Transport	No	Elements (sub-sector plans as listed below) but no overall sector roadmap
Airports	Yes	Aviation sector strategy and airports master plans completed in 2011 under TSCP
Roads	Yes	Roads sector strategy and maintenance plan completed in 2012 under TSCP.
Sea Ports	Partial	Elements of a Ports sector strategy plan prepared under TSCP
QSW Nuku'alofa	Partial	Outdated QSW Master Plan is under review, but not a formal master planning process
Other Islands	Partial	Maritime Needs Safety Assessment completed in 2012 under TSCP, but not a long-term development roadmap
Multi-Sector		
Climate Change	Draft	*(Draft) Joint Action Plan on Climate Change Adaptation and Disaster Risk Management 2010-2015*, July 2010

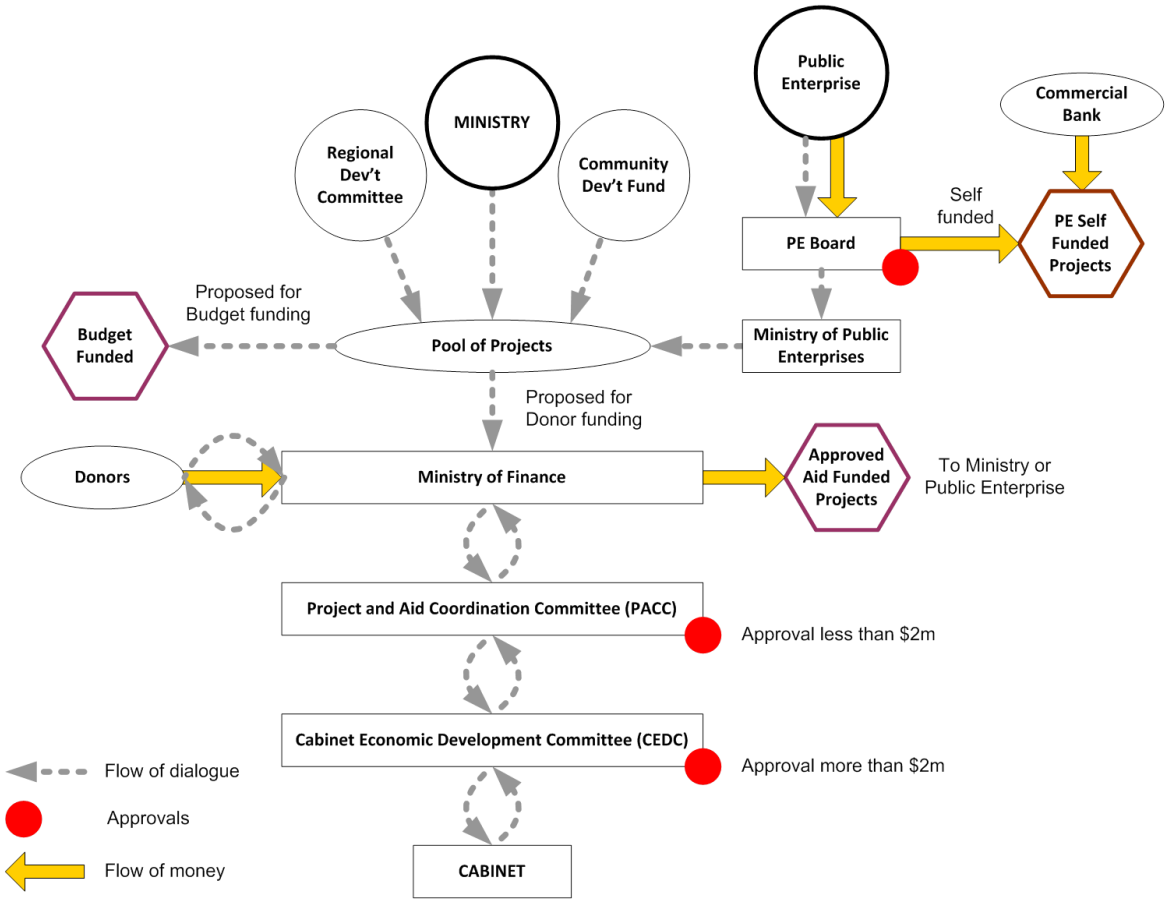
The project proposal and funding process

It is also important to understand the process for approval and funding of individual projects. Within the framework established by the overall planning process, individual infrastructure projects are proposed to decision makers (Government, Boards, etc) for funding or support. These proposed projects follow different paths depending on whether the source of funding is from:

- the Government Budget;
- development partners (funds in cash or kind, grant, or loan); or
- internal resources of Public Enterprises (or the private sector).

Figure B.5 provides an overview of the process.

Figure B.5: Overview of the project proposal and funds flow process

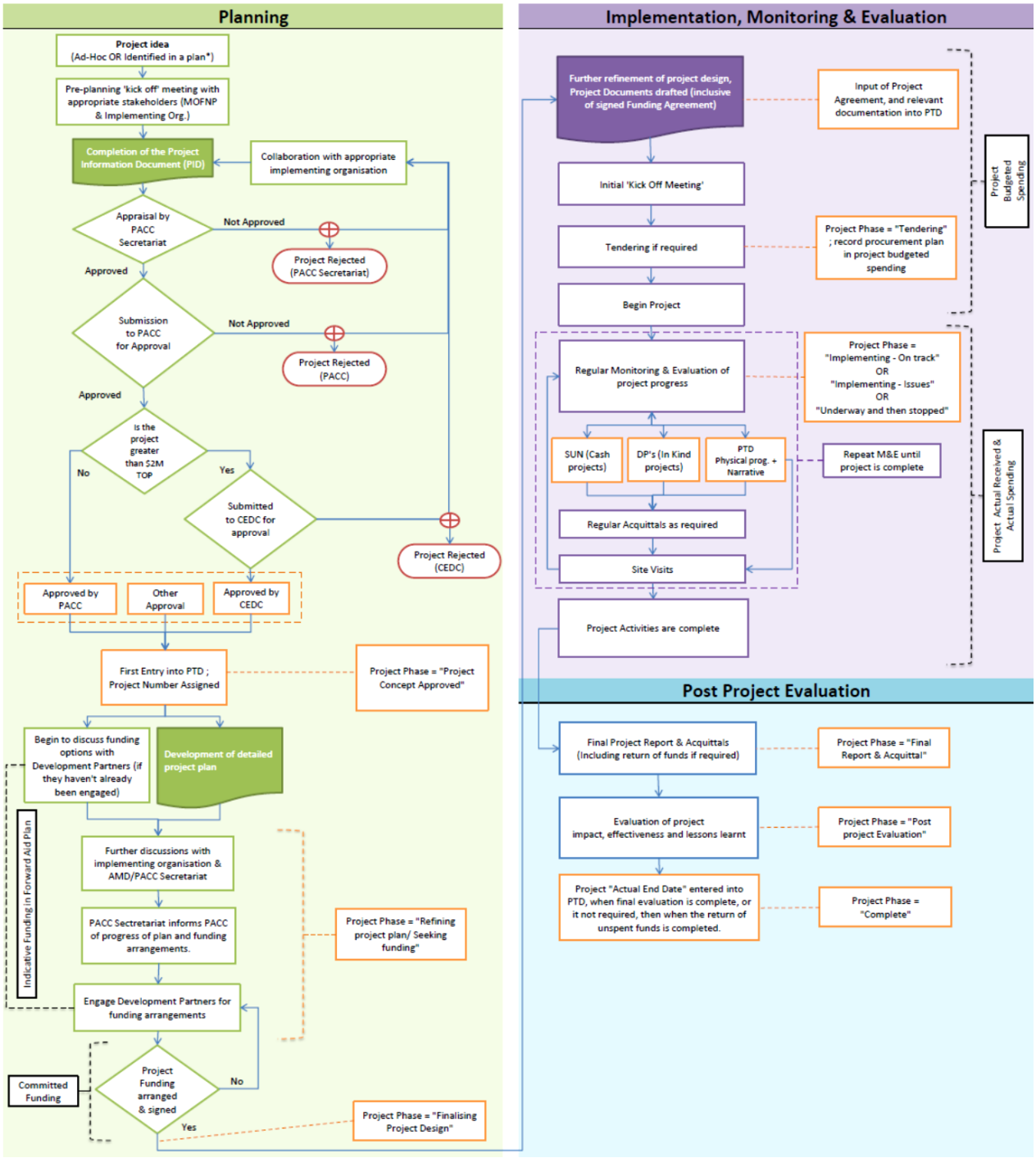


Projects proposed for Budget funding follow a relatively simple process. Ministries submit proposals to the pool of candidate projects being considered for Budget funding. Projects approved for funding become part of the draft Budget which is then considered by the Cabinet Economic Development Committee (CEDC), taking into account consistency with national development priorities and ultimately approved by Cabinet and Parliament. Disbursements for approved projects are made through the MFNP and the relevant Ministry delivers the project.

For Public Enterprises, proposed infrastructure investments are referred to the Board of the Public Enterprise and may be self-funded using internal resources or borrowings from a commercial bank. Projects suitable for development partner funding are referred to the Ministry of Finance & National Planning (MFNP) Aid Management Division and processed as described below.

For projects supported by development partner funds, the process is more complex. Proposals for infrastructure projects can arise from a range of sources, notably Ministries, Regional Development Committees, communities, and Public Enterprises. The project proposals are then submitted to Aid Management Division of the MFNP which coordinates all aid programs, except for a few specific development partners. Since NIIP2010, considerable work has been done by the MFNP on streamlining and systematising the process. The process is shown in detail in Figure B.6.

Figure B.6: The project management cycle for projects funded by development partners



Briefly, the process proceeds as follows. Agencies proposing projects for support must prepare a Project Information Document (PID). The PID includes details of project scope, objectives, and policy context; monitoring & evaluation framework; environmental and social impacts; risks; and capital and recurrent costs. The PID represents a significant advance since NIIP2010 in terms of proposal format and coverage of issues, but the current PID is lacking with regards to coverage of CCA/DRM issues. A quick scan of recent submissions suggests that agencies are focusing on project descriptions and give insufficient attention to the provision of reliable estimates of capital and recurrent operation/maintenance costs. These issues are taken up in more detail in Annexes D and E.

The PIDs are evaluated by the Aid Management Division and then submitted to the Project and Aid Coordination Committee (PACC) for its consideration. The PACC is chaired by the Minister of Finance and National Planning and members are CEOs from central agencies. If projects are approved, then those with costs under T$2 million are submitted to development partners for consideration. For projects with costs more than T$2 million, the proposal is

referred to the CEDC for approval before submission to development partners for funding. The MFNP Aid Management Division conducts constant dialogue with the development partners for possible financing of projects. For projects that are referred to development partners and approved, the development partner funds are deposited directly to the Government accounts. Funds for Public Enterprises are transferred to them. Disbursements are made through the MFNP.

B.4: Sector status and investment plans

The NIIP has an important role to play at many levels in the infrastructure planning and development process. In particular it is:

- a companion document to the TSDF that guides development of the economic infrastructure sector, and corporate planning and budgeting in the sector;
- a central reference point for information about current and planned investments in the economic infrastructure sector; and
- a catalyst for an improved and streamlined process for infrastructure planning.

This section completes the snapshot of the economic infrastructure sector. It provides a brief overview of current issues, performance, and investment plans for each sub-sector. References to specific investment projects follow the numbering system specified in Annex A.

ENERGY

Tonga has one of the highest levels of access to electricity in the region with around 85 per cent of the population on-grid and high levels of supply reliability. At the same time, Tonga has historically had one of the highest costs of electricity in the region.[2] In part, this was a result of Tonga's almost 100 per cent reliance on diesel-powered generation for on-grid services. System losses were also high at around 17 per cent, but are coming down and are expected to reduce to around 13 per cent by 2015. This is more consistent with international benchmarks.

The energy sector is in a phase of rebuilding and transformation. Tonga Power is investing heavily from its own resources to rehabilitate the electricity generation and supply system to increase efficiency and safety (E1-5); and is working with development partners (AusAID, the EU, New Zealand Aid, and the WB) to upgrade village power supply systems (E6). At the same time, initiatives are underway to transform electricity production with a move towards greater stability and self-sufficiency. In 2009, the Government responded to the twin challenges of reducing the Tongan contribution to global Greenhouse Gas (GHG) emissions and improving national energy security by approving a policy target to supply 50 per cent of electricity generation through renewable resources.

The Government's response to this target is set out in the *Tonga Energy Road Map (TERM) 2010-2020.*[3] A number of projects are already underway that contribute to meeting the TERM objectives. These include installation of an 1.3MW solar generation facility on Tongatapu (with assistance from the NZ Government)(E10); an on-grid solar generation facility on Vava'u (with assistance from Abu Dhabi)(E14); investment in off-grid solar power systems for households in outer-islands (with support from the Japanese Government)(E7); research into other sources of renewable energy (such as wind power, tidal power, producing bio-fuel from coconuts, etc); and investigation of options for stabilising and potentially reducing the cost of petroleum fuels by measures such as hedging and/or improving the fuel supply chain.

In the short-medium term, the investment emphasis in the energy sector (Table B.7) continues to be on improving the efficiency of electricity generation and distribution, reducing reliance on imported petroleum, and a move towards greater energy self-sufficiency by increasing the use of renewable energy sources and other measures. This includes proposed projects to increase the solar generation capacity on Tongatapu (E11) and outer islands (E16); pilot projects for other renewable energy sources (coconut oil/land fill gas (E12)); biomass generation from woodchips and forestry waste on 'Eua (E15); and the facilitation of investment by households and the private sector in energy efficiency through a possible Tonga Green Energy Incentive Fund (E13). Depending on the outcomes of investigation of options for stabilising and potentially reducing the cost of petroleum fuels, there may be a need to upgrade bulk fuel storage facilities on Tongatapu (E9), and in the longer term, relocate the fuel storage facilities outside of the tsunami and storm surge risk zone (E17). Initiatives to increase the efficiency and safety of electricity distribution (E19) are also a

[2] Pacific Power Association, *Performance Benchmarking for Pacific Power Utilities- Benchmarking Report 2011* (2012).
[3] World Bank, *IDA/IFC Country Assistance Strategy to the Kingdom of Tonga FY2011-2014* (2010); *Tonga Energy Road Map 2010-2020.*

priority. In the longer term, the option of relocating power lines underground to critical infrastructure, such as the hospital, should also be considered to reduce vulnerability to damage due to natural disasters (E18).

Table B.7: Energy sector – major projects underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18	FY19 to 23
E1	Distribution Network Improvements (multi-year)	5.2	U	PE		⇔
E2	Additional/Replacement Generators (Tongatapu)	23.0	U	PE		⇔
E3	Additional/Replacement Generators (Vava'u)	1.1	U	PE		⇔
E4	Additional/Replacement Generators (Ha'apai)	3.1	U	PE		⇔
E5	Additional/Replacement Generators ('Eua)	2.6	U	PE		⇔
E6	Village Networks (electricity pole replacement)	13.5	U	DG		
E7	Outer-island Off-Grid power (solar)	4.5	U	DG		
E8	Improved Street Lighting	0.8	U	G		
E14	Solar Generation (Vava'u)	6.7	C	DG		
E11	Solar generation (Tongatapu - Additional 1-2MW)	24.0	P	U		
E12	Renewable energy pilots (Coconut Oil/land fill gas)	3.0	P	U		
E15	Biomass Generation ('Eua)	10.0	P	U		
E9	Upgrade Bulk Fuel Logistics (Tank Farm, Bunkering)	30.0	P	U		
E16	Outer Islands On-Grid Renewable Energy Project	9.0	P	U		
E19	Upgrade of Nuku'alofa Electricity Network	25.7	P	U		⇔
E13	Energy Roadmap TGIF Projects	tbd	P	U		⇔
E17	Relocate Tongatapu Power Station and Tank Farm	tbd	P	U		⇔
E18	Relocate Critical Power Lines Underground	tbd	P	U		⇔
	TOTAL	T$162.2				

Notes: 1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

TELECOMMUNICATIONS

Tonga is well positioned in terms of access to basic telecommunications services. Mobile phone and internet services are available throughout the country, including in smaller and more remote communities. The completion of an undersea fibre-optic link to Fiji, scheduled for 2013 (T6), will deliver a step-change in speed, capacity, and quality that will redefine telecommunications in Tonga; offset some of the geographical disadvantage experienced by the country; and create new economic and social opportunities. In addition, local investments by the Tonga Communications Corporation (TCC) and Digicel are underway to reticulate high-speed broadband on Tongatapu (T7); progressively improve telecommunications infrastructure and services (telephone, radio, internet) to accommodate emerging applications (such as mobile internet, multi-media, and interactive applications) (T1,2); and improve coverage in less-populated islands (T4). Competition and private sector involvement in the telecommunications sector has been a strong force driving these developments.

Telecommunications also has a vital role to play during natural disasters and other emergency situations. In particular, AM Radio continues to play an important role in sending messages to outer island communities including information about scheduled arrivals of shipping and airline services. As a lifeline during times of natural disasters, it has a critical role in broadcasting regular weather reports and cyclone and tsunami warnings. The installation of a new AM transmission tower on Tongatapu has addressed some deficiencies in the AM coverage (T5), but problems remain with reception in northern island groups, as well the CCA/DRM resilience of AM transmission and other telecommunications media, such as the mobile phone system.

In the short term, proposed projects in the telecommunications sector (Table B.8) focus on extending the undersea fibre-optic cable link to Ha'apai and Vava'u (T9). This project is linked to a proposed extension of the international fibre-optic cable from Tongatapu to Samoa; development of Government services that take advantage of enhanced

internet capability (E-Government T8); and strengthening the early warning capability and CCA/DRM resilience of the AM transmission infrastructure (T10).

Table B.8: Telecommunications – major projects underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18					FY19-23
T1	Upgrade TCC Fixed line services and cabling	-	U	PE						⇔
T2	TCC Mobile phone Next Generation Network (NGN)	-	U	PE						⇔
T4	Outreach – Expanding Services to small islands	1.6	U	DG						
T6	International Fibre-Optic Cable	53.0	U	DG						
T7	Local Reticulation of High Speed Internet	8.0	U	PE						
T10	Communications for Early Warning and Disaster Recovery	6.0	P	U						
T8	E-Government	20.0	P	U						
T9	Fibre-Optic Cable to Ha'apai, Vava'u (and Samoa)	30.0	P	U						
	TOTAL (excluding TCC)	T $ 100.6								

Notes:
1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

WATER AND SANITATION

All Tongans have access to clean drinking water and around 85 per cent of households have piped water supply. Thus, the water sector is performing well in terms of meeting the Millennium Development Goals (MDGs) and providing basic access to clean water. However, problems exist in the efficiency of water supply and a major challenge facing the reticulated water supply system is to reduce water losses. Significant progress has been made, but current levels of non-revenue water[4] vary from 15-40 per cent. This compares to benchmark levels of 20-30 per cent achieved by some developing countries in the Asia-Pacific region and 10 per cent in developed countries.[5]

Projects underway or recently completed in the water sector (Table B.9) focus on reducing water losses and upgrading the efficiency of the Nuku'alofa water supply and distribution system under the Nuku'alofa Urban Development Sector Project (NUDSP)(W2) and through expert technical advice supported by the Government of Japan; upgrading village water supplies throughout the country (W1); and upgrading the Neiafu water supply system on Vava'u. The Tonga Water Board (TWB) is implementing these projects in association with development partners (see Annex A for more details).

Planning is less well advanced for the medium-longer term[6], but at this stage, there are anticipated needs for an integrated program of upgrading outer-islands water systems (W3); and investment to extend the Nuku'alofa supply area and capacity to cater for urban growth (W4). Installing facilities to reduce the mineral content (soften) the Nuku'alofa water supply has also been proposed by the TWB (S6). In the longer term, new well-fields are likely to be required for Nuku'alofa (S5) and Neaifu, Vava'u (S7) to ensure the water supply meets expected growth in demand.

In many countries, the water sector also includes sanitation as part of the overall water cycle. Although Tonga currently has no central sewerage system in any urban area, important issues relating to the disposal of grey water and septage (sludge pumped from septic tanks) are emerging and are likely to require a coordinated response in the short-medium term. A grey water collection system has been implemented as part of the Nuku'alofa CBD redevelopment project. Sanitation is an area where the Government is planning to place greater emphasis in the future. As a starting point, the Government urgently needs to consider sanitation issues as part of an overall water sector roadmap.

[4] Non-revenue water is an important measure of efficiency. It refers to the difference between system input volume and the billed or authorised consumption, and includes un-billed consumption from faulty meters, illegal connections or under-billing as well as physical losses from leakages and overflows.
[5] Pacific Water and Waste Association, *Development of a Water Utility Benchmarking System – Benchmarking Report 2011* (2011); Asian Development Bank, *Asian Water Supplies: Reaching the Urban Poor* (2003).
[6] The water sector currently does not have an up-to-date medium-long term development roadmap, but it is expected that a long-term roadmap, at least for Nuku'alofa will be developed as part of the NUDSP.

Table B.9: Water and sanitation – major projects underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18	FY19-23
W2	Rehabilitate the Nuku'alofa water system	7.0	C	DG		
W6	Water Softening for Nuku'alofa System	8.0	P	U		
W3	Outer Islands water supply improvements	15.0	P	U		
W4	Expand Nuku'alofa system to growth areas	11.4	P	U		
W5	Development of a new Tongatapu well-field	10.0	P	U		⇔
W7	New Well Field for Neiafu, Vava'u	12.0	P	U		⇔
	TOTAL	T $ 63.4				

Notes:
1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

SOLID WASTE

In 2007, a new solid waste collection system was implemented on Tongatapu and the Waste Authority Limited (WAL) was established to take control of solid waste collection and disposal. This includes responsibility for disposal of sludge from septic tanks (septage) at the Tapuhia facility. On most other islands, formal arrangements for solid waste collection are not in place. However, the operational model for solid waste collection; charging and revenue collection; and management on Tongatapu has not worked as well as expected. Initiatives are underway to improve operational and financial performance. These initiatives plus investments in facilities and equipment will continue and gather pace under the Nuku'alofa Urban Development Sector Project (NUDSP)(S5), with support from the Asian Development Bank (ADB) and the Australian Government. On Vava'u, a program is also underway to improve the operational and environmental performance of the existing landfill facility, with assistance from the Government of Japan.

In the short-medium term, planned projects focus on improved solid waste sector performance throughout Tonga (Table B.10). This includes proposed further investment equipment in facilities and for the WAL, including improved septage disposal facilities (S1,2), and development of solid waste disposal arrangements for Ha'apai (S6). On Ha'apai no formal arrangements are currently in place for the collection or disposal of solid waste. Options being considered include the development of an engineered landfill facility on Ha'apai; or a transfer station on Ha'apai with waste transported to the Tapuhia facility on Tongatapu for disposal. The development of a new semi-aerobic landfill facility is likely to be required on Vava'u (S3) in the medium-longer term.

Table B.10: Solid Waste – major projects underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18	FY19-23
S5	Sustainable Solid Waste Services in Nuku'alofa	2.8	C	DG		
S1	Additional capacity for septage treatment	3.0	P	U		
S2	Equipment Renewal Program	2.0	P	U		
S6	New Landfill or Transfer Station on Ha'apai	4.0	P	U		
S3	New Vava'u Semi-Aerobic Landfill Facility	5.0	P	U		
	TOTAL	T $ 16.8				

Notes:
1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

ROADS

Tonga has an extensive road network and one of the highest levels of road network density in the region[7]. This network provides good access links to communities in terms of connectivity but in some areas the condition has deteriorated significantly due to insufficient emphasis on maintenance.

[7] Measured in terms of road length/square km of land area. See: Pacific Region Infrastructure Facility, *Pacific Infrastructure Performance Indicators* (2011).

The Government is addressing this problem through several road rehabilitation and upgrading programs in association with its development partners (Table B.11). The National Roads Improvement Project (R1) has rehabilitated selected trunk roads throughout the country; the Nuku'alofa Redevelopment program improved roads in the city centre (M1); the Integrated Urban Development Sector Program (IUDSP) is upgrading major routes into Nuku'alofa from the south (R2); and the Transport Sector Consolidation Project (TSCP)(R3) is trialling a new approach to road maintenance that makes greater use of private sector involvement. Contracts for routine maintenance have been awarded to private firms and are underway. Studies undertaken as part of the TSCP program provide a strategy for road maintenance over the next five to 10 years, including recommendations for road maintenance programming, institutional reform, sustainable funding mechanisms (such as a road fund), and private sector participation. In addition to these broader programs, commitments are already in place for specific investments to rehabilitate the Vaipua Bridge (Vava'u)(R4) and Foa Causeway (Ha'apai)(R5).

In the short-medium term, the Government will continue this emphasis on road maintenance and rehabilitation. This involves planned projects to rehabilitate key roads throughout the country, including trunk and agricultural roads on Tongatapu (R8); an outer-islands road upgrading program (R10); and resealing the key road link from Nuku'alofa to Fua'amotu International Airport (R9). In the longer term, the Government may also consider options for upgrading the Toula Causeway on Vava'u (R7); and a new road linking Nuku'alofa with the southern side of Fanga'uta Lagoon by bridge or a causeway (R8). This road would provide better access to the southern and eastern sides of Tongatapu and the airport, and could provide an alternative evacuation/access route in case of natural disaster. However, it will require detailed planning, feasibility and design studies, environmental impact assessment and approval, and the identification of a suitable funding source.

Table B.11: Roads – major investments underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18					FY19-23
R2	Integrated Urban Development Sector Program	12.0	U	DL						
R3	Transport Sector Consolidation Project (Roads)	11.6	C	DG						
R4	Vaipua Bridge (Vava'u)	7.8	C	DG						
R9	Resealing of Tongatapu Airport Rd	11.6	P	U						
R11	Tongatapu Trunk Roads Program	16.0	P	U						
R10	Outer Islands Roads Upgrading Program	10.0	P	U						
R7	Upgrading of Toula Causeway (Vava'u)	20.0	P	U						⇔
R8	New road link to southern side of Fanga'uta Lagoon	50.0	P	U						⇔
	TOTAL	T $ 118.2								

Notes:
1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

MARITIME

The maritime sector plays a vital role in the Tongan economy and community. It supports tourism; inter-island and international commerce; and inter-island travel for social, educational and medical needs. The existing ports have sufficient capacity for foreseeable needs[8] and there are no plans to build any new ports for commercial shipping operations. In addition, the international ports comply with relevant international and International Maritime Organisation (IMO) operating requirements. Although the port system meets basic needs for coverage, capacity, and compliance, the standard of infrastructure has suffered from a lack of investment in core infrastructure and facilities and an insufficient emphasis on the maintenance of outer-island ports and channels.

Recent investments in the maritime sector include Government-funded minor works at all ports necessary for the operation of the new inter-island ferry (P2); upgrading of navigational aids and other port upgrades under the TSCP; and investments by Ports Authority Tonga (PAT) in upgrading ship and cargo handling facilities and equipment at Queen Salote Wharf (forklifts, fenders, pavements P3,4,5,6,8). The cruise ship terminal at Vuna Wharf (Nuku'alofa) has also been completed and commenced operation in December 2012 (P7). Responsibility for implementing these

[8] Based on utilisation estimates from *Tonga Transport Sector Review* (2005) and updated to 2012.

projects is split between PAT which is responsible for Queen Salote International and Domestic Wharves at Nuku'alofa, and the Ministry of Transport (MOI) which is responsible for all other ports.

Safety is the Government's key priority for the maritime sector. In the short-medium term, planned investments (Table B.12) continue the focus on addressing deficiencies in safety (navigational aids, channels, etc) and cargo handling facilities (fenders, pavements). Building resilience to CCA/DRM in the maritime sector is an emerging priority. These two major issues come together in the proposed Maritime Sector Safety and Resilience (P9) project, which would be a major initiative designed to transform and modernise the maritime sector (especially for inter-island shipping); and prepare a long-term roadmap for sector development. The aim is to address urgent safety issues with an integrated sector-wide approach; and substantially upgrade the overall performance of the sector, so that maritime infrastructure matches the quality and safety of the new inter-island ferry MV *'Otuanga'ofa*.

Table B.12: Ports and shipping – major investments underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18					FY19-23
P6	Replace Fender at QSW International Wharf	1.0	C	PE						
P3	Reseal Queen Salote Wharf (QSW Int. and Dom.)	11.3	C	PE						
P10	Vuna Wharf (Stage 2 Marina)	20.0	P	U						
P9	Maritime Sector Safety and Resilience	20.0	P	U						
P17	Multi-purpose Barge	4.5	P	U						
P16	Nafanua ('Eua) Port Upgrade	3.0	P	U						
P12	Yellow Pier Upgrade	7.5	P	U						
P11	Upgrade of the Queen Salote Domestic Wharf	9.0	P	U						
P13	New Slipway at QSW	1.5	P	U						⇔
P14	Barge for Deep Water Dredging	1.0	P	U						⇔
P15	Upgrade of Vava'u port	25.0	P	U						⇔
	TOTAL	T $ 101.9								

Notes:
1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

AIRPORTS

Aviation also plays a vital role in the Tongan economy and community in terms of tourism; inter-island and international commerce; and travel for social, educational and medical needs. The existing commercial airports provide sufficient coverage to all island groups, and at this stage, there are no plans to build any additional airports. The airports have sufficient capacity for expected growth in passenger demand, but the length and current condition of runways place some limits on operation of larger aircraft. Much of the infrastructure is nearing the end of its useful life or requires upgrade to continue to meet international and national safety and security standards. Tonga already meets required service standards and complies with International Civil Aviation Organisation (ICAO) requirements, or has been granted a temporary exemption from some requirements during a transition period. All commercial airports in Tonga are managed by Tonga Airports Ltd (TAL).

A significant investment program is already underway or committed in the airport sector, with a focus on meeting safety and security compliance requirements in terms of fire and rescue capability, security screening, navigational aids, and runway condition. This includes upgrading and reconfiguring the international arrivals area at Fua'amotu (A6) and resurfacing of runways at Fua'amotu (A8) and Vava'u (A10), which were priority projects under the first NIIP. The investments are being managed by TAL, with support under the WB-funded TSCP and PAIP programs, and in line with the strategic development plan for Tonga airports developed with supported under the TSCP.
Additional planned investments in the airport sector in the short term (Table B.13) will continue the task of maintaining compliance with increasingly stringent safety and security requirements; ensuring that current aircraft types and new international aircraft likely to be used on Tonga services can operate without weight restrictions; and keeping Tonga competitive as an exporter and international travel destination. In particular this includes resurfacing of the runways, taxiways, and apron at Ha'apai (A11), and a new control tower at Fua'amotu (A12). In the medium-longer term, expanding the apron and taxiway areas at Fua'amotu (A9) becomes a priority to cater for larger

international aircraft; reduce congestion; provide more flexibility in aircraft operations; and provide additional parking space for aircraft.

Table B.13: Airports – major investments underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18					FY19-23
A6	Upgrade International Arrivals area (Fua'amotu)	1.5	C	DG						
A8	Resurfacing of Fua'amotu runway, apron, taxiway	38.0	C	DG						
A10	Resurfacing of Vava'u runway, apron, taxiway	11.0	C	DG						
A9	Expand apron area at Fua'amotu	25.0	P	U						
A7	Additional Fire Tender (Vava'u)	1.0	P	U						
A11	Resurfacing Ha'apai runway, apron, taxiway	9.0	P	U						
A12	Control Tower for Fua'amotu	7.0	P	U						
A13	New Aircraft Hangar at Fua'amotu	2.0	P	U						
	TOTAL	T $ 93.8								

Notes:
1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

MULTI-SECTOR

Multi-sector projects generally fall into two broad categories. The first involves complex construction projects with the need for coordination across several sectors, such as electricity, telecommunications, and water. The Nuku'alofa CBD Redevelopment (M1) is an example is this type of multi-sector project. It involved upgrading basic infrastructure in the CBD area, including roads, underground power and additional High Voltage supply, drainage, grey water collection system, footpaths, and street lighting. Another example is restoration of basic infrastructure on Niuatoputapu following the tsunami in 2009. Complex multi-sector projects expected in the next five to 10 years include preparation for the Pacific Games 2019 and the planned Government Ministerial Complex.

The second category involves cross-cutting issues, especially climate change adaptation and disaster risk management (CCA/DRM). The Government is committed to working with development partners to better manage CCA/DRM risks, and initiatives are already underway to strengthen Government capability in this area and ensure that adequate consideration is given to CCA/DRM issues in infrastructure development. The *Joint Action Plan on Climate Change Adaptation and Disaster Risk Management 2010-2015* has been prepared with assistance from the Global Environment Facility (GEF), Applied Geoscience and Technology Division of the Secretariat of the Pacific Community (SPC-SOPAC), and United Nations Development Program (UNDP). Implementation is underway, especially in relation to smaller community-based initiatives. In addition, a *Strategic Program for Climate Resilience for the Kingdom Of Tonga* has been prepared under the Pilot Program for Climate Resilience (PPCR) process. These documents provide a framework for developing and implementing infrastructure responses to CCA/DRM. For a more detailed discussion of CCA/DRM issues, see Annex D.

Planned multi-sector investments focus on complex multi-sector construction projects, and on increasing resilience of the community and economy to CCA/DRM impacts (see Table B.14). This includes coastal protection initiatives on Tongatapu (M2,3); infrastructure supporting improved disaster response and evacuation throughout the country (M4); and a package of works to strengthen the resilience of community infrastructure (water supply, telecommunications, port, etc) on Ha'apai (M5). In the medium-longer term, coordination of multi-sector infrastructure supporting the Pacific Games 2019 (M7) and planned Government Ministerial Complex (M6) will become priorities. At this stage, the requirement for development/upgrading basic infrastructure and services (power, water, telecoms, roads, etc) is not clearly defined, so these projects have been included in list of planned projects but have not been costed.

Table B.14: Multi-sector – major projects underway, committed or proposed

Ref	Project	Estimated Cost (T$ million)	Status	Funding Source	FY14-18					FY19-23
M2	Coastal Protection - Eastern Tongatapu	15.0	P	U						
M4	Disaster Response & Evacuation Infrastructure	12.0	P	U						
M5	Ha'apai Community Resilience	12.0	P	U						
M3	Western Tongatapu Resilience	20.0	P	U						
M6	Government Ministerial Complex	tbd	P	U						
M7	Pacific Games 2019	tbd	P	U						
	TOTAL	T$59.0								

Notes:
1. Includes investment projects that are underway, committed or proposed.
2. Planned expenditure is for the period 2013/14 to 2022/23 and does not include any prior expenditure on projects already underway. See Annex A for more details.

B.5: Overview of planned investments

If all of the planned infrastructure investments (underway, committed, proposed) are made, the total effect would be investment of around T$580 million over the next five years; and an additional T$140 million in a five to ten year period (Table B.15). This includes all high/medium/low-priority proposed projects, which at this stage, do not have a confirmed funding source and may not be implemented during the five to 10 year period.

The split of planned investments by sector over the next five years is shown in Figure B.7. If all proposed projects go ahead, around T$100 million or more would be invested in each of the energy, telecommunications, roads, aviation, and maritime sectors. Approximately 70 per cent of total infrastructure investments will be made by Public Enterprises using a combination of self-funding from their own resources and participation in a range of development partner programs. The Government would make the remaining investments, mostly with assistance from grants from development partners. Government investments are in the roads sector and outer-islands ports.

Planning is less well advanced for the period 2016-2020. At this stage, around T$140 million of planned investments have been identified and this is expected to increase as medium-longer term planning solidifies.

Table B.15: Planned investment by sector and year (in TS millions)

Project [1]	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2023	TOTAL
Energy	29.6	47.8	35.4	20.3	11.9	17.1	162.1
Telecommunications [2]	47.3	25.3	23.0	5.0	0.0	0.0	100.6
Water	8.0	12.0	7.3	9.6	4.6	22.0	63.5
Solid waste	5.9	5.9	5.0	0.0	0.0	0.0	16.8
Roads	10.6	8.5	11.1	10.3	7.7	70.0	118.2
Ports and shipping	20.4	21.2	20.1	16.1	0.0	29.0	106.8
Airports	74.8	11.0	9.0	0.0	0.0	0.0	94.8
Multi-sector	5.0	15.0	25.0	14.0	0.0	0.0	59.0
TOTAL	201.6	146.7	135.9	75.3	24.2	138.1	721.8

Notes:
1. Includes investment projects that are underway, committed, or proposed.
2. Excludes the TCC.

These figures should be viewed in context of recent and possible future trends in infrastructure expenditure. Figure B.8 shows the possible expenditure profile; again, on the assumption that all proposed projects on the NIIP2013 long list go ahead. It also includes previous years covered by NIIP2010 for comparison. Over the first two years of the period covered by NIIP2010, there was a peak in infrastructure investment as a number of major projects were implemented. This includes completion of the National Roads Improvement Program; Nuku'alofa CBD infrastructure redevelopment and Vuna Wharf cruise ship terminal; and delivery of the new inter-island ferry. Following a period of reduced activity in 2012/13, there is another peak possible in the period from 2013/14 to 2015/16 if all proposed projects go ahead as planned. In part this occurs because several large projects that are already underway or

committed are scheduled for implementation. This includes laying of the undersea fibre-optic communications cable to Fiji (T7) and resurfacing of the Fua'amotu and Vava'u airport runways (A8,10). These three projects have some T$90 million of committed expenditure scheduled for 2013-14.

Figure B.7: Planned investment by sector over the next five years

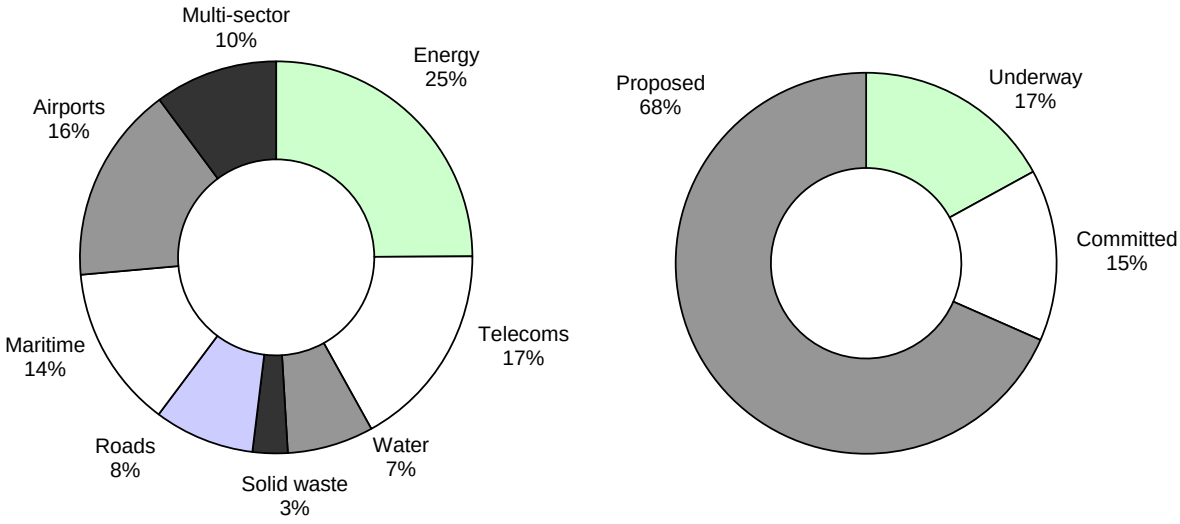
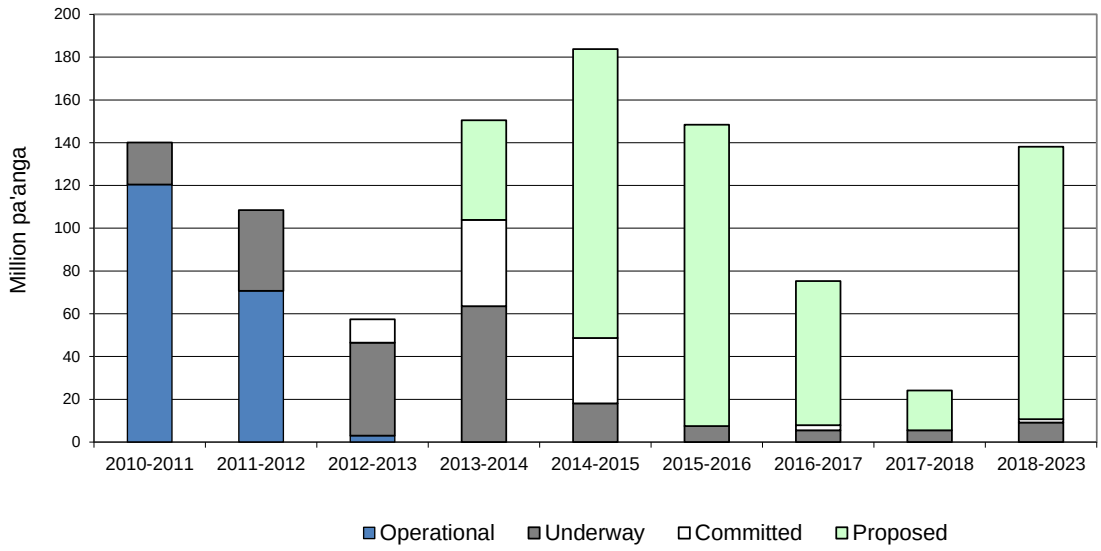


Figure B.8: Recent and possible future trends in infrastructure investment



Considering the scale of infrastructure investment required to implement all proposed projects on the NIIP2013 long list and completing projects already underway and committed at the same time, the scenario shown in Figure B.8 does not appear feasible with the available financial resources and implementation capacity. Therefore, decisions needed to be made about investment priorities. The next step is to prioritise the proposals and develop a sustainable investment program for NIIP2013.

Annex C: Project prioritisation

This Annex describes the conceptual framework and methodology that was used to prioritise the NIIP projects; and applies the methodology to the pool of proposed projects described in Annexes A and B. This process has yielded the set of projects which are ready to commence in the next five years and considered to be a high priority in terms of aligning well with overall Government objectives and delivering a high level of benefits to the community.

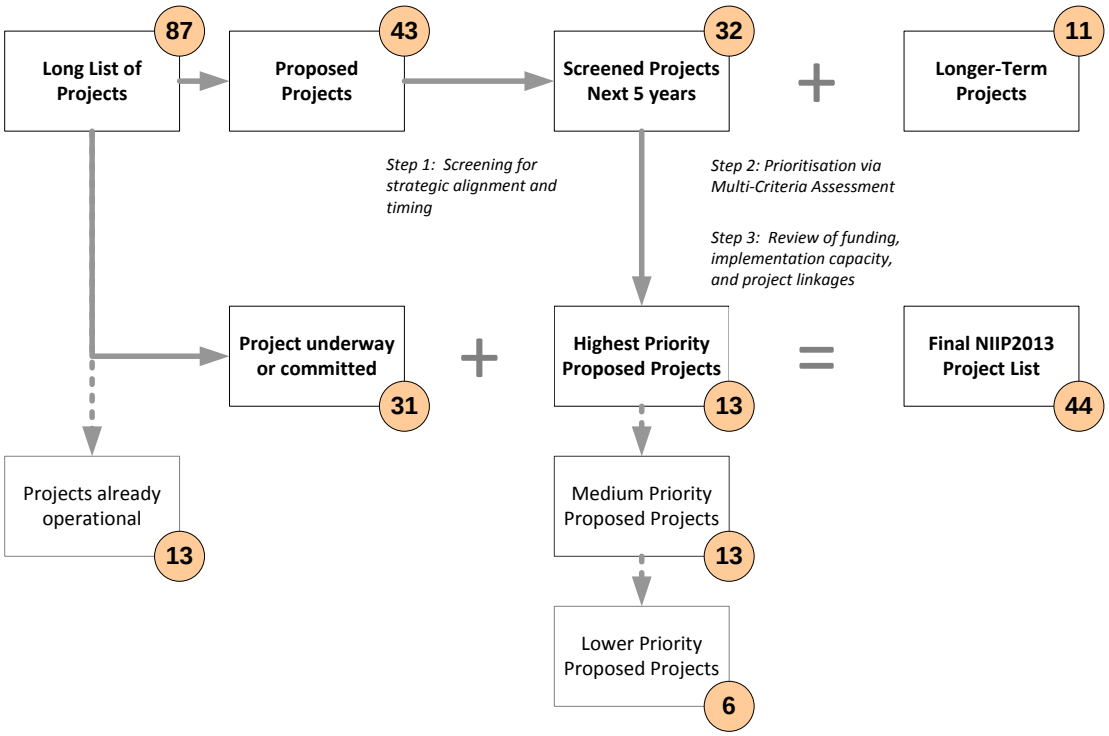
C.1: Projects in NIIP2013 coverage

A long list of projects was prepared in consultation with stakeholders in infrastructure sub-sectors, and drawing on a review of the implementation of NIIP2010 (see Annex A). The long list encompasses:

- Projects included in NIIP2010 which are now *operational*.
- Projects in infrastructure sub-sectors which are *underway* or *committed*.
- *Proposed* projects identified through sector analysis and consultation with infrastructure managers and then refined to ensure that the project objectives, concept, and likely costs were clearly identified.

Projects included in NIIP2010 which are now operational, and projects in infrastructure sub-sectors which are underway or committed, were automatically included in the coverage of NIIP2013. Proposed projects were the subject of a screening and prioritisation process (outlined below), which identified the high priority proposed projects to be given first consideration in this NIIP. Figure C.1 summarises the project processing system for this NIIP.

Figure C.1: Preparation of the NIIP project list



C.1: Projects in NIIP2013 coverage

The steps involved in prioritising the list of proposed projects and packaging them for inclusion in this NIIP were as follows:

1. Screening (for strategic alignment and whether the project is needed in the next five years).
2. Multi-criteria assessment (to rank projects in terms of the strength of project benefits).
3. Iteration of results of the multi-criteria assessment with the funding strategy, an assessment of implementation capacity, and a review of linkages among projects to select the package of high projects for inclusion in the NIIP development strategy.

Step 1: Screening

This step involved screening proposed projects for strategic alignment (consistency with government policy), timing (checking that the project is needed within the timeframe of this NIIP), and noting availability of cost-benefit analysis.

The strategic alignment check considered consistency with government development objectives, focusing in particular on the *Tonga Strategic Development Framework 2011 – 2014* (TSDF). Other important facets of the development planning framework in Tonga include the Millennium Development Goals (MDGs), sector level plans, district level plans, and entity level plans such as corporate and business plans. The intention of the strategic alignment check was to identify and screen out any projects which do not support the objectives of this hierarchy of plans. In practice, it would appear that all projects on the list of proposed projects are accorded high priority in their infrastructure sectors and have been developed with the planning framework in mind. No projects were screened out in this check.

The project timing check screened out eleven projects which were considered to address longer term needs and would not be needed within the next five years.

Most projects on the list of proposed projects are at an early stage of development, without formal project documentation and pre-feasibility studies. Projects were not screened out on the basis of lack of project preparation and documentation, and this may mean that some attrition will occur during the implementation of this NIIP as more detailed studies are undertaken of individual projects.

Projects which passed the screening step were then subject to Step 2, a multi-criteria assessment.

Step 2: Multi-criteria assessment

Projects passing the screening step were then appraised using a multi-criteria assessment (MCA), which involved scoring against a range of criteria designed to capture the strength of project benefits and how well projects advance TSDF objectives, including:

- lowering the cost of business and supporting economic development;
- improving the quality of life of people; and
- improving resilience to climate change and natural disasters.

MCA is a rapid appraisal technique, applied in the absence of detailed pre-feasibility studies for many proposed projects. It must be acknowledged that the MCA is not able to fully capture the viability of projects as it does not involve a rigorous comparison of project costs and benefits. This means that all proposed projects, including those scoring well in the multi-criteria assessment, need to undergo more detailed project preparation and appraisal (including cost-benefit analysis and in some cases environmental impact assessment) before proceeding.

The starting point for the selection and weighting of criteria for the multi-criteria assessment was a review of the criteria and weights used in NIIP2010, undertaken with MFNP staff and then considered by the Government's NIIP Working Group. Factors considered in this review included developments since the preparation of NIIP2010, most notably the release of the TSDF.

The major changes introduced in the criteria used in this NIIP were the addition of a headline criterion dealing with climate change adaptation (CCA) and disaster risk management (DRM), and broadening the scope of the readiness headline criterion used in NIIP2010 into a project sustainability headline criterion, with financial, technical, and institutional dimensions. The criteria and sub-criteria selected for the MCA are described in Table C.1.

The criteria capture key economic, social, environmental, CCA/DRM, and project sustainability considerations. They are by necessity high-level criteria, given that they are to be applied to projects across the full range of infrastructure sub-sectors: energy, telecommunications, water and sanitation, solid waste management, roads, maritime, airports, and multi-sector.

Table C.1: Criteria used in multi-criteria assessment

Headline criteria	Sub-criteria	Descriptions
Economic	Access to markets	Whether the project creates new economic opportunities, especially through improving access to markets, with flow on effects such as job creation.
	Cost / efficiency	Whether the project reduces the cost to consumers and/or the cost of supply (through efficiency gains).
	Service capacity	Whether the project maintains or increases capacity to cater for demand for services, especially demand arising from increased economic activity.
Social	Social access	Whether the project improves access to social services and opportunities, including education and health services, recreation etc.
	Service coverage	Whether the project extends basic service coverage to new areas and/or more people.
	Service quality / reliability / safety	Whether the project improves the overall quality, reliability, or safety of infrastructure services delivered to consumers.
Environmental	Effects on ambient soil, water, or air quality	Whether the project impacts on ambient soil, water, or air quality.
	Effects on terrestrial and marine ecosystems	Whether the project impacts on terrestrial and/or marine ecosystems.
Climate change / Disaster risk management	Disaster risk management or climate change adaptation function	Whether the project has an existing or potential DRM or climate change adaptation function.
	Degree of resilience to climate variability or climate change	Whether the project is able to cope with the potential effects of climate variability or climate change.
	Effects on GHG emissions	Whether the project has an impact on GHG emissions.
Project sustainability	Financial	Whether the project is able to support the ongoing costs of operation and maintenance through user charges etc.
	Technical	Whether the technology used in the project is appropriate, and able to be operated and maintained.
	Institutional	Whether the institution responsible for the project has sufficient capacity for implementation, operation and maintenance.

The weighting of headline criteria used in the multi-criteria assessment was:

Economic	30%
Social	30%
Environmental	10%
Climate Change / DRM	10%
Project Sustainability	20%

Comparing these weights with those used in NIIP2010, the major changes were the addition of a headline criterion dealing specifically with CCA and DRM, and broadening the scope of the Readiness headline criterion used in NIIP2010 into a Project Sustainability headline criterion, with financial, technical, and institutional dimensions. The review also considered the weighting attached to each criterion with the aim of simplifying the weightings and better reflecting the balance of economic, social, and environmental objectives of the TSDF and the need for project sustainability. The weighting of the Social criterion was increased to give equal weight to Social and Economic headline criteria; and the weighting applied to the Environmental headline criterion in NIIP2010 has been distributed equally between the Environmental and CCA/DRM headline criteria. The weighting applied to the Project Sustainability headline criterion is similar to the weighting of the Readiness headline criterion in NIIP2010, but with a high weighting attached to the financial sustainability sub-criterion. Overall, economic and financial factors continue to have the highest weighting in the MCA. Within headline criteria weightings, weights were applied to individual sub-criteria on the basis of their perceived importance.

A worksheet was developed to facilitate the screening and multi-criteria analysis steps in short-listing of projects for this NIIP. Sub-criteria were scored on a scale of 0 to 5 (scores of 4 and 5 represent strong performance against the criteria, scores of 2 and 3 represent moderate performance, and scores of 0 and 1 represent weak performance).

Scoring was undertaken against the base case of the project not going ahead (thus, for example, avoiding a cost or loss of a benefit is considered as well as generating a benefit). Preliminary scoring was undertaken by the technical assistance team working together with the MFNP, with the results reviewed by a workshop of representatives of government agencies with a stake in infrastructure provision. The results of the MCA are shown in Table C.2.

Table C.2: Results of the multi-criteria assessment

Ref.	Sector/Project	Economic (30%)	Social (30%)	Environmental (10%)	CCA/DRM (10%)	Project sustainability (20%)	Total (100%)
	Energy						
E9	Upgrade Bulk Fuel Facilities (Tank Farm, Bunkering)	18	8	6	6	20	58
E11	Solar Generation (Tongatapu - Additional 1-2 MW)	26	6	6	6	20	64
E15	Biomass Generation ('Eua)	22	6	6	5	14	53
E16	Outer Islands On-Grid Renewable Energy Project	26	8	6	6	19	65
E19	Upgrade of Nuku'alofa Electricity Distribution Network	20	10	6	6	17	59
	Telecommunications						
T9	Fibre-Optic Cable to Ha'apai, Vava'u	30	24	2	7	17	80
T10	Communications for Early Warning and Disaster Recovery	6	26	6	9	17	68
	Water and sanitation						
W3	Outer Islands Water Supply Improvements (Vava'u, Ha'apai, 'Eua)	24	22	4	7	16	73
W4	Expand Nuku'alofa Water System to Growth Areas	18	22	4	6	16	66
W6	Water Softening for Nuku'alofa	12	10	6	3	16	47
	Solid waste						
S1	Additional Capacity for Septage treatment	22	8	10	5	9	54
S2	WM Equipment Renewal Program	20	12	8	3	9	52
S3	New Vava'u Semi-Aerobic Landfill	16	16	8	6	7	53
S6	New Landfill or Transfer Station on Ha'apai	22	20	10	6	7	65
	Roads						
R9	Resealing of Tongatapu Airport Rd	10	10	4	6	11	42
R10	Outer Islands Roads Upgrading Program	22	20	4	8	11	65
R11	Tongatapu Trunk Roads Program	20	18	4	7	11	60
	Maritime						
P9	Maritime Sector Safety and Resilience	24	20	6	9	11	70
P10	Vuna Wharf Development (Stage 2 Marina)	20	6	6	5	13	50
P11	Upgrade of the Queen Salote Domestic Wharf	16	16	6	5	16	59
P12	Yellow Pier Upgrade	8	12	6	3	13	42
P16	Nafanua ('Eua) Port Upgrade	22	16	2	7	10	58
P17	Multi-purpose Barge	16	14	2	6	13	50
	Aviation						
A7	Additional Fire Tender (Vava'u)	12	18	6	4	14	54
A9	Expand Apron and New Taxiways at Fua'amotu	18	10	6	7	17	58
A11	Resurfacing Ha'apai Runway, Apron, Taxiway	26	22	6	8	15	78
A12	Control Tower for Fua'amotu	18	14	6	6	17	62
A13	New Aircraft Hangar at Fua'amotu	12	8	4	3	17	45
	Multi-sector						
M2	Coastal Protection - Eastern Tongatapu	14	24	6	9	10	63
M3	Western Tongatapu Resilience	12	22	6	9	11	60
M4	Disaster Response and Evacuation Infrastructure	16	26	6	9	10	67
M5	Ha'apai Community Resilience	8	26	5	9	7	55

Note: scores for headline criteria are the weighted sum of sub-criteria scores (with each sub-criterion scored on a scale of 0 to 5).

Step 3: Selection of proposed projects for inclusion in the plan

The MCA provided a ranking of projects in relation to the strength of project benefits. Converting these rankings to the selection of proposed projects for inclusion in the five-year horizon for detailed investment planning in NIIP involved a consideration of the following factors:

- availability or potential availability of finance (see Annex F for details);
- implementation capacity, both in relation to the institutions responsible for the projects and those implementing projects (in particular the construction sector); and
- linkages among projects (there may be a case for advancing projects with lower rankings in the multi-criteria assessment, if they have important synergies with other projects).

Based on the MCA ranking and these considerations, projects were graded into three bands as *High*, *Medium*, or *Lower* priority. 13 projects were considered of highest priority (with a total capital cost of T$172 million). These projects have the highest MCA scores (score>60), and as a package, have a total investment cost that is considered feasible within current funding constraints. The other bands comprise 10 projects considered to be of medium priority (with a total capital cost of T$146 million), and nine projects of lower priority (with a total capital cost of T$74 million). The high priority projects should be the first considered in the NIIP investment plan for the period 2013/14 to 2017/18. The results of the project prioritisation process are shown in Table C.3.

Table C.3: Prioritisation of proposed projects

Ref.	Project	Capital cost (T$ million)	MCA score	Priority
T9	Fibre-Optic Cable to Ha'apai, Vava'u	30	80	High
A11	Resurfacing Ha'apai Runway, Apron, Taxiway	9	78	High
W3	Outer Islands Water Supply Improvements (Vava'u, Ha'apai, 'Eua)	15	73	High
P9	Maritime Sector Safety and Resilience	20	70	High
T10	Communications for Early Warning and Disaster Recovery	6	68	High
M4	Disaster Response and Evacuation Infrastructure	12	67	High
W4	Expand Nuku'alofa Water System to Growth Areas	11	66	High
S6	New Landfill or Transfer Station on Ha'apai	4	65	High
R10	Outer Islands Roads Upgrading Program	10	65	High
E16	Outer Islands On-Grid Renewable Energy Project	9	65	High
E11	Solar Generation (Tongatapu - Additional 1-2 MW)	24	64	High
M2	Coastal Protection - Eastern Tongatapu	15	63	High
A12	Control Tower for Fua'amotu	7	62	High
M3	Western Tongatapu Resilience	20	60	Medium
R11	Tongatapu Trunk Roads Program	16	60	Medium
P11	Upgrade of the Queen Salote Domestic Wharf	9	59	Medium
E19	Upgrade of Nuku'alofa Electricity Distribution Network	26	59	Medium
E9	Upgrade Bulk Fuel Facilities (Tank Farm, Bunkering)	30	58	Medium
P16	Nafanua ('Eua) Port Upgrade	3	58	Medium
A9	Expand Apron and New Taxiways at Fua'amotu	25	58	Medium
M5	Ha'apai Community Resilience	12	55	Medium
A7	Additional Fire Tender (Vava'u)	2	54	Medium
S1	Additional Capacity for Septage Treatment	3	54	Medium
S3	New Vava'u Semi-Aerobic Landfill Facility	5	53	Lower
E15	Biomass Generation ('Eua)	10	53	Lower
S2	WM Equipment Renewal Program	2	52	Lower
P17	Multi-purpose Barge	4	50	Lower
P10	Vuna Wharf Development (Stage 2 Marina)	23	50	Lower
W6	Water Softening for Nuku'alofa System	8	47	Lower
A13	New Aircraft Hangar at Fua'amotu	2	45	Lower
P12	Yellow Pier Upgrade	7	42	Lower
R9	Resealing of Tongatapu Airport Rd	11	42	Lower

The total investment cost over five years for projects underway and committed (T$173 million) and high priority proposed projects (T$172 million), together with the ongoing maintenance costs of these investments (T$14.0 million per year by the end of the first five years of NIIP2013 including those projects from NIIP2010 now operational, with T$3.3 million of this relating to new projects, see Annex E), is considered manageable. Implementation capacity, involving a mix of international and national contractors, is also considered adequate. Lastly, the review of linkages among projects did not identify any need to advance projects with lower rankings in the multi-criteria assessment, due to synergies with other projects.

The 13 high priority projects are presented by infrastructure sub-sector in Table C.4. All sub-sectors addressed by the NIIP process have at least one project included in the list of high priority projects. Notably, in comparison with NIIP2010, projects directed at the provision of services to outer islands are more strongly represented, as are projects supporting CCA and DRM.

Table C.4: High priority projects by sector

Sector	Project	Est. cost (T$ million)
Energy	Outer Islands On-grid Renewable Energy Project	9
	Solar Generation (Tongatapu - additional 1-2 MW)	24
Telecommunications	Fibre-optic Cable to Ha'apai, Vava'u	30
	Communications for Early Warning and Disaster Recovery	6
Water	Outer Islands Water Supply Improvements (Vava'u, Ha'apai, 'Eua)	15
	Expand Nuku'alofa Water System to Growth Areas	11
Solid waste	New Landfill or Transfer Station on Ha'apai	4
Roads	Outer Islands Roads Upgrading Program	10
Maritime	Maritime Sector Safety and Resilience Program	20
Aviation	Resurfacing Ha'apai Runway, Apron, Taxiway	9
	New Control Tower for Fua'amotu	7
Multi-sector	Disaster Response and Evacuation Infrastructure	12
	Coastal Protection – Eastern Tongatapu	15

Tables C.5 and C.6 respectively show the projects by sector that have been accorded medium and lower priority. Given constraints on funding and implementation capacity, it is unlikely that these projects can be implemented within the next five years. However, they can be retained for future consideration as the NIIP is rolled over in future years.

Table C.5: Medium priority projects by sector

Sector	Project	Est. cost (T$ million)
Energy	Upgrade of Nuku'alofa Electricity Distribution Network	26
	Upgrade Bulk Fuel Facilities (Tank Farm, Bunkering)	30
Solid waste	Additional Capacity for Septage treatment	3
Roads	Tongatapu Trunk Roads Program	16
Maritime	Upgrade of the Queen Salote Domestic Wharf	9
	Nafanua ('Eua) Port Upgrade	3
Aviation	Expand Apron and New Taxiways at Fua'amotu	25
	Additional Fire Tender (Vava'u)	2
Multi-sector	Western Tongatapu Resilience	20
	Ha'apai Community Resilience	12

Table C.6: Lower priority projects by sector

Sector	Project	Est. cost (T$ million)
Energy	Biomass Generation ('Eua)	10
Water	Water Softening for Nuku'alofa System	8
Solid waste	New Vava'u Semi-Aerobic Landfill Facility	5
	WM Equipment Renewal Program	2
Roads	Resealing of Tongatapu Airport Rd	12
Maritime	Multi-purpose Barge	5
	Vuna Wharf Development (Stage 2 Marina)	23
	Yellow Pier Upgrade	7
Aviation	New Aircraft Hangar at Fua'amotu	2

Annex D: Climate change adaptation and disaster risk management issues

Tonga is particularly vulnerable to natural disasters, the effects of climate variability, and long-term climate change.[1] Between 1991 and 2010, climate and non-climate related disasters in the form of cyclones, droughts, tsunamis, and storm surge cost Tonga an average of 1.18 per cent of GDP annually and affected thousands of households. Climate change is expected not only to exacerbate the frequency and/or intensity of extreme climate events in Tonga, but is projected to cause long-term, and in some cases irreversible, changes to climate. Disaster risk management (DRM) and climate change adaptation (CCA) actions have been identified by the Government of Tonga and development partners as critical elements of the country's future development strategy.[2]

Infrastructure development and maintenance activities, particularly activities related to the energy, telecommunications, water, waste management, and transport sectors covered by the NIIP, are also recognised as vital to the continued economic development of the country and the improved wellbeing of its population. Yet the infrastructure sector in Tonga has been identified as being particularly at risk from the effects of future climate change, including climate variability, extreme events, and non-climate related natural disasters.

The mainstreaming of DRM and CCA issues into the NIIP is timely both in a national and an international context. At the national level, the Government of Tonga has prepared and endorsed the *Joint National Action Plan on DRM and CCA for 2010 to 2015* (JNAP) that highlights priority actions for DRM and CCA over the next decade, including activities in the infrastructure sector. Information on future climate scenarios and natural disaster risks in Tonga has been refined, providing a clearer view of climate and natural disaster risks to infrastructure development and operation. In addition, development partners are initiating new operations for Tonga that address CCA issues in general and in the infrastructure sector. There is a window of opportunity to use this national-level momentum as a catalyst for integration of relevant DRM and CCA issues for the infrastructure sector into the NIIP.

At the international level there is a growing body of research into the effects of climate change and natural disasters on economic infrastructure, and into approaches to increase the resilience of infrastructure.[3] Increased understanding of the links between economic infrastructure, social well-being, and economic development, and of the economic benefits of proactive adaptation measures for infrastructure, have contributed to a growing interest in this issue. Sources of international CCA funding have also increased since the preparation of the NIIP2010 and may open up financing opportunities for Tonga in its quest to climate-proof its infrastructure. Another prospect is to ensure that the NIIP builds on international experience and best practice in terms of identifying cost-efficient and effective measures for enhanced climate resilience.

The overall objective of this Annex is to determine the risk posed to economic infrastructure in Tonga by climate change and natural disasters[4] and to integrate suitable measures to reduce that risk in the NIIP. The specific objectives are as follows:

- document the context within which NIIP updating is conducted, including the identification of a vision and a series of guiding principles and actions for the integration of DRM and CCA issues in the NIIP process; and
- document the outcomes of the integration of DRM and CCA issues in NIIP2013 including a discussion of the likely consequences of natural disasters and climate change on priority investments, and a discussion of the broad implications for the design, costing, maintenance, and financing of these investments.

[1] The *World Risk Report*, ranks Tonga as having the second highest risk globally to natural disaster risk based on consideration of exposure, susceptibility, coping capacity and adaptive capacity (United Nations University: Institute for Environment and Human Security, 2011); a Small States Secretariat analysis ranks Tonga third out of 111 countries in terms of vulnerability to climate change; whilst the Global Climate Risk Index ranks Tonga 19th out of 179 countries in terms of observed average annual losses as a percentage of GDP due to climate related disasters between 1991 and 2010, and 19th in terms of deaths per hundred thousand of population in this same period.

[2] Kingdom of Tonga, *National Strategic Planning Framework* (2010).

[3] See for example Department of Environment, Food and Rural Affairs (DEFRA), *Climate Resilient Infrastructure: Preparing for a Changing Climate* (2011); Royal Academy of Engineers, *Infrastructure Engineering and Climate Change Adaptation: Ensuring Services in an Uncertain Future* (2011); J Neumann, *Adaptation to Climate Change: Revisiting Infrastructure Norms* (2009).

[4] In the context of the analyses contained in this report, 'climate change and natural disasters' refers to current and future climate variability, longer term changes in mean climatic parameters, and non-climate related natural disasters, namely tsunamis and earthquakes.

D.1: Development of a framework for the integration of DRM and CCA issues in the NIIP

The development of a framework to guide the integration of DRM and CCA issues in the NIIP updating process was based on:

- a review of the way in which such issues were considered in the development and implementation of the NIIP2010; and
- a review of international best practice for the treatment of DRM and CCA issues in infrastructure planning and development.

NIIP2010 contain very limited reference to DRM or CCA issues. There are references to the multi-function role that some infrastructure can play in responding to natural disasters (e.g. the importance of AM radio communications for early warning systems (EWSs), or the dual use of roads for evacuation). However, the potential dual-use function of infrastructure is not carried forward into the analysis or development of priority projects. There is no explicit consideration of DRM or CCA issues in the multi-criteria analysis (MCA) that was used to prioritise projects. The climate change mitigation benefits of potential projects are considered in a qualitative manner in the MCA, but no link is made to CCA. Furthermore, NIIP2010 contains no explicit consideration of the risks to infrastructure or the ways in which infrastructure investments could be rendered more climate resilient.

NIIP2010 recognised that the JNAP preparation process was being conducted in parallel to its development and recommends that future revisions of the NIIP address DRM and CCA issues. It contains reference to an unidentified, un-costed climate change adaptation project to be implemented in the medium term, and envisages that future versions of the NIIP will include a priority theme related to DRM and CCA that will be closely aligned with the recommendations of the JNAP.

Discussions with Government stakeholders involved in the development and implementation of NIIP2010 revealed a generally high level of awareness of issues related to climate change and natural disasters, but a relatively low awareness of Government policy to address climate change, or of practical solutions to address climate change and natural disaster risks in infrastructure planning and development. In addition, the stakeholder consultation indicated that:

- there is no legal obligation for the treatment of climate and natural disaster risks in infrastructure development, and technical capacity to carry out such work was low within sector agencies and public enterprises;
- integration of measures into NIIP2010 projects was carried out on a case-by-case basis and was influenced by the skills of the implementing body, and in some cases, the requirements of donors or of international financial partners; and
- there is no clear framework or systematic approach for climate risk analysis or resilience building in the sector.

All stakeholders welcomed the opportunity to include DRM and CCA issues in the updating of the NIIP both as a means of identifying pragmatic and cost-effective measures to address climate change and natural disaster risks in the infrastructure, and as an important step in mainstreaming these issues into Government sector policy.

A framework for the integration of DRM and CCA aspects into the NIIP process, including a vision and a series of principles, was developed in consultation with stakeholders. The following vision statement was agreed upon:

> *"Infrastructure projects contained in the NIIP2013 have optimal levels of climate resilience, and where relevant have been developed to maximise their CCA and/or DRM function."*

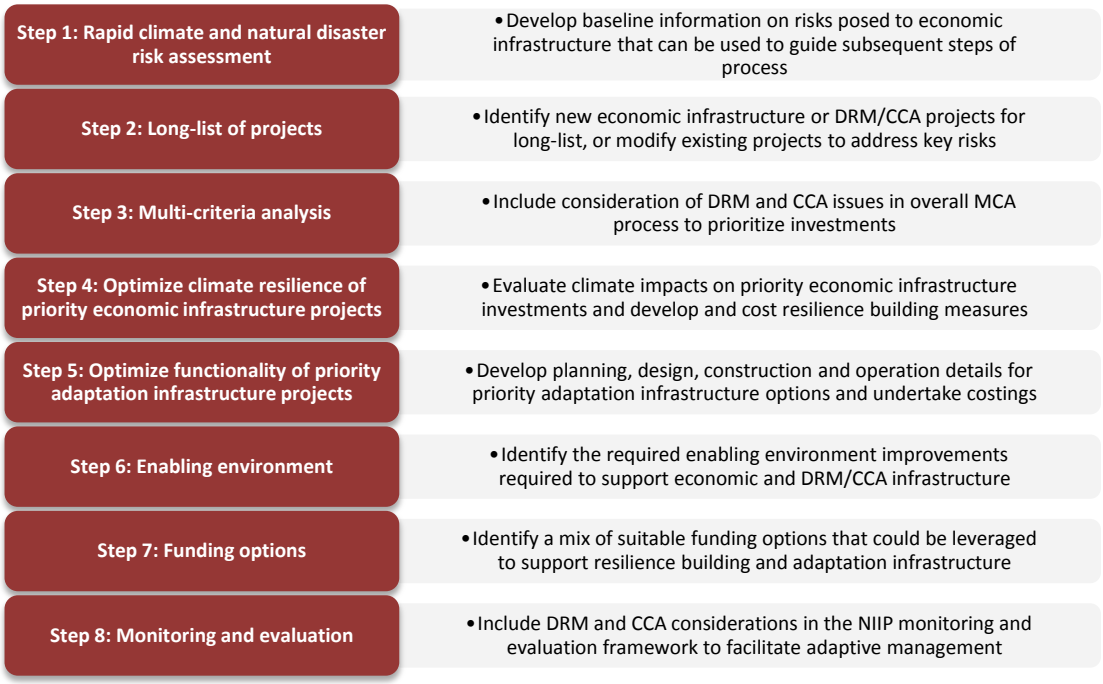
To achieve this vision, the following principles were then developed to guide the integration of DRM and CCA issues in the NIIP process:

1. Mainstreaming of DRM and CCA issues: DRM and CCA are mainstreamed throughout all stages of NIIP2013 development; this includes consideration of CCA/DRM issues in project identification and prioritisation, project development and costing, and monitoring and evaluation.

2. Short-term and long-term climate risks: consideration is given both to existing and short-term future climate risks, and, as relevant to the lifespan of infrastructure included in NIIP2013, future changes in the frequency and/or intensity of extreme events and long term changes in average climate.
3. Integration throughout infrastructure life-cycle: DRM and CCA issues are considered throughout the life-cycle of planned investments; i.e. throughout planning, design, construction, operation, maintenance, costing, and budgeting.
4. DRM and CCA enabling environment: actions to enhance the enabling environment for DRM and CCA are considered in line with infrastructure investments to ensure that the necessary 'software' is in place to maximise the effectiveness of investments.
5. Cost-effectiveness of actions: actions relating to DRM and CCA issues are based around a 'no-regrets' and 'low-regrets' approach to project identification to optimise cost effectiveness of future investments.
6. Adaptive management approach: the integration of DRM and CCA issues will be viewed as a flexible and ongoing process, subject to adaptive management principles; the results of monitoring and evaluation will allow future review and refinement of DRM and CCA issues in the future iterations of the NIIP.

The steps that were followed to integrate DRM and CCA issues in the updating process for the NIIP are illustrated below (Figure D.1).

Figure D.1: Actions to Integrate DRM and CCA issues in NIIP2013



D.2: Analysis of the vulnerability of economic infrastructure to climate change and natural disasters

This section contains a preliminary analysis of the vulnerability of economic infrastructure in Tonga to climate and natural disasters. Vulnerability is defined as the degree to which a system is susceptible to, and unable to cope with, the adverse effects of climate variability, long-term climate change, and/or natural disasters.[5] Vulnerability is taken to be a function of geographical exposure to changes in climate (including climate variability) or natural disasters, the degree and severity of the impacts caused, and the prevailing degree of resilience or adaptive capacity that allows systems to respond to and absorb the impacts of climate change, including climate variability and natural disasters.

The largely qualitative climate vulnerability assessment presented in this section is based on a desktop review of existing information sources and discussions with Government and development partner counterparts in Tonga and the Pacific region. It is based on:

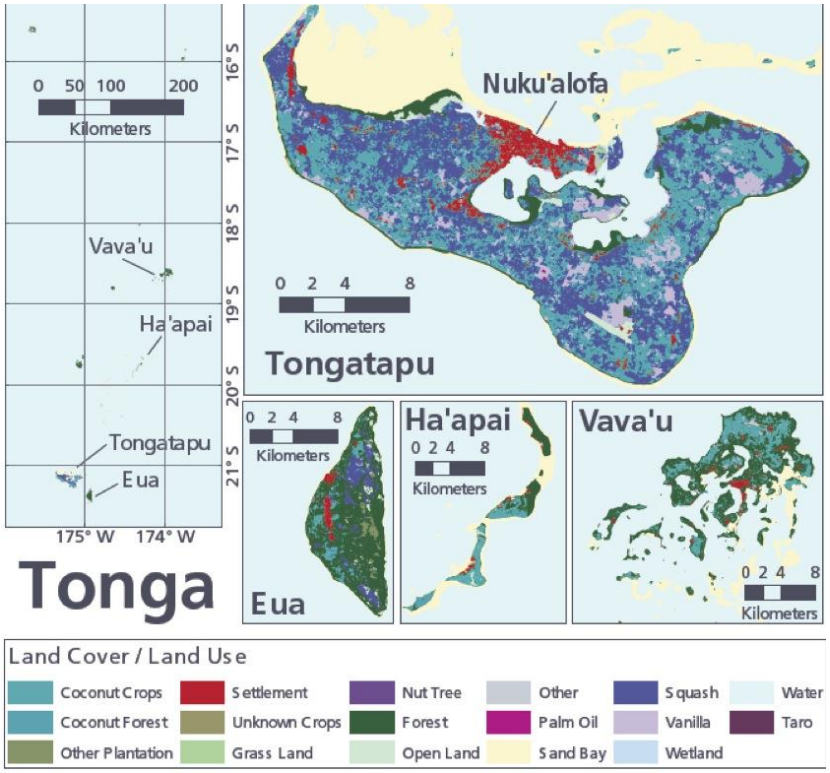
[5] Based on the widely accepted definition adopted by the Intergovernmental Panel on Climate Change (2007).

- the preparation of a climate and natural disaster profile for Tonga that documents current knowledge of the current and projected future exposure to climate change and natural disasters (specifically earthquakes and tsunamis);
- the preparation of a rapid risk assessment for economic infrastructure including preparation of climate and natural disaster risk assessments for each economic infrastructure sector, and consideration of broad spatial patterns of risk; and
- an analysis of the key features of the country's and the sector's enabling environment for DRM and CCA that determines the institutional adaptive capacity.

Climate and natural disaster profile

This section provides an overview of the current climate and recent observed trends in climate in terms of average terrestrial and marine parameters (rainfall, temperature, sea level, sea surface temperature, and ocean acidifications), as well as extreme climate events (drought, cyclones, and storm surge). Figure D.2 shows the configuration of islands and land use in Tonga.

Figure D.2: Land use in Tonga



Source: Pacific Catastrophe Risk Assessment and Financing Initiative, 2011.

Located in the western South Pacific Ocean, Tonga has a typically tropical climate. There is a marked wet season between November and April, when two-thirds of annual rainfall occurs. The remaining rainfall is experienced in the dry season between May and October. Average annual rainfall varies across the country; figures are higher in Niua Fo'ou (2453mm/year), Niua Toputapu (2374mm/year), and Vava'u (2150 mm/year), than in Tongatapu (1721mm/year) and Ha'apai (1619 mm/year). Inter-annual rainfall variability is high and during the wettest years, total annual rainfall can be three times higher than during the driest years. The El Niño Southern Oscillation (ENSO) is a major influence on inter-annual rainfall variability. Trends in annual rainfall for the period 1950 to 2009 are not statistically significant.

Seasonal changes in air temperature result from the location of Tonga close to the sub-tropics, with sea surface temperature (SST) of surrounding waters exerting an influence on seasonal variations. Average annual air temperatures vary from 27˚C at Niua Fo'ou and Niua Toputapu, to 24˚C on Tongatapu. During the wet season, air temperature is generally higher than during the dry season and diurnal and seasonal variations can reach as high as 6°C throughout the country. Increases in air temperature (warming trends) have been observed for annual and

seasonal mean air temperatures in Nuku'alofa for the period from 1950 to 2009, with the strongest trends of 0.16°C/decade recorded in the wet season. Data from 1970 to 2009 indicate warming trends of 0.4 to 0.9˚C in annual mean temperature in Ha'apai, Vava'u and Niua Toputapu.

Sea level trend data indicate rising sea levels of approximately 6mm/year since 1993; this equates to a cumulative sea level rise (SLR) of approximately 114mm in this 19-year period. The rate of sea level rise experienced is greater than the global average of 3.2 ± 0.4 mm/year. SLR is associated with coastal erosion and can increase the magnitude of storm surge as it provides a higher 'starting point' for wave action. Coastal erosion is being experienced along much of the northern coastline of Tongatapu, and along the coastline of Lifuka Island in Ha'apai.

SST data indicates that warming has been experienced at the rate of approximately 0.06°C per decade since 1970. However, at the regional scales in which the models operate, natural variability certainly plays a large role and it is difficult to identify long-term trends. SST is of concern because it plays a role in coral bleaching events: the last major coral bleaching event in the waters surrounding Tonga was in 2000. Anecdotal evidence indicates that smaller-scale coral bleaching events have become more frequent in recent years.

Ocean acidification, which is driven by the absorption of carbon dioxide (CO_2) in seawater and measured in terms of the aragonite saturation state (Ω_{ar}), is an important influence on coral growth and the development of healthy reef ecosystems. In the Tongan region, the aragonite saturation state declined from around Ω_{ar} = 4.5 in the late 18th century, to Ω_{ar} = 4.0 ± 0.1 by 2000, indicating increased seawater acidity.

On average, Tonga experiences 17 tropical cyclones per decade with most occurring in the wet season between November and April. Tropical cyclones exhibit high inter-annual variability ranging from zero some years to five cyclones per year in other years. Tropical cyclone incidence is highest in ENSO years. This high inter-annual variability makes it difficult to identify long term trends in cyclone frequency, however there is some evidence that decadal frequency is increasing with seven cyclones experienced in the 1960s, compared to 15 in the 1990s. Storm surge and extreme sea level events are most commonly associated with named tropical cyclones.

Droughts in Tonga are linked to low rainfall during ENSO periods. The last three major drought events were in 1983, 1998, and 2006. During these droughts, annual rainfall measured from 70-142mm/year, more than ten times less than average annual rainfall in non-drought periods.

Projected future climate conditions

Information on climate projections for Tonga has been drawn from recent analyses undertaken by the Pacific Climate Change Science Program (PCCSP) and is based on the outputs of 18 global circulation models (GCM) for three emissions scenarios.[6] The projections discussed in this section are drawn from global level models and as such refer to average change over the broad geographic region of Tonga, including the islands and surrounding ocean.

The 'most likely climate future' for Tonga as described by the PCCSP is for warmer conditions with little change in rainfall. Intra-annual rainfall variability is expected to change with wet season rainfall expected to increase and dry season rainfall expected to decrease, but with an overall net effect of little change in total annual rainfall. The intensity and frequency of extreme rainfall days is projected to increase. Changes in inter-annual rainfall are strongly influenced by ENSO conditions and because there is no consensus view of the likely evolution of ENSO under climate change scenarios, it is not possible to develop projections for changes in inter-annual rainfall variability.

Air temperature in Tonga is expected to continue to increase. An increase of <1°C is projected by 2030, with increases of up to 2.5°C projected by 2090. The intensity and frequency of extreme hot days is projected to increase. For example, a maximum daily air temperature of at least 32.5°C currently has a return period of 200 years, but by 2050, it is projected that this return period will decrease to 35 years.[7]

Increases in mean sea levels are expected to continue. The analyses carried out by PCCSP project a SLR of 50-150mm by 2030, and 200-600mm by 2090. Climate change is also expected to have a significant effect on the return periods of extreme high sea levels that persist for at least an hour and which can cause coastal flooding, accelerated coastal

[6] Scenarios used are drawn from the Intergovernmental Panel on Climate Change (2007) and are B1 – a low emissions scenario, A1B – a medium emissions scenario, and A2 – a high emissions scenario; the corresponding timeframes are three twenty-year periods centred on 2030, 2055 and 2090 relative to 1990.

[7] John E Hay & Associates, *Mainstreaming Environmental Considerations in Economic and Development Planning Processes in Selected Pacific Developing Member Countries: Climate Risk Profile for Tonga,* Asian Development Bank Technical Assistance Consultants Report (2008).

erosion, and saline intrusion into groundwater (see Table D.1). An hourly sea level of 2.2m currently has a return period of 579 years; by 2050, it is projected that this return period will decrease to 1.5 years.

Table D.1: Return Periods for hourly sea level at Nuku'alofa

Hourly Sea Level (m)	Observed Return Period (Years)	Projected Return Period in 2050 (Years)
1.9	3.3	1.0
2.0	17	1.0
2.1	98	1.0
2.2	579	1.5
2.3	>1000	5.1
2.4	>1000	24
2.5	>1000	122

Source: John E Hay & Associates, 2008.

Table D.2 provides an estimate of the population and land area that could be affected by SLR scenarios of 0.3m and 1.0m, with and without storm surge, and highlights the negative synergies projected to occur between SLR and storm surge. Table D.2 indicates that with a SLR of 0.3m (a scenario in the middle of the projected range), 14 per cent of the population and nearly four per cent of the land area of Tongatapu could be inundated. If the same SLR scenario occurred simultaneously with a storm surge equivalent to that recorded in 1983, over one third of the population and over 10 per cent of the land area of Tongatapu could be affected by periodic inundation. Ha'apai, a group of 43 low elevation (≈ 1.0m ASL) coral islands, is likely to be significantly affected by SLR.

Table D.2: Estimates of population and land area affected by SLR in Tongatapu

	No storm surge		With storm surge (2.8m based on historic records)		
	SLR = 0.3m	**SLR = 1.0m**	**No SLR**	**SLR = 0.3m**	**SLR = 1.0m**
Population affected	3,000 (4.3%)	10,000 (14.2%)	22,000 (31%)	27,000 (37%)	33,000 (46%)
Land area affected	3.1 km^2 (1.1%)	10.3 km^2 (3.9%)	n.a.	27.9km^2 (11%)	37.3km^2 (14%)

Source: Adapted from Mimura, 1999; population estimates have been updated to reflect 2006 census data.

SST is expected to continue to increase at a rate that is comparable with (or slightly weaker) than air temperature increase. By 2050, the return period of a maximum water temperature event of 31°C is projected to have decreased to once every five years, compared to the current period of once every 33 years. Ocean acidification is also expected to continue to increase with aragonite saturation state values projected to reach Ω_{ar} = 3.5 by 2035, and continue to decline thereafter.

Little change in the frequency of drought events is projected. Mild droughts are expected to occur between six and nine times in a twenty year period, while moderate and severe droughts are projected to occur once to twice or once every twenty years respectively.

Forecasts in relation to cyclone frequency and intensity are inconclusive. In the southeast Pacific Basin (0 - 40°S, 170°E - 130°W) where Tonga is located, the frequency of tropical cyclones is expected to decrease. These projections are at a large scale and it is difficult to draw conclusions for Tonga, particularly in light of the prevailing high inter-annual frequency of cyclones. The intensity of cyclones may increase (i.e. an increase in the proportion of the most severe cyclones). Most models indicate a reduction in tropical cyclone wind hazards north of the 20°S latitude and an increase in hazard south of this latitude. Tonga is traversed by the 20°S latitude and thus national level projections are again difficult to develop. There is some evidence that the frequency of extreme wind gusts (often associated with cyclones) could increase. For example, a maximum daily wind gust of at least 65m/s is currently a one in 100 year event; by 2050, it is projected that a wind gust of this magnitude will become a one in 50 year event.[8]

[8] John E Hay & Associates, *Climate Risk Profile for Tonga.*

Table D.3 presents a summary of the future climate scenarios projected for Tonga in terms of likely outcomes, as well as in terms of the level of confidence of outcomes, which is effectively a measure of the degree to which the different GCMs agree on an outcome.

Table D.3: Summary of future climate projections for Tonga

Climate Parameter	Projected Outcomes		Confidence Level	
	…direction of trend	*…degree of change*[9]	*…direction of trend*	*…degree of change*
Annual average air temperature	Continued increase	0.6°C in 2030 to 2.6°C in 2090	Very high	Moderate
Total annual rainfall	Little change	1% increase in 2030 to 9% increase in 2090	Low	Low
Wet season rainfall	Increase	2% increase in 2030 to 16% increase in 2090	Moderate	Moderate
Dry season rainfall	Decrease	1% increase in 2030 to 3% decrease in 2090	Moderate	Low
Sea level	Continued increase	5 -15 cm increase in 2030 to 20 - 60 cm increase in 2090	Very high	Moderate
Annual average SST	Continued increase	0.6°C in 2030 to 2.4°C in 2090	Very high	Moderate
Annual maximum aragonite saturation state	Continued increase	3.4Ω_{ar} in 2030 to 2.4Ω_{ar} in 2090	Very high	Moderate
Cyclone frequency	Decline	Not available	Moderate	Not available
Cyclone intensity	Increase	Not available	Not stated	Not stated
Mild drought frequency	Little change	7 - 9 times / 20 year period	Low	Low
Moderate drought frequency	Little change	1 – 2 times / 20 year period	Low	Low
Severe drought frequency	Little change	1 time / 20 year period	Low	Low

Source: Adapted from Pacific Climate Change Science Program, 2011.

Natural disasters: tsunamis and earthquakes

Tonga is located along one segment of the Pacific Ring of Fire in the Pacific Ocean where the Indo-Australian and Pacific tectonic plates meet. This area is an extremely active seismic zone with the potential to generate major tsunamis. Earthquakes occur regularly in the Tonga region. In the last decade, over 900 events with a magnitude greater than 5.0 on the Richter scale (defined as moderate earthquakes) have been recorded within a radius of 500km from Nuku'alofa.[10]

Since the beginning of the 19th century, 21 small tsunami events (< 1.0m) have affected Tonga and in 1919 a tsunami with wave heights of more than 2.5m affected Ha'apai. In 2009, two consecutive earthquake events caused a major tsunami event that affected the north of Tonga.

Preliminary tsunami inundation modelling for Tongatapu indicates that the northern coast of the island is particularly susceptible to tsunami events generated by earthquakes. The modelling indicates that the channelling effects of the nearby coral reefs could cause the most significant inundation effects in the Nuku'alofa urban area with the projected impacts greatest at the eastern extreme of this area.[11] Furthermore, earthquake and tsunami loss (from one or multiple events in a calendar year) exceeding T$270 million and causing up to 575 casualties is to be expected, on average, once every 100 years in Tonga.[12]

[9] The 'degree of change' presented in Table 2.1 provides a range from the lowest to the highest projected value across all models and all across all timeframes.

[10] US Geological Service Earthquake Database, http://neic.usgs.gov (accessed 21 November 2012).

[11] The modelling and the associated tsunami evacuation plan is being carried out by the MLECCNR in collaboration with the NEMO, and with the support of SOPAC. At the time of writing the modelling results and mapping had not been finalized and could thus not be included in the report. Information presented above is based on discussions with officers from MLECCR and NEMO. It is proposed to carry out a similar modelling exercise for Ha'apai in the near future.

[12] Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), *Country Risk Profile for Tonga* (2011).

Past climate and natural disaster impacts on infrastructure

A review of published data and consultation with stakeholders has been used to document information of the impacts of past and current climate change and natural disasters on infrastructure in Tonga. This information has been used to inform the rapid risk assessment carried out in the following sections.

TROPICAL CYCLONES

Since 1960, over 60 storms and cyclones have affected Tonga. Between 1900 and 2012, eleven major tropical cyclones struck Tonga, affecting more than 190,000 people and causing a combined damage costing upwards of T$140 million.[13] Tropical Cyclone Waka in 2002 was the most damaging of these major cyclones in economic terms and caused estimated T$89 million in damage, and affected 60 per cent of the housing stock, 25 schools, and infrastructure in the water supply, energy, telecommunications, and marine transport sectors. Tropical Cyclone Rene in 2010 caused damage in the infrastructure sector alone in the order of T$19 million, including damage to housing, tourism infrastructure, and roads and causeways. Damage included collapse or partial damage to houses, blockage of Nafanua Harbor in Eua, partial causeway failure, and blockage of roads by debris.[14]

STORM SURGE

Storm surge is most often linked with tropical cyclone activity. The most severe recorded storm surge occurred during Cyclone Isaac in 1983 where a storm surge of about 1.6m acted on top of a high spring tide causing major flooding on Tongatapu and major damage to residential dwellings. During Tropical Cyclone Eseta in 2003, storm surge caused major damage to tourism infrastructure in Ha'atafu, Kolovai, and Fo'ui on Tongatapu, and forced the closure of Nafanua Harbor in Eua for two weeks. Storm surge has damaged seawall infrastructure on the north-eastern coast of Tongatapu and worsened coastal erosion along unprotected sections of coast on Tongatapu and Ha'apai. Storm surge causes saline infiltration of groundwater supplies in the northern coastal areas of Tongatapu and the western coast of Lifuka Island. The current road configuration along the north-eastern coast of Tongatapu lacks adequate drainage structures and in the event of overtopping of the road, seawater ponds on the land side of the road and must be pumped or evaporate.

SEA LEVEL RISE AND COASTAL EROSION

With infrastructure concentrated in the coastal zone and low elevation, much of the infrastructure stock on the northern coast of Tongatapu is vulnerable to sea level rise and coastal erosion. Coastal villages in the Nuku'alofa area including Popua, Tukutonga, and also the small islands of Nukunukumotu, are currently affected by flooding and sea level rise particularly during spring tides. Much of the north-eastern coastline of Tongatapu, from Niutoua to Nukuleka villages, and the north western coastline is eroding and undermining road infrastructure. Ha'apai is the most affected of the outer island groups due to the low elevation of its many islands. There is already evidence of significant coastal erosion on the western coast Lifuka Island, the largest and most populated island in Ha'apai. Prevailing erosion rates in this location are estimated at ≈1.3m/year. The telecommunications tower on Lifuka Island has been decommissioned due to risks posed by coastal erosion, and the hospital is located within several metres of the eroded shoreline.

FLOODING

Flooding in Tonga is uncommon but when it occurs, prolonged heavy rain, storm tides, and heavy wave action are its primary causes.[15] Flooding is most common during the wet season (November-April) and is mostly associated with the passage of a tropical cyclone or storm. Periods of abnormally high rainfall persisting for more than three months are rare. The areas mainly affected are the coastal low-lying areas including the northern coastal zone of Tongatapu and the Ha'apai group of islands. These low-lying areas are subject to the ponding of water, flooding of homes and commercial buildings, and blockage of road infrastructure. The water usually dissipates within 48-72 hours once the rain ceases. Rainfall induced flooding is not considered to be a high risk as the land mass is relatively small with low topography, and the soils for the most part are relatively free draining. Cyclone Jasmine in February 2012 brought significant rainfall and flooding to Tongatapu.

DROUGHTS

During the 1997/1998 drought event, water supplies on islands in the Ha'apai group were severely affected and drinking water had to be shipped to residents.

[13] EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be, Université Catholique de Louvain, Brussels (Belgium). Major tropical cyclones recorded in the database include those that killed 10 or more people, or affected 100 or more people, or triggered declaration of a station of emergency or a call for international assistance.

[14] National Emergency Management Office, *Revised Initial Damage Assessment Report of the National Emergency Operations Committee on Tropical Cyclone Rene* (2010).

[15] Tonga Meteorological Service, *Climate Summary of Tonga* (2006).

TSUNAMIS AND EARTHQUAKES

Tsunamis and earthquakes since 1900 have historically caused less damage than cyclones when measured in economic terms. Such events caused T$18.8 million in damages over this period, compared to T$142.3 million for cyclones.[16] However, tsunamis and earthquakes have the potential to cause more significant damage to infrastructure per event than cyclones.[17] In 2009, two successive earthquakes measuring 8.1 and 8.0 on the Richter scale caused a tsunami that killed nine people, inundated 55 per cent of the total land area, and destroyed roughly half the housing stock on the northern island of Niua Toputapu as well as the island's hospital.[18] In 1977 an earthquake with a magnitude of 7.2 on the Richter scale caused considerable damage to infrastructure in the south of the country; and in 2006 an event measuring 7.9 on the Richter scale caused damage to the hospital and wharf in Ha'apai. This event is thought to have caused a subsidence of ≈ 23cm on the western side of Lifuka Island, thereby increasing the relative sea level.[19]

Future climate and natural disaster risks for economic infrastructure

A qualitative rapid risk assessment (RRA) was undertaken to provide a preliminary evaluation of the relative climate and natural disaster risks across different types of economic infrastructure in both the short term (0 – 10 years) and the long term (10 – 50 years). The main steps in the RRA were as follows:

- The development of a long-list of the potential primary (direct) and secondary (follow-on or indirect) impacts on economic infrastructure in Tonga based on observations of past and current impacts, a literature review, stakeholder consultation, and international experience.
- The identification of a short-list of the highest risk primary impacts due to: (a) the likelihood of the climate or natural disaster manifestation occurring in the short-term (0 – 10 years) and the long term (10 to 50 years); and (b) the possible severity of the impact based on a consideration of the depth and (temporal and spatial) extent of impact, including the risk of the impact causing cascade failure of other infrastructure types.
- 'Ground-truthing' and ranking relative RRA scores to allow for the development of RRAs for each economic infrastructure sector.

Table D.4: Long-List of potential primary and secondary impacts by infrastructure sector

Infrastructure Sector	Climate Change Manifestations	Potential Primary Impacts	Potential Secondary Impacts
Energy (generation and transmission)	Cyclone / storm frequency or intensity Sea level rise Rainfall intensity Extreme heat Drought	Wind induced damage Flooding / coastal erosion Changes to water table or soil moisture leading to foundation or sub-structure failure Corrosion from salt aerosol deposits	Increased maintenance and repair costs Electricity outages leading to disruption to economic activity / provision of social services Increased demand with system capacity exceeded Accelerated deterioration of assets Increased cost of electricity Pollutant escape leading to soil and water pollution
Communications	Cyclone / storm frequency or intensity Drought Rainfall intensity	Wind induced damage Changes to water table or soil moisture leading to foundation or sub-structure failure	Increased maintenance and repair costs Communications outages leading to disruption to economic activity / provision of social services Accelerated deterioration of assets Increased cost of telecommunications

[16] *Emergency Events Database,* www.emdat.be.
[17] Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI), *Country Risk Profile for Tonga.*
[18] Ministry of Lands, Survey and Natural Resources (MLSNR), *Pacific IWRM Project Results Note: Improvement and Sustainable Management of Neiafu, Vava'su's Groundwater Resource* (2009).
[19] Secretariat of the Pacific Community, 'Lifuka Island Tonga at the forefront in understanding climate change impacts on small islands," (16 March 2012), http://www.spc.int/en/component/content/article/216-about-spc-news/869-lifuka-island-tonga-at-the-forefront-in-understanding-climate-change-impacts-on-small-islands.html.

Infrastructure Sector	Climate Change Manifestations	Potential Primary Impacts	Potential Secondary Impacts
Water supply and treatment (rainwater harvesting and groundwater supplies)	Cyclone / storm frequency or intensity Drought Extreme heat Rainfall intensity Sea level rise	Wind induced damage Inadequate rainfall or recharge of groundwater Design capacity exceeded leading to failure Increased salinity of groundwater Increased evaporation from storage Design capacity exceeded leading to failure Changes to water table or soil moisture leading to foundation or sub-structure failure Flooding and pollution of water supply Corrosion of pipelines due to saltwater intrusion	Decreased water quality Decreased water quantity and availability Increased maintenance and repair costs Increased costs for alternative means of water supply Accelerated deterioration of assets Increased cost of water supply Health impacts Outages to water supply leading to disruption to economic activity and provision of social services
Wastewater management	Cyclone / storm frequency or intensity Rainfall intensity Sea level rise Higher temperatures Drought	Wind induced damage Flooding and pollution of water supply Design capacity exceeded leading to failure Changes to biological treatment parameters Changes to water table or soil moisture leading to foundation or sub-structure failure	Increased maintenance and repair costs Increased costs for alternative means of water supply Accelerated deterioration of assets Increased cost of wastewater treatment Marine ecosystem effects of water pollution (social, economic, and ecological)
Solid waste management	Rainfall intensity Sea level rise Drought Higher temperatures	Flooding leading to leachate escape and pollution Changes to water table or soil moisture leading to foundation, liner or sub-structure failure Coastal erosion Breaching of close and/or rehabilitated landfill sites Increased rate of vermin reproduction	Increased maintenance and repair costs Accelerated deterioration of assets Water and land pollution effects on surrounding land use, marine ecosystems, and public health
Transport (ports, road and air transport)	Cyclone / storm frequency or intensity Sea level rise Ocean acidification Rainfall intensity Drought	Wind or wave damage from cyclones or storm surge Deterioration/corrosion of underwater concrete structures from wave action chemical action Blockages of shipping lanes due to increased siltation Flooding induced damage to pavement, embankments and drainage structures Wind or water flow induced damage to bridges or culverts Coastal erosion Changes to water table or soil moisture leading to foundation or sub-structure failure	Increased maintenance and repair costs Accelerated deterioration of assets Increased frequency of closures / disruptions to service leading to disruption to economic activity and accessibility to social services

The RRA indicates that in the short-term cyclones and storm surge are potentially the most damaging climate manifestations across all economic infrastructure sectors (Figure D.3). The risks are greatest in the energy and ports sectors, with fuel storage facilities, overhead transmission lines and outer island ports infrastructure particularly at risk. In the long-term, cyclones and storm surge remain the most potentially damaging events, but tsunami and earthquake damage are also identified as events with potentially high risk for economic infrastructure. These latter events have a lower likelihood of occurring but could cause severe impacts (Figure D.4). The risks remain highest in the energy and ports sectors, and for overhead transmission lines, energy generation infrastructure, fuel storage, and outer island port infrastructure.

Sea level rise, although having a high likelihood of occurring in the future, is considered to be of lower risk than cyclones, storm surge and non-climate related natural disasters in both the short and long term. The relatively gradual and predictable nature of this climate manifestation will allow the severity of impacts to be progressively managed. The sector-level risks associated with the remaining identified climate manifestations, increased rainfall intensity, drought, higher air temperatures and ocean acidification, are considered likely to be lower in both the short and long term.

Figure D.3: Relative climate and natural disaster risk by sector and event type (short-term: 0 – 10 years)

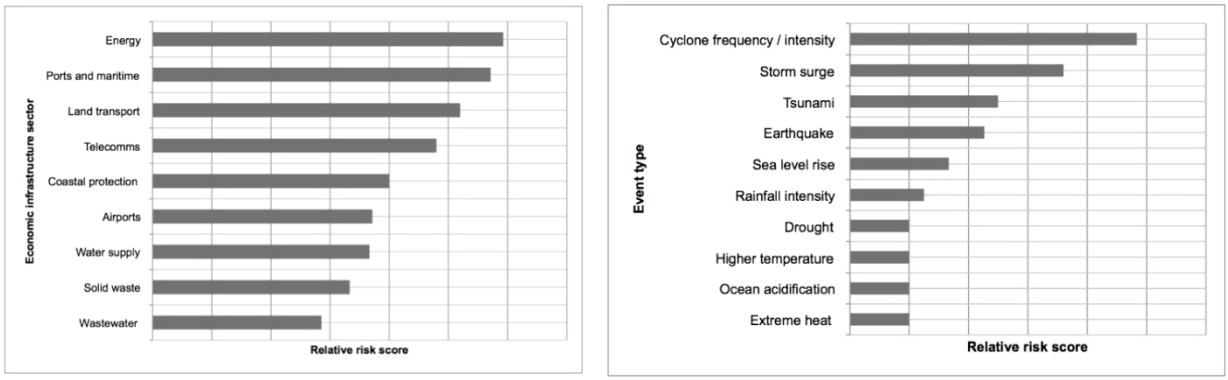
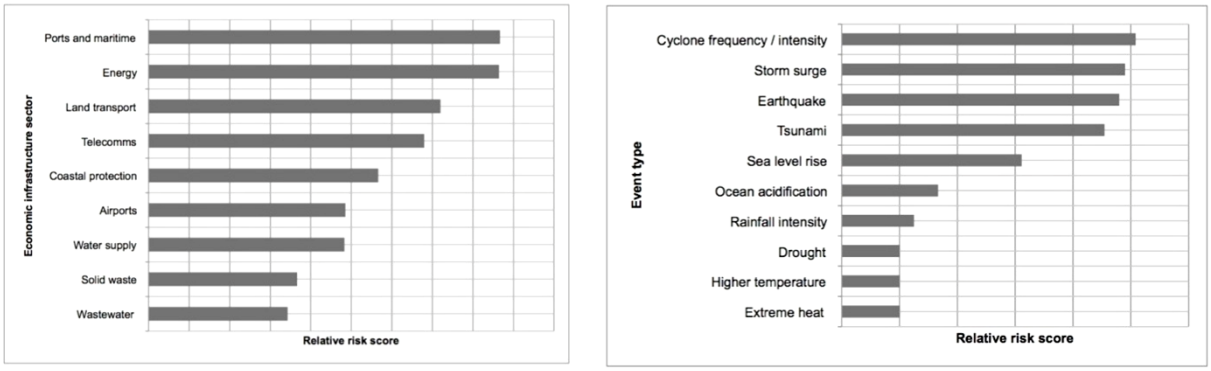


Figure D.4: Relative climate and natural disaster risk by sector and event type (long-term: 10 – 50 years)



Risk assessment by economic infrastructure sector

ENERGY

The energy infrastructure sector is considered to be at high risk in both the short and long term from climate change and natural disasters. The risk assessment of energy infrastructure was based on an evaluation of the effects of climate change and natural disasters on the central fuel storage facilities in Tongatapu; electricity generation infrastructure, namely the Tonga Power Board (TWB) managed diesel generation plants in Tongatapu, the solar power generation farm in Tongatapu that provides approximately four per cent of the national grid, and outer islands diesel generating plants; and overhead energy transmission lines. Wind and wave induced damage to the central fuel storage, overhead transmission lines, and diesel and solar power facilities during storm or cyclone events have been identified as the most potentially damaging impact in the short-term. In the long-term, storm surge induced flooding and structural damage to the central fuel storage, generation facilities and tsunami and earthquake induced structural damage of all energy infrastructure have been identified as additional high level risks. The Tongatapu central fuel storage is consistently ranked as a high risk in both the short and long term due to its proximity to the shoreline (≈ 50m).

The severity of impacts in this sector is heightened by the fact that failures of the energy generation or transmission network have a high probability of causing cascade failures in other infrastructure sectors that rely on a secure energy source, for example water supply, air transports, and communications.

PORTS

Infrastructure in the ports sector is considered to be at high risk from climate change and natural disasters in both the short and long term. Port infrastructure on Tongatapu and outer islands ports were considered in the risk assessment. Wind and wave induced damage from cyclones and/or storm surge to outer islands ports was considered to be the highest risk impact in the short-term, followed by wave or wind damage to port infrastructure on Tongatapu. The lower risk can be explained by the higher design and construction standards of the port infrastructure in Tongatapu compared to the outer islands. An assessment of risks for the long-term concluded that in addition to those risks identified for the short-term, tsunami or earthquake damage to port infrastructure throughout the country would be a high risk. In both the short term and long term, wave action or intense rainfall leading to blockage of navigation channels was identified as a medium-level risk for port infrastructure throughout the country.

Risks in this sector are exacerbated by the potential for adverse effects on movements of freight and passengers if infrastructure is non-operational. Ocean transport is the main means of carriage between islands. Damage to infrastructure that reduces accessibility would have a range of economic and social implications such as disruptions to economic activity, reduced access to social services, and could hamper natural disaster response efforts.

LAND TRANSPORT

At a sector level, land transport infrastructure, notably roads, is considered to be at medium-to-high risk from climate change and natural disasters in both the short and long term. The highest levels of risk are confined to those sections of the network located in low-lying and/or coastal zones. Flooding and associated damage to pavements and drainage structures on low-lying coastal roads as a result of storm surge or wave action during cyclones is considered to be the most potentially damaging; these not only cause flooding and damage to infrastructure, but create obstacles to the evacuation of affected populations and the planning and implementation of disaster responses. Coastal erosion from rises in sea level, which is already evident along unprotected sections of low-elevation roads such as those running from Fo'ui to Ahau and from Nukuleka to Manuka on Tongatapu, is also considered to be a high risk to infrastructure in affected locations. As noted, the gradual and relatively predictable nature of this impact limits its overall risk rating. The lower risk rating for this sector compared to the energy and ports infrastructure sector reflects the fact that the entire network would not face the same level of risk, and the lesser duration of impacts linked to flooding or overtopping of road infrastructure.

TELECOMMUNICATIONS

Telecommunications infrastructure, in the form of telephone and radio communications towers and fibre optic cabling, is at medium risk from climate change and natural disasters. Wind induced damage during cyclones is expected to be the most potentially damaging impact. At a network level, the relatively dispersed nature of infrastructure and its relatively young age contributes to the overall risk rating. However, certain pieces of infrastructure, notably communications infrastructure linked to disaster warnings and the coordination of response efforts and communications infrastructure on outer islands is individually at high risk. Fibre optic cabling is at low risk in locations where it is underground, although any sections to be installed above ground would have a high risk rating comparable to that of overhead energy transmission lines.

COASTAL PROTECTION

For the purposes of this analysis, coastal protection infrastructure includes seawalls or other types of foreshore protection. Such infrastructure is considered to be at medium risk from climate change and natural disasters in both the short and long term. This risk rating is largely influenced by the potential impacts of wave and wind induced damage to foreshore protection infrastructure during cyclones or storm surge. The temporary or permanent failure of such infrastructure could produce adverse effects on other infrastructure types including roads and groundwater supply in the outer islands. The risk is higher in the long term due to the higher likelihood of intense cyclone events, storm surge, and tsunamis.

AIRPORTS

Airport infrastructure, including runways, control towers, meteorological equipment, and related infrastructure, is considered to be at low-to-medium risk from climate change and natural disasters. The main national airport is located on relatively high elevation land (+38m ASL) in the south-eastern part of Tongatapu. The main risk to airport infrastructure is associated with wind damage to the control tower and meteorological equipment and office buildings during a cyclone event. The risk is exacerbated by the important role that this infrastructure could play in the event of a natural disaster by allowing international air access to Tonga, and by providing meteorological information to inform disaster response efforts.

WATER SUPPLY

The overall sector level risk for water supply infrastructure is low-to-medium in the short and long term. This risk rating is highly influenced by the inland location of the major groundwater well-field in Tongatapu and its location on high elevation land in Tongatapu. In its current configuration, it is unlikely that this water supply that services the majority of the Tongan population would b be affected by saline intrusion due to sea level rise, or wave action during cyclones or storm surge. However, the lower sector level risk assessment for water supply infrastructure masks potentially significant local risks to groundwater supplies on outer islands, or in coastal areas in Tongatapu or Lifuka Island. Sea level risk and heightened storm surge activity would present a high risk to the viability of these water supplies.

SOLID WASTE AND WASTEWATER

The overall sector level risk for waste management, including both solid and liquid waste, is low-to-medium. The solid waste facility in Tongatapu has recently been constructed inland at a relatively elevated location on Tongatapu, and is an engineered facility. There is a minimal risk of damage from climate change or natural disasters other than temporary flooding from increased rainfall intensity, or a low risk of damage from earthquake. The former landfill site in Tongatapu is located in the low-lying coastal zone and the site was rehabilitated in 2007. Given the location of this facility, and the fact that it was un-engineered (i.e. without lining or other protection measures), it would have been at high risk of adverse impacts from flooding due to storm surge, tsunami, or increased rainfall intensity. However, given the extensive rehabilitation work and ongoing groundwater and leachate monitoring, the risk of breaching of this site is low.

Wastewater collection and treatment throughout Tonga is by way of septic tanks. In coastal areas there is a risk that the infiltration of septic tanks by rainfall or seawater could occur; however, such impacts would be confined to the coastal zone and would not increase the sector level risk assessment.

Secondary impacts of climate change and natural disasters

The primary impacts of climate change and natural disasters on economic infrastructure would have the potential to generate a range of secondary, indirect impacts. The most notable potential secondary impacts include: increased maintenance and repair costs, accelerated deterioration of assets, increased costs of supply, and increased frequency of closures/disruptions to service. These secondary impacts have both social and economic implications (for example disruptions to economic activity and access to social services), and in some cases, environmental implications (such as increased pollutant or sediment runoff to marine environments during flooding). These possible consequences need to be considered in infrastructure planning and costing, design, construction and maintenance.

Rapid analysis of spatial patterns of relative climate and natural disaster risk

Understanding climate risk in Tonga can be enhanced by overlaying spatial patterns of risk atop considerations of sector level risk. Detailed risk mapping is underway for Tongatapu and Ha'apai based on detailed elevation data and models of future projected sea level rise and tsunami risk. This mapping was unavailable at the time of report preparation, therefore a qualitative rapid analysis of the broad spatial patterns of risk was conducted to inform analyses for NIIP2013. A definition of vulnerability as a function of exposure, sensitivity, and adaptive capacity, and knowledge of the main drivers of vulnerability in Tonga, established the following rapid assessment criteria for determining spatial patterns of relative climate and natural disaster risk in Tonga:

- Exposure: exposure to SLR and tsunamis;
- Sensitivity: population density; and
- Adaptive capacity: physical isolation and ease of access to information.

Through the application of these criteria, the following areas (described in no particular order) with the highest levels of climate and natural disaster risk were identified:

- North-eastern coastal zone of Tongatapu, including the Nuku'alofa CBD: identified because of high exposure to tsunamis and sea level rise, and high population density.
- Low lying islands of Ha'apai including Lifuka Island: identified because of high exposure to sea level rise, and presumably tsunamis, relatively high physical isolation, and low ease of access to information.
- The Niuas: identified because of exposure to tsunamis, very high physical isolation, and relatively low ease of access to information.

D.3: Existing enabling environment for DRM and CCA

The enabling environment for DRM and CCA comprises the set of interrelated legislative, institutional, political, technical, and cultural conditions that influence the ability to plan and implement DRM and CCA actions in an effective manner. The characterisation of the enabling environment will help develop actions geared towards optimising strengths and overcoming barriers for effective DRM and CCA management. This section focuses on the following three components of the enabling environment for DRM and CCA that are considered to be particularly important for economic infrastructure in Tonga:

- decision support tools, which relates to knowledge and information availability;
- governance framework, including legislation, institutions, and policies; and
- financing for DRM and CCA, including external assistance and support.

Decision support tools

The national meteorological monitoring network includes seven, 24-hour terrestrial weather stations on Tongatapu and at the airports on the outer islands. There are also links to regional monitoring networks for cyclones and tsunamis. Relatively complete historical atmospheric temperature datasets are available, while datasets for oceanic parameters are less comprehensive.[20]

The recent completion of a Lidar topographic survey for Tongatapu and Lifuka Island, Ha'apai, has provided a sound dataset for risk mapping for sea level rise, storm surge, and tsunamis. Work on tsunami risk mapping for Tongatapu is being completed by the Ministry for Lands, Environment, Climate Change and Natural Resources (MLECCNR) and will underpin the development of a Tsunami Evacuation Plan over the next 12 to 18 months. It is proposed to extend this work to Lifuka Island and to carry out a similar exercise on both Tongatapu and Lifuka for storm surge risks. Sea level rise risk mapping remains less well developed but will be an important tool for future infrastructure planning. Training of Tonga Meteorological Service (TMS) and JNAP secretariat staff on the use of Lidar data will be carried out in early 2013.

Government framework

The national climate change policy and the JNAP have received high-level Government support, with the JNAP in particular representing a major step forward in the identification and documentation of the country's DRM and CCA priorities. Efforts are now needed to ensure translation of the JNAP policies and actions into sectoral policy, legislation, and work programs. The integration of DRM and CCA issues into the NIIP2013 has the potential to act as a pilot project for other sectors in this regard.

The *Emergency Management Act 2007* establishes the institutional and organisational framework for DRM activities, with a focus on response activities, but does not address CCA. The environmental impact assessment (EIA) legislation makes very limited reference to DRM and CCA issues. There is thus no clear legal framework or entry point for CCA that obliges proponents to assess the interaction of infrastructure with climate or natural disasters, or to identify and implement appropriate resilience building measures.

Technical capacity within Government in relation to CCA and DRM is limited to a relatively small number of personnel within the JNAP Secretariat, NEMO, and TMS. Specific skills and decision support tools to support climate risk analysis and resilience building for large-scale economic infrastructure are lacking, as much of the focus of capacity building to date has been on smaller scale community level infrastructure adaptation. Staff members require more comprehensive and targeted skills so they can act as focal points for CCA and DRM issues throughout the whole of Government.[21]

Line ministries, civil society, the private sector (including Public Enterprises who are responsible for the operation of a large proportion of economic infrastructure in Tonga), local consultants, and professional organisations such as the Institution of Professional Engineers for Tonga, generally have limited knowledge on CCA or DRM analysis methods or in the development of responses to protect infrastructure. There is however a strong interest in the issue and an understanding of the types of risks that could be posed. Little technical or material capacity exists for CCA or DRM on the outer islands, despite the DRM responsibilities of outer island authorities for natural disasters.

Financing for DRM and CCA

Due to the high level of climate and natural disaster vulnerability of Pacific countries, the region has been a focus of DRM and CCA support from many donors. An inventory of ongoing DRM and CCA projects included in the Strategic Program for Climate Resilience (SPCR) indicates that since 2007, between T$3.5 million and T$5.0 million has been provided to Tonga.[22] The majority of this support has been in technical assistance (i.e. policy development, capacity

[20] Pacific Climate Change Science Program (PCCSP), *Climate Change in the Pacific: Scientific Assessment and New Research*, *Volume 2 Country Reports: Chapter 14 – Tonga* (2011).
[21] Asian Development Bank, *Strategic Program for Climate Resilience for the Kingdom of Tonga* (2012) presents a more detailed assessment of the specific capacity building needs across sectors.
[22] Asian Development Bank, *Strategic Program for Climate Resilience for the Kingdom of Tonga.*

building, and institutional reform) or community level adaptation works. To date, there has been no significant investment support for infrastructure resilience building in Tonga. The recently secured contribution of approximately T$1.1 million from the EU-led Global Climate Change Alliance (GCCA) to contribute to the construction of foreshore protection in north-eastern Tongatapu is one of the first such operations.

The most significant donors in the DRM and CCA domain over the last five years have been the Asian Development Bank (ADB), Global Environment Facility (GEF), Australian Agency for International Development (AusAID) and Japan International Cooperation Agency (JICA), with the Gesselschaft für International Zusammenarbeit (GIZ), Global Facility for Disaster Reduction and Recovery (GFDRR), United Nations Development Program (UNDP), United States Agency for International Development (USAID), and International Union for Conservation of Nature (IUCN) also responsible for financing and/or implementation of programs.[23] Much of this support has been channelled through regional initiatives coordinated by the Secretariat for the Pacific Community (SPC)/Applied Geoscience and Technology Division of the Secretariat of the Pacific Community (SOPAC) or the South Pacific Regional Environment Program (SPREP).

D.4: Identification and analysis of projects for NIIP2013

Integration of DRM and CCA issues in the long-list of projects

As part of the integration of DRM and CCA considerations in the updating of the NIIP, the initial long-list of infrastructure projects was reviewed. A number of projects were added or modified to the long-list including:

- Additional economic infrastructure projects identified to respond to a risk that was identified during the rapid risk assessment.
- The modification of long-listed economic infrastructure projects to incorporate climate resilience building measures in the design, construction, operation, or maintenance phases.
- Projects with a specific and targeted CCA or DRM related objective that were identified from the JNAP or through stakeholder consultation to respond to a specific CCA or DRM need.

Additional infrastructure projects

Two additional projects in the energy sector were included in the long-list of projects to address those vulnerabilities identified through the economic infrastructure sector risk assessment:

- **Project E17 - Relocate Tongatapu power station and tank farm:** the existing Tongatapu power station (incorporating diesel and solar generation facilities) is located on the northern edge of Fanga'Uta Lagoon and the bulk fuel storage facilities are located at low elevation, approximately 50m from the northern Tongatapu shoreline. Both these pieces of infrastructure were assessed as facing high risk from cyclones, storm surge, earthquakes, and sea level rise, and are located within a high-risk tsunami zone. To address these vulnerabilities, a new project involving the relocation of the power station and tank farm to an as yet unidentified higher elevation location, outside of the projected tsunami zone, was included in the long-list.

- **Project E18 - Undergrounding of key sections of electricity distribution services on Tongatapu:** all electricity transmission infrastructure in Tonga is located aboveground. Overhead electricity transmission lines were identified as being amongst the most vulnerable types of infrastructure to cyclones, storm surge, earthquakes, and tsunami events. To address these vulnerabilities, a new project involving the undergrounding of (as yet unidentified) key sections of electricity supply on Tongatapu, which is the centre of the country's economic activity and the most densely populated zone in the country, was included on the long-list.

Climate-proofing measures for identified economic infrastructure projects

Table D.5 presents a range of general climate-proofing measures for economic infrastructure. During the multi-criteria analysis, it was assumed that long-listed projects would incorporate measures as needed from the list below to optimise their climate resilience in line with the vision for the NIIP2013.

[23] Asian Development Bank, *Strategic Program for Climate Resilience for the Kingdom of Tonga* presents a detailed stocktaking of past and present DRM and CCA projects in Tonga.

Table D.5: 'General' climate-proofing measures for economic infrastructure projects

▪ Detailed climate risk analysis to feed into site selection and project design ▪ Application of climate–proofed design and construction codes and materials selection codes (such codes would be developed as part of enabling environment activities included in the NIIP2013) ▪ Adaptive and flexible operating regimes including contingency plans ▪ Adaptive and flexible maintenance regimes including contingency plans for example increased frequency of maintenance e.g. road clearing prior to rainy season ▪ Adaptive and flexible monitoring of asset condition and adaptive management approaches e.g. pre-wet season, and post-disaster and post-wet season checks of infrastructure.

In addition to these general measures, more comprehensive and project specific resilience building measures were defined for a sub-set of projects on the long-list. The choice of projects for these measures was based on the results of the risk assessment and focused on projects in high-risk infrastructure sectors or locations. The modified projects are described below:

- **Project P9 – Maritime sector safety and resilience:** in its original form this project included the upgrading and rehabilitation of existing outer islands ports on Ha'apai, Vava'u, Eua, and Niuas to improve safety and reliability. Outer island ports were identified as being at high climate and natural disaster risk and the original project was modified to include retrofitted resilience building measures as a major component of the project.

- **Project W3 – Outer islands water supply improvements:** in its original form this project included the rehabilitation and extension of the water supply infrastructure on the outer islands. While at the sector level, water supply was not considered to be at high risk from climate change or natural disasters, the assessment identified that water supply systems on the outer islands that relied on groundwater were at high risk because of the effects of sea level rise and storm surge on salinity levels. It was therefore considered suitable to include comprehensive resilience building measures in the project.

- **Project T10 – Communications for early warning and disaster recovery:** given the importance of the AM radio network for cyclone early warning and post-disaster recovery, this project was developed by identifying the essential elements of a number of activities suggested by the Tonga Broadcasting Corporation and includes: (i) the construction of an AM radio tower on Vava'u to improve operational reliability of the AM radio network both for Tongatapu and the outer islands; and (ii) the relocation and climate-proofing of the central AM radio broadcasting facilities in Tonga.

Identified DRM and CCA Projects

The JNAP was the starting point for identifying the group of DRM and CCA projects to be included in the long-list of projects. Infrastructure projects proposed in the JNAP that are not yet underway or committed were isolated, and where necessary, related smaller projects were grouped to form a package of works of a scale suitable for possible inclusion in the NIIP2013. Additional projects were identified through consultations with stakeholders to allow projects that have been developed since the completion of the JNAP in 2010 to be considered. The JNAP Technical Working Group (TWG) endorsed the identified group of DRM and CCA projects for inclusion in the long-list. The final group of projects was as follows:

- **Project M2 – Eastern Tongatapu coastal protection project:** this project involves the rehabilitation and construction of foreshore protection structures along an approximately 7.9km section of the north-eastern coast of Tongatapu between Nukuleka and Manuka.

- **Project M3 – Western Tongatapu resilient infrastructure project:** this project involves the development of coastal protection structures along approximately 16km of the north-western coast of Tongatapu, and the rehabilitation of village water supplies.

- **Project M4 – Disaster response and evacuation infrastructure project:** this project involves a range of infrastructure to support disaster response coordination and capacity, and to support community evacuation prior to natural disaster events.

- **Project M5 – Ha'apai infrastructure resilience building project:** Ha'apai is considered to be the most vulnerable of the outer island groups due its low elevation. This project involves a package of works to

increase community resilience on Lifuka Island, particularly to address severe coastal erosion on the western side of the island.

D.5: Costs of DRM and CCA resilience building measures in long-list projects

The projects in the NIIP2013 are mostly at the concept stage of development. Project level budget estimates that have been developed are indicative with a relatively large margin of error. It was not possible to develop detailed project specific cost estimates for the identified DRM and CCA measures, or to carry out cost/benefit analyses of these measures. The additional cost implications of incorporating climate-proofing measures into long-listed projects were estimated in broad terms in collaboration with infrastructure specialists in the project team and have been included in the project budget estimates. The incremental cost implications of DRM and CCA measures were generally within the margin of error in project budget estimates.

Climate-proofing of new or replacement infrastructure is generally considered to be more cost effective than retrofitting existing infrastructure during upgrading works. The average costs of climate proofing new or replacement infrastructure (expressed as a percentage of total capital costs) are 1.4 per cent for the East Asia and Pacific Region, and 0.8 per cent for all lower-middle income countries.[24] Costs are however strongly project specific both for new infrastructure and for retrofitting works, and it is difficult to generalise across sectors or within countries.[25] Detailed costs of climate proofing needs for NIIP2013 projects will be developed during future stages of project development.

D.6: CCA and DRM issues associated with priority projects in the NIIP2013

The NIIP2013 long-list of projects was screened and ranked using a multi-criterion analysis (MCA) process as described in Annex C. The list of high and medium priority projects to emerge from this process is reproduced in Table D.6. Two key themes emerged in the list of priority projects that have relevance in the discussion of CCA/DRM issues. Climate and natural disaster resilience is a major component of four of the thirteen high priority projects, and two of the nine medium priority projects. Additionally, infrastructure development in the outer islands is the focus of eight of the thirteen high priority projects, and three of the medium priority projects. Because of their physical isolation, the outer island groups, specifically Ha'apai and the Niuas, are amongst the most vulnerable regions of Tonga despite their low population densities. Even those projects that do not have a specific CCA/DRM focus will contribute to reducing the overall vulnerability of the outer islands communities.

[24] G Hughes, P Chinowsky and K Strezpek, *The Costs of Adapting to Climate Change for Infrastructure,* Economics of Adaptation to Climate Change – World Bank Discussion Paper No. 2 (2010).

[25] See for example M Parry et. al., *Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and Other Recent Estimates,* International Institute for Environment and Development and the Grantham Institute for Climate Change (2009).

Table D.6: Results of the NIIP2013 project prioritisation process

Project No.	Project Name	Indicative Budget (T$ million)
High-Priority Projects		
E11	Solar generation (Tongatapu – Additional 1-2 MW)	24.0
E16	Outer Islands On-Grid Renewable Energy Project	9.0
T9	Fibre-Optic Cable to Ha'apai, Vava'u etc	30.0
T10	Communications for Early Warning and Disaster Recovery	6.0
W3	Outer Islands water supply improvements (Vava'u, Ha'apai, 'Eua)	15.0
W4	Expand Nuku'alofa water supply system to growth areas	11.4
S6	New Landfill or Transfer Station on Ha'apai	4.0
R10	Outer Islands Roads Upgrading Program	10.0
P9	Maritime Sector Safety and Resilience	20.0
A11	Resurfacing Ha'apai runway, apron, taxiway	9.0
A12	Control Tower for Fua'amotu	7.0
M2	Coastal Protection – Eastern Tongatapu	15.0
M4	Disaster Response and Evacuation Infrastructure	12.0
Medium Priority Projects		
E9	Upgrade Bulk Fuel Facilities (Tank Farm, Bunkering)	30.0
S1	Additional capacity for septage treatment	3.0
R11	Tongatapu Trunk Roads Program	16.0
P11	Upgrade of the Queen Salote Domestic Wharf	9.0
P16	Nafanua ('Eua) Port Upgrade	3.0
A7	Additional Fire Tender (Vava'u)	2.0
A9	Expand apron and new taxiways at Fua'amotu	25.0
M3	Western Tongatapu Resilience	20.0
M5	Ha'apai Community Resilience	12.0

For each of the high and medium priority projects, including DRM and CCA projects, this section documents:

- the DRM and/or CCA function of the project (if any); and
- the resilience of the project to climate change and natural disasters including the additional resilience building measures that would be integrated into the project to address risks and optimise the CCA or DRM function.

The majority of projects are at the pre-concept or concept stage. A fine-scale climate, natural disaster risk analysis, and concept design for resilience building measures would need to be carried out for individual projects.

High priority projects

Project E11 - Solar generation (Tongatapu - Additional 1-2MW): *the DRM and CCA function of this project is medium*. At the national level, it would increase resilience in the energy sector by incrementally reducing reliance on imported energy sources. Resilience will be maximised as far as possible through the adoption of appropriate design standards for wind loads and flooding; however, the physical fragility of the technology means that there will remain a degree of residual vulnerability in the infrastructure. The location of the additional solar panel capacity will to a large degree influence the magnitude of the residual vulnerability. If the additional capacity is located at the current solar power farm site, it is at high risk from cyclones, storm surge, and tsunamis. Location of the infrastructure in a higher elevation, less exposed site would reduce the degree of resilience building measures that would be required and the overall vulnerability, but may negatively effect on the cost-effectiveness of the project due to the need to establish ancillary infrastructure to support its operation.

Project E16 - Outer islands on-grid renewable energy project: *the DRM and CCA function of the project is medium-to-high.* The project would result in decreased community vulnerability through reduced reliance on imported sources of energy and increase redundancy in the energy supply network. Overhead transmission lines and solar panels typically

have low resilience to climate and natural disasters; particularly wind damage from storms and cyclones. A degree of resilience could be built into the project through the structural reinforcement of these elements to the extent possible, but a degree of residual vulnerability will remain. Emphasis should be placed on operational procedures that facilitate a rapid switch to alternative sources of energy supply in the event of a natural disaster.

Project T9 - Fibre-optic cable to Ha'apai, Vava'u: *the DRM and CCA function of the project is high*. It would significantly improve the resilience of communications links to the outer islands thereby increasing, amongst other things, access to information on climate and weather conditions, including extreme events. It would facilitate pre-disaster planning and alerts, and post-disaster response efforts. The project resilience is medium-to-high. The likelihood of an earthquake or tsunami of a magnitude likely to damage the cable is low, although the consequences could be severe if such an event did occur. The cable would be designed and laid in line with international standards that optimise its physical resilience to the marine environment. Measures to minimise impacts on coral reefs not only protect marine biodiversity, but also safeguard the coastal protection function of coral reefs. Potential measures could include the selection of cable route to optimise natural gaps in the reef, minimise the area of reef traversed or severing of habitat, laying of the cable through less sensitive reef areas, use of horizontal directional drilling, or anchoring of cables close to reef areas to avoid cable movement. The landing station would require the incorporation of design measures to ensure its resistance to flooding and cyclone impacts, such as those incorporated in the Tongatapu landing station.

Project T10 - Communications for early warning and disaster recovery: *the DRM and CCA function of this project is high.* AM radio provides a critical communications link in times of extreme weather events and natural disasters, and is the official means of broadcasting cyclone warnings. It is particularly important for outer islands communities where Internet and mobile phone coverage is more limited. The resilience of the project to climate and natural disasters is high. The project would increase the resilience of the central Tonga Broadcasting Corporation (TBC) control centre on Tongatapu to flood and wind damage. thereby optimising its ability to operate during and after cyclone events. The project would also provide a new AM radio tower on Vava'u that would be constructed to withstand projected wind loads during future cyclone events. This new tower would enhance the reliability of services to Vava'u and the Niuas and increase overall network reliability should the existing AM radio tower in Tongatapu suffer damage.

Project W3 - Outer islands water supply improvements (Vava'u, Ha'apai, 'Eua): *the DRM and CCA function of the project is high.* Groundwater supplies in Ha'apai in particular are already being affected by rising sea levels and storm surge. Similar effects could occur to coastal groundwater supplies in the other islands. Project resilience is medium-to-high. Through the integration of climate-proofing measures for water supply infrastructure, increased security and quality of supply will be provided for outer islands communities. Measures could include the relocation of water storages outside storm surge and sea level rise zones, replacement of household and village concrete water tanks damaged by earthquakes with more resilient models to foster use of rainwater harvesting as a secondary water source, and relocation where possible of corroded pipes or pipes located in saline intrusion areas or replacement with suitable anti-corrosive materials. Further analysis of the future evolution of groundwater capacity and quality under different climate change scenarios would support project development.

Project W4 - Expand Nuku'alofa system to growth areas: *the DRM and CCA function of the project is low-to-medium.* Households that currently rely on individual wells and rainwater will have a more secure supply. The resilience of the project to climate and natural disasters is high and does not require the integration of specific resilience building measures. The project will be located in relatively elevated areas of Tongatapu and the undergrounded infrastructure will not be at risk of storm surge, sea level rise, or cyclones.

Project S6 - New landfill or transfer station on Ha'apai: *the DRM and CCA function of the project is low-to-medium.* The project would reduce additional stresses on climate-affected groundwater supplies and coastal ecosystems by improving environmental management of solid waste. If the option for a new landfill is selected, its resilience will be largely influenced by the site selection process, namely the ability to develop the project outside of tsunami; storm surge or sea level rise risk zones. Climate risk mapping that is proposed to be carried out for Lifuka will be an invaluable tool in this regard. The landfill drainage and runoff systems will need to be designed to cater for future projected rainfall intensity.

Project R10 - Outer islands roads upgrading program: the *DRM and CCA function of this project is medium-to-high* at a project level due to increased accessibility for vulnerable outer island communities, and high to very high for

individual elements of the project that could serve as evacuation routes in times of natural disaster, or could be developed to incorporate a coastal protection function. To enhance the DRM and CCA function of the overall project, priority could be given to upgrading of those elements of the road network that could fulfil such functions. A high degree of resilience could be integrated into the project through the adoption of climate-proofing measures at the design, construction, and operation stages of the infrastructure. Design of road cross-sections and drainage structures should cater for projected future rainfall, projected sea levels and coastal erosion rates, flood and storm surge, and to allow egress of floodwaters to avoid ponding of water. Selection of pavement materials should be suitable for expected maximum air temperatures. Maintenance regimes should be adapted as necessary to include pre-wet season clearing and rehabilitation of drains, regular post-cyclone or storm monitoring, and procedures for rapid post-cyclone or storm emergency rehabilitation works.

Project P9 - Maritime sector safety and resilience: *the DRM and CCA function of this project is high.* The outer islands ports that are included in this project are critical for passenger and freight transport between islands. The project has been developed to improve the resilience of these ports to future climate change and natural disasters, as well as advance overall port safety. Once implemented, the resilience of the ports to climate change and natural disasters would be high. Resilience building measures incorporated in the project could include elevation of wharves, strengthening and reinforcement of structures, investigation of the need to reconfigure structures to prevent or reduce downstream coastal erosion and encourage sand replenishment, and treatment of underwater structures to minimise physical and chemical corrosion.

Project A11 - Resurfacing Ha'apai runway, apron, and taxiway: *the DRM and CCA function of the projects is high.* While airports do not account for a large proportion of passenger or freight traffic between the islands, they are of importance for urgent freight and passenger movements for example, in the event of a natural disaster, or access during times when ocean carriage is not possible. If this project is not carried out, the airport will be restricted to light aircraft movements and eventually close (as it will no longer comply with civil aviation safety standards) resulting in increased isolation of Ha'apai. Lifuka is a low elevation island, but Salote Pilolevu Airport is located at 9m AMSL and more than 100m from the shoreline. The main risk to the project would arise from a relatively low likelihood, but high consequence tsunami or earthquake event. The DRM and CCA function of the project is high. Resilience building measures can be built into this project through the choice of suitable pavement materials to cater to prevailing temperatures, and adequately sized drainage to cater to projected future rainfall intensity.

Project A12 - Control tower for Fua'amotu: *the DRM and CCA function of this project is medium* and is related to the incremental improvement in aircraft safety and capacity that would occur during a disaster relief operation. The airport is located on relatively elevated ground in the southeast of Tongatapu and is not within a tsunami risk zone. Cyclone wind damage poses the most substantial potential risk to this project and resilience will be accommodated through the adoption of suitable wind design loads.

Project M2: Eastern Tongatapu coastal protection project*: the DRM and CCA function of this project is very high.* This project involves the rehabilitation and construction of foreshore protection structures along an approximately 7.9km section of the north-eastern coast of Tongatapu between Nukuleka and Manuka. This area contains six coastal villages with housing and road infrastructure located in close proximity to the shoreline. Coastal erosion from rising sea level and storm surge is evident along the entire coastline and is threatening to undermine houses and road infrastructure. In some sections, seawalls had previously been constructed but a lack of maintenance had resulted in their deterioration after storm events, and due to ongoing sea level encroachment. Resilience of the project, and thus optimisation of its DRM and CCA, will be achieved through the use of appropriate foreshore designs based on hydrological analyses. It will be necessary to ensure that adverse effects on coastline adjacent to foreshore protection (i.e. through a displacement of wave energy from seawalls to unprotected sections of coastline) are avoided.

Project M4 - Disaster response and evacuation infrastructure project: *the DRM and CCA function of this project is very high.* This project involves a range of infrastructure to support disaster response coordination and capacity, and to support community evacuation prior to natural disaster events. The NEMO, Tonga Meteorological Office (TMO), and the seismic unit of the Geology Department have important roles to play prior to, during and following natural disasters. The disaster response command centre and disaster response equipment storage is located in the Ministry of Infrastructure (MOI) complex in Nuku'alofa which is in a tsunami risk zone. The Tonga Meteorological Service (TMS) is located at Fua'amotu Airport but their offices are of poor quality. Communication between these agencies is via mobile telephone and high frequency radio; both of which are subject to disruption during major natural disasters. The project would entail the construction of a joint, climate-proof disaster command centre where the TMS and

disaster response equipment storage could be based permanently, and where all disaster response agencies could operate in the event of a natural disaster.[26] The project would include the connection of this facility to the underground fibre-optic cable that is currently being developed throughout Nuku'alofa.

This project would also support the infrastructure required to aid the implementation of the Tongatapu Tsunami Evacuation Plan currently under preparation. This infrastructure would include road upgrading to allow rapid egress from high-risk zones, installation of signage and sirens, and the construction of evacuation shelters in tsunami safety zones which are provisionally identified at Mount Siame in the main urban area, the elevated land near the New Zealand High Commission and the Nuku'alofa well-field. The project does not include the construction of a crossing of the Funga'uta Lagoon that was considered separately in the NIIP process but not retained in the list of priority projects.

Medium priority projects

Project E9 - Upgrade bulk fuel facilities (tank farm, bunkering): *the DRM and CCA function of this project is medium.* It has been developed to support a national reform of supply logistics for bulk fuel purchases. The bunkering of the bulk fuel facilities would increase protection against climate and non-climate related natural disasters but it is unlikely that cost-effective retrofitting measures could be developed to reduce residual risks from climate change and natural disasters. This issue would require detailed consideration during project development.

Project S1 - Additional capacity for septage treatment: *the DRM and CCA function of this project is low.* There may be some benefit to the coastal protection of mangroves and coral reefs because of incremental reductions in pollutant loads in runoff. The project is located in a zone at low risk from climate change and natural disasters. Resilience building measures would include adequate drainage control structures to meet future projected rainfall.

Project R11 - Tongatapu trunk roads program: *the DRM and CCA function of this project is low to medium.* The project would involve upgrading mostly rural roads on the southern side of Tongatapu. While increased accessibility to services for the beneficiary communities would result in a decrease of overall vulnerability, none of the roads in question has a specific DRM or CCA function such as serving as an evacuation route. Targeted roads are not located in areas subject to risk from sea level rise, storm surge, flooding, or tsunamis. A high degree of resilience could be integrated into the project through the adoption of climate-proofing measures at the design, construction, and operation stages of the infrastructure. Design of road cross-sections and drainage structures should cater for projected future rainfall and the choice of pavement materials should be suitable for expected maximum air temperatures. Maintenance regimes should be adapted as necessary to include pre-wet season clearing and drain rehabilitation, regular post-cyclone or storm monitoring, and procedures for rapid post-cyclone or storm emergency rehabilitation works.

Project P11 - Upgrade of the Queen Salote domestic wharf: *this project would have a low DRM and CCA function*. The project involves minor wharf side improvements to the existing domestic wharf to improve comfort and the organisation of passengers. The project does not involve structural rehabilitation of the wharf and there is thus no opportunity to incorporate resilience building measures into the project.

Project P16 - Nafanua ('Eua) port upgrade: *this project has a high DRM and CCA function.* It would involve significant structural reconfiguration of the existing port at 'Eua, which has been adversely affected in the past by cyclone wind and wave damage, to allow berthing by the new passenger ferry. During the project there would be an opportunity to incorporate resilience building measures into port infrastructure thus creating a climate resilient port for use both by the new passenger ferry and other smaller ferries and ships. Given the importance of the wharf to passenger and freight movements, this would result in improved general accessibility to services on Tongatapu, and increased accessibility for post-disaster response services. Resilience building measures incorporated in the project would include the elevation of the wharf, strengthening and reinforcement of structures, and treatment of underwater structures to minimise physical and chemical corrosion.

[26] The location of this centre would need to be defined during detailed project planning but Fua'amotu Airport has been identified as a suitable location given the need for TMS to manage the weather stations that are located there on a 24-hour basis.

Project A7 - Additional fire tender (Vava'u): *the DRM and CCA function of this project is low* and is related to the incremental capacity to combat fire at Vava'u airport in the case of a natural disaster. There are no specific resilience building measures that need to be incorporated in this project.

Project A9 - Expand apron and new taxiways at Fua'amotu: *the DRM and CCA function of this project is medium* and is related to the incremental improvement in aircraft safety and capacity that would occur during a disaster relief operation. The airport is located on relatively elevated ground in the southeast of Tongatapu and is not in a tsunami risk zone. Resilience would be built into the project through appropriately designed drainage structures and pavements to cater for future projected rainfall and temperatures.

Project M3: Western Tongatapu resilient infrastructure project: *the DRM and adaptation function of this project is very high.* The JNAP Secretariat has been working with local communities to develop a resilience building project along the north-western coast of Tongatapu. The project involves the development of coastal protection structures with a mixture of hard foreshore protection infrastructure and mangrove rehabilitation along the north-western coast of Tongatapu. The project would extend approximately 16km from Kanokupolu to Muifonua Point. This section of coastline is already subject to coastal erosion that is affecting shoreline stability and road infrastructure in the western section. The project would also involve the rehabilitation and climate-proofing of village groundwater supplies that are being affected by sea level rise and storm surge. Measures would include the relocation of water storages outside of storm surge and sea level rise zones, the rehabilitation of household and village concrete water tanks damaged by earthquakes with more resilient models to foster use of rainwater harvesting as a secondary water source, and relocation where possible of corroded pipes or pipes located in saline intrusion areas or replacement with suitable anti-corrosive materials.

Project M5: Ha'apai infrastructure resilience building project: *the DRM and CCA function of this project is very high*. Ha'apai is considered to be the most vulnerable of the outer island groups due primarily to its low elevation. The SPC-led, AusAID funded Pacific Adaptation Strategy Assistance Program (PASAP) project has been working with communities on Ha'apai and the Government of Tonga to develop a package of works to increase community resilience on Lifuka Island, particularly to address the severe coastal erosion on the western side of the island. To date, a suite of infrastructure needs for Ha'apai have been identified through discussions with the PASAP team and the JNAP TWG and packaged into the Ha'apai Infrastructure Resilience Project for consideration in the NIIP2013. Infrastructure activities include: (i) opening the wharf structure at the port to encourage sand movement to the south of the wharf where severe coastal erosion is being experienced; (ii) sand replenishment activities and foreshore protection along an approximately 3km section of western coastline; (iii) relocation of the hospital that is at risk of being structurally undermined by coastal erosion; and (iv) the rehabilitation of water supply for households along the western coast of Lifuka to protect against saline intrusion and reduce reliance on the diminishing groundwater supply.

D.7: Improvements to the enabling environment for DRM and CCA

The NIIP is an integrated strategy that includes priority investment projects and supporting initiatives (reforms, capacity building, technical assistance, etc) that are required to ensure the effective development of the infrastructure sector. Supporting improvements to the CCA/DRM enabling environment will be indispensable to the effective implementation of the CCA/DRM elements of the priority projects contained in the NIIP2013. Such activities will target actions in each of the three components of the enabling environment considered in the earlier discussion:

- decision support tools;
- governance framework (i.e. institution and capacity building, planning, policy, and legislation); and
- financing mechanisms.

This section focuses on the first two areas of support, while financing issues are discussed in the next section. The priority actions listed in this section have been discussed with the JNAP TWG to ensure consistency with JNAP priorities and other planned or ongoing interventions.

Decision support tools

Reinforcement of the meteorological monitoring network: the performance of the national monitoring network and the completeness of the data produced would be enhanced by the installation of additional monitoring equipment,

including weather radar stations, oceanic parameter monitoring equipment (e.g. sea surface temperature and tidal gauges), and upgraded terrestrial monitoring stations on the outer islands.

Risk modelling and mapping: a priority will be to ensure the completion of tsunami risk modelling and mapping, and the development of storm surge and SLR risk modelling and mapping for Tongatapu and Ha'apai based on the recently completed Lidar elevation survey for these islands.

Climate projections for Building Code and Road Design Standard revision: ongoing analyses and refinement to determine projected return periods for extreme events, including temperature, intense rainfall, extreme high tides, and wind, will be required to feed into revision of the Building Code and Road Design Standard.[27] The TMS and JNAP Secretariat are being trained by AusAID and CSIRO Australia in the application of the climate projection tool Pacific Climate Futures that contribute to this process.[28]

Groundwater capacity analysis and measurement: there is currently little information on groundwater capacity on outer islands, yet groundwater resources are already subject to saline intrusion as a result of sea level rise and storm surge. Analysis of groundwater supply capacity and quality in coastal areas of Tongatapu and outer islands under different climate change scenarios will be required to contribute to water supply planning, and will directly support the development of Project W3 – Outer islands water supply improvement. Linked to these activities, support will also be required to improve the implementation of the newly drafted groundwater management legislation that aims to prevent over-abstraction and better manage the groundwater resource.

Planning, policy, and legislation

Revision of national Building Code and Road Design Standard: one of the highest overall priorities for enabling environment improvement is the revision of the Building Code 2007 to include reference to projected future return periods for extreme climate events. As a secondary priority the national Road Design Standard should similarly be revised. The current Building Code (that applies to all building and non-building structures including seawalls, foreshore protection structures, telecommunications, energy infrastructure, and ports) and the national Road Design Standard are based only on historic climate data. A rolling schedule of future updates for the Building Code and Road Design Standard should be developed (say every five years) to allow progressive integration of future refinements to climate and natural disaster projections.

National and sub-national climate and natural disaster risk plan preparation: the results of risk modelling should be used to develop national or sub-national climate and natural disaster risk plan(s) that identify spatial zones at risk climate change or natural disasters. Such plans could be prepared as standalones or integrated into spatial plans created under the *Spatial Planning and Management Act 2012*.

DRM and CCA checklist for infrastructure planning: a standard rapid assessment checklist for infrastructure development or upgrading is required to ensure the systematic consideration of DRM and CCA issues in the early stages of planning. The checklist would allow the identification of key climate and natural disaster risks, appropriate design standards, and a menu of possible resilience building measures to be considered in project planning and design.

Infrastructure post-disaster response planning: infrastructure asset disaster response plans should be developed including reference to measures to enable basic network level functioning of key services during and following disasters, standardised post-disaster damage assessments for infrastructure, and measures for identifying and fast-tracking priority rehabilitation works. Adopting a Build Back Better policy with requirements for climate resilient design standards for post-disaster rehabilitation or upgrading works will ensure that climate resilience of the infrastructure stock is progressively increased.

Planning for climate resilient infrastructure monitoring and maintenance: this includes the development of a manual containing recommendations for revised infrastructure monitoring and maintenance. The manual would address standard requirements for pre- and post-wet season monitoring, and pre- and post- cyclone event monitoring, as well as suggestions for changes to maintenance schedules; for example pre-wet season clearing and rehabilitation of drains, and procedures for rapid post-cyclone or storm emergency rehabilitation works.

[27] Initial work on this issue is contained in John E Hay & Associates, *Climate Risk Profile for Tonga*. The PACCSAP is working with PCRAFI to better understand future tropical cyclone wind hazard risk for the Pacific region including at the national scale. The outputs of this work, which are expected in mid-2013, will assist in the development of building codes and design standards.

[28] Pacific Climate Change Science Program, *Current and Future Climate of Tonga* (2011), www.pacificclimatechangescience.org.

Revision of legal framework: priority actions for legislative improvement include the integration of DRM and CCA issues into legislation that regulates environmental approvals for infrastructure development (*i.e. the Environmental Assessment Act 2003, Environmental Impact Assessment Regulations 2010* and the *Spatial Planning and Management Act 2012*). The proposed revisions would focus on ensuring proponents and approving authorities for infrastructure projects systematically consider the climate and natural disaster risks that could operate on projects and the necessary adaptation and resilience building measures to be integrated in the project. Sector or issue specific legislation (including legislation relating to spatial planning and coastal protection) should be progressively reviewed and refined to make specific reference to climate and natural disaster risks.

Guidelines on coastal protection and resilient water supply: there is evidence of communities and village authorities autonomously developing DRM and CCA responses to coastal erosion and saline infiltration to groundwater supplies, often without due consideration of the range of options available and the effects of such infrastructure on nearby villages. An additional priority in this category therefore relates to the development of user-friendly, non-technical guidelines on the development of foreshore protection and climate resilient rural water supply schemes.

Institutions and capacity building

Strengthening of CCA and DRM focal points: targeted capacity building for personnel in the JNAP Secretariat, TMS, and NEMO in relation to climate change projections, climate and natural disaster risk analysis for infrastructure, and disaster response planning. The aim is that these institutions and personnel have the core competencies in relation to these issues and become sources of information for the rest of Government. The JNAP Secretariat should assume a coordination role for skills analysis and the identification of needs to avoid duplication or gaps in the capacity building programs supported by different donors.

Strengthening of coordination role of JNAP: the JNAP Secretariat has as one of its main functions the securing and coordination of donor support to CCA and DRM activities in Tonga. The development and assessment of options for post-2014 funding of the JNAP Secretariat is important so it can fulfil its mandated roles of project coordination, project proposals, financing applications, and the provision of technical expertise to line ministries and public enterprises. Challenges will remain for Tonga to access new sources of CCA funding that are coming on-line outside of traditional multilateral and bilateral donors. Technical capacity strengthening in CCA and DRM project development will also be required for JNAP Secretariat staff. During the preparation of the NIIP2013, initial discussions were held between the JNAP Secretariat and the NIIP Working Group to identify future means of collaboration that would facilitate the institutionalisation of CCA and DRM issues in the infrastructure sector. Options for a solid working relationship between these two organisations will continue to be explored by the Government of Tonga.

Capacity building within line ministries: in line with any future revision of the *Environmental Impact Assessment Act* or *Spatial Planning and Management Act*, institutional strengthening will be required within the MLECCNR and the National Spatial Planning Authority to ensure adequate resources and capacity in relation to CCA and DRM issues. Technical capacity building for personnel in line ministries and public enterprises responsible for infrastructure planning, development, and operation will be required in relation to climate and natural disaster risk analysis, the development of response measures, methods for cost-benefit analysis for climate resilience building, DRM activities, application of EIA legislation, application of the refined building code and road design standard, and the skills and information available within the JNAP Secretariat, TMS, and NEMO.

Technical training related to revised Building Code and Road Design Standard: in line with the revision of the Building Code and Road Design Standard, training for MOI staff responsible for inspection and enforcement will be required together with training for private sector organisations on the use of the building code and road design standard.

Other capacity building: ongoing and regular capacity building for personnel and community leaders on outer islands in relation to the development and operation of DRM and CCA response measures, disaster response planning and coordination. Broad community awareness on climate and natural disaster risks, response planning, and disaster response drills will need to be raised.

Financing mechanisms for CCA and DRM

This section presents a summary of the financing mechanisms that could be targeted for the financing of CCA or DRM activities included in the NIIP2013 whether as stand-alone projects, or through financing the additional costs involved in building climate and natural disaster resilience in economic infrastructure projects (see Table D.7).

In recent years, the funding available for DRM and CCA activities has increased. Traditional donors are paying greater attention to the mainstreaming of climate issues in their operations and are providing enhanced support for targeted DRM and CCA activities, either through standalone financing or as an increment to traditional infrastructure or development financing. A number of new sources of funding that focus on CCA related interventions have also been created both at the national and international level.

CCA SPECIFIC FUNDING SOURCES

A range of potential financing sources are available:

- The Pilot Program for Climate Resilience (PPCR) is a multi-donor source of financing, managed by the World Bank (WB). The framework for PPCR support in Tonga was approved in April 2012 with the endorsement of the country specific Strategic Program for Climate Resilience (SPCR) by the Climate Investment Fund.[29] A provisional budget of T$26 million (USD15 million) for PPCR implementation in Tonga was identified and an additional T$9 million (USD5 million) has since been earmarked for Tonga. The SPCR referred to support for hard and soft activities related to climate-proofing of infrastructure. Detailed project preparation in expected to commence in early 2013. Discussions with the team responsible for leading this exercise indicate that climate-proofing of infrastructure remains a priority theme of future PPCR support and reference will be made to the NIIP2013 in the identification of specific project interventions.

- The Adaptation Fund supports CCA projects in developing countries that are parties to the Kyoto Protocol. Since its commencement in 2010, it has approved around 25 projects with an average budget of T$11.6 million. Projects have typically included a community adaptation component and there are numerous examples of activities in coastal and island communities supported by the Fund. Pacific region countries including Fiji, the Cook Islands, and Solomon Islands have submitted successful projects to the Fund. The JNAP Secretariat proposes to target the Adaptation Fund to finance the Ha'apai Community Resilience Project. This funding strategy appears sound given the community-based adaptation nature of the project, its estimated budget of T$11.9 million, and its location is a sensitive coastal zone in a Pacific region's Small Island Developing States.

- The Global Climate Change Alliance (GCCA) is a global platform for knowledge exchange and financial support for climate change initiatives in developing countries. Tonga is already benefiting from support from this fund under the regional SPC led Pacific Small Island States program. Additional support could be sought from this fund for short-term (<1 month), targeted technical assistance activities to support implementation of DRM/CCA projects identified in the NIIP. The types of activities to be supported could include project formulation, policy development, technical advice, feasibility studies, or compliance with climate funding requirements.

- Future calls for proposals under other CCA or DRM focused funds such as the German International Climate Initiative (e.g. for foreshore protection works or water resource management works involving ecosystem based elements; median project financing T$1.5 million) or the ACP-EU Natural Disaster Risk Reduction (NDRR) Program (e.g. for institutional or minor investments works related to DRM capacity; project financing ranges generally from T$0.4 to 1.75 million) could be relevant to the priority activities contained in the NIIP2013 and will require monitoring. Many donors and funds are likely to give preference to regional initiatives and Tonga's continued active involvement in regional forums on climate change issues will allow future regional opportunities to be identified. Evolution of the global Green Climate Fund will also require monitoring as this could become a significant source of adaptation funding in the medium term.

MULTILATERAL AND BILATERAL DONORS

Climate change adaptation and disaster risk management activities are expected to remain high on the agenda of all multilateral and bilateral donors active in Tonga. The upcoming PPCR appears to be the main vehicle of support for future CCA initiatives by the ADB, WB, and AusAID. The JICA has indicated its willingness to consider CCA and DRM projects on a case-by-case basis and is now considering two projects – T$11 million for the eastern Tongatapu coastal protection project and T$5.2 million for tsunami evacuation infrastructure. Based on the outcomes of discussions with the main donors in Tonga, the integration of climate and natural disaster resilience building measures in infrastructure development projects is expected to be looked upon favourably by donors, and in the future it may become a pre-requisite for project financing. The integration of resilience building measures in NIIP2013 projects is therefore

[29] Asian Development Bank, *Strategic Program for Climate Resilience for the Kingdom of Tonga.*

considered likely to aid in attracting project financing. Future discussions with donors could also explore the concept of climate change budget support to support cross-cutting DRM and CCA issues throughout a number of sectors.

POST-DISASTER RESPONSE AND REHABILITATION FUNDING

Contingency funds and insurance schemes are important for providing rapid access to finance for post-disaster response and rehabilitation. Tonga, with the support of the Japanese Government, is a pilot country in the WB led regional Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) risk insurance scheme that would support post-disaster rehabilitation costs for infrastructure and other sectors. The Tonga National Emergency Fund, established in 2008 under the *Emergency Act 2007*, is a solely Government financed fund that aims to allow rapid access to financing in the event of a disaster. Strengthening the operation of the Tonga National Emergency Fund through the establishment of formal procedures and an independent Fund Board, would allow this fund to be used as a consolidated vehicle for donor contributions to post-disaster support, and would enhance harmonisation and coordination in the use of donor and Government funds in the event of a disaster.

Table D.7: DRM and CCA funding sources for Tonga

Fund Name	Previous and Current Financing to Tonga	Feasibility to contribute to financing NIIP2013 priority project
ACP-EU Natural Disaster Risk Reduction (NDRR) Program	None to date.	Potential source of funding for institutional strengthening and policy activities. Feasibility of accessing funds will depend on timing and priorities of future calls for proposals. Project financing generally of T$0.4 to 1.75 million.
Adaptation Fund	None to date.	Eligible activities include institutional, community and infrastructure vulnerability reduction measures. Potential source of future financing for both climate proofing of infrastructure and enabling environment improvements. Average project financing T$11.6 million.
Asian Development Bank	Participation in regional knowledge generation activities. Leading and contributing to PPCR grant.	Tonga's current budgetary policy does not allow for any new loans from MDBs or other parties. Funding for new projects from ADB will therefore be restricted to grant funding. The PPCR PPTA and implementation is programmed in the ADB's Country Operations Business Plan for 2013 – 2015 and is likely to represent the major national level support for CCA in the near future. Scope for inclusion in future regional TA activities on climate change.
Australian Aid	Participation in regional knowledge generation activities. Contributing to PPCR grant.	AusAid is contributing to the PPCR program through the ICCAI; discussions with staff in Tonga indicate that while this is likely to be the main source of CCA funding for Tonga in the future one-off proposals for other activities included in the JNAP will be considered for financing.
Global Climate Change Alliance	SPC-GCCA Pacific Small Island States (regional) & GCCA Pacific Islands Forum support programme (regional)	Tonga does not have a GCCA national programme. Future support possible through regional initiatives or customized short-term technical assistance.
Green Climate Fund	None	Established under auspices of UNFCCC as a major international adaptation fund but is not yet operational. Expected to be operational post 2020.
International Climate Initiative (ICI) Germany	Tonga is a partner country in the Pacific Mangrove Initiative that is being financed until 2013 by the ICI Germany	CCA support is targeted towards ecosystem based adaptation measures but projects involving financing and insurance pilots, data management and water resources have also been financed. New projects are selected through a two-stage procedure that takes place once a year. Median financing envelope of T$3.4 million.
JICA	Numerous projects including training and capacity building activities with TMS, rural DRM activities, earthquake observation assistance.	JICA is currently considering proposals submitted by JNAP Secretariat for funding of the eastern Tongatapu coastal protection and part of the tsunami evacuation plan road infrastructure. A decision on these projects is expected in early 2013. JICA has indicated that it will seek to ensure that climate resilience is taken into account in future infrastructure investments.
National Emergency Fund	Use for post-emergency relief.	The Fund is available to fund post-disaster spending with the approval of Cabinet. The potential for this fund to be used as a vehicle for donor support to disaster relief activities could be investigated in the future subject to the development of procedures for fund use and establishment of a Board.
Pacific Disaster Risk Financing and Insurance Program (PCRAFI)	None. Fund is in initial stages of establishment.	Tonga is part of a two-year pilot regional risk insurance scheme. The Government of Japan is supporting the insurance scheme premium payment. Funds would be available to contribute to disaster relief in the event of a tsunami, earthquake or cyclone. Funding from the Pacific Disaster Risk Financing and Insurance Program could be channelled through the national emergency fund if appropriate governance structures are put in place.

Fund Name	Previous and Current Financing to Tonga	Feasibility to contribute to financing NIIP2013 priority project
Pilot Program for Climate Resilience – PPCR	None to date.	The approved SPCR document (April, 2012) identifies climate proofing of infrastructure and improvements to the enabling environment for PPCR financing. Project preparation will commence in early 2013 and draw on findings of NIIP2013 to set priorities. Provisional budget of ≈ T$35 million (USD 20 million).
World Bank	Contributing to PPCR grant.	Tonga's current budgetary policy does not allow for any new loans from MDBs or other parties. Funding for new projects from WB will therefore be restricted to grant funding. Climate adaptation funding envisaged in current Country Assistance Strategy.

Although climate change mitigation is not a specific focus of this analysis, dedicated funding sources for mitigation projects (such as renewable energy) exist and could be targeted as sources of financing for relevant elements of NIIP implementation. Examples of these funding sources include Tonga's GEF5 STAR allocation under the climate change focal area; the European Union Energy Development Fund (EDF) 10; the European Commission's Global Energy Efficiency and Renewable Energy Fund (GEEREF) for private-public partnerships; the multilateral Clean Technology Fund (a financing stream under the Climate Investment Fund); and bilateral programs which include renewable energy amongst their priorities for support in Tonga.

D.8: CCA/DRM indicators for monitoring and evaluation of the NIIP

The NIIP has a high-level strategic focus with the aim of facilitating development of the infrastructure sector. This includes objective outcomes to mainstream CCA/DRM into infrastructure planning, design and implementation, and improve the resilience of the infrastructure system. From a CCA/DRM perspective, the following high level indicators would provide a baseline for monitoring the impact of climate change and natural disasters on the infrastructure system, and rate of take-up of climate-proofing; and for framing, monitoring, and evaluating of future updates of the NIIP:

- Actual incremental cost of climate proofing of infrastructure: broad information on the costs of building resilience into infrastructure is available at a global level and through selected country case studies. However, the accuracy of information in a given setting is highly dependent on country and regional infrastructure planning practices, design norms and standards, and climate characteristics. Data generated on the realised cost of climate resilience building in Tonga would be useful for future national and regional planning exercises. Information on this indicator would be collected by the line ministries or Public Enterprises conducting infrastructure development works.

- Post-disaster infrastructure damage: post-event damage estimates based on the use of standardised data collection and analysis procedures would primarily be used for disaster response planning and priority setting. A secondary use of this data would be to analyse the benefits of climate-proofing infrastructure (i.e. by comparing the 'with and without' scenarios) that could provide information for future national and regional planning exercises. Information on this indicator is currently collected by line ministries and Public Enterprises and collated by the NEMO, although procedures and capacity for data collection would need to be reinforced.

- Rate of adoption of revised Building Code and national Road Design Standard: the benefits of revising the national Building Code and Road Design Standard to take into account future climate projections will only be realised if there is a high-degree of adoption. This indicator will monitor the rate of adoption of the Code and Standard in NIIP2013 projects and allow for the development of targeted awareness raising and capacity building programs to increase their use as necessary. Information on this indicator would be collected by the building control unit within the Ministry of Infrastructure.

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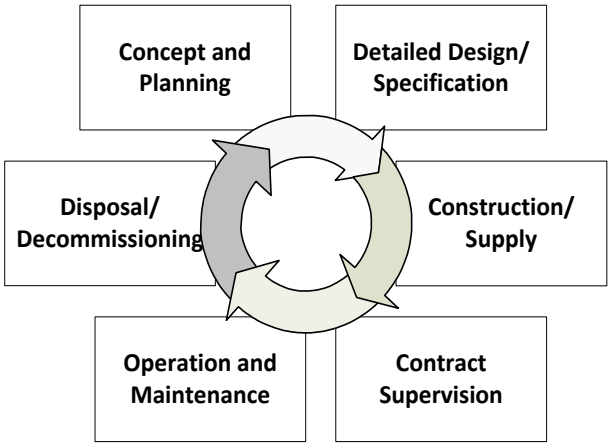
Annex E: Analysis of life-cycle costing issues

This Annex examines the life-cycle costs of infrastructure and the current balance between maintenance needs and maintenance spending in Tonga. It also examines the maintenance implications of the NIIP infrastructure investment program. Issues of future funding of maintenance are covered as part of the funding strategy in Annex F.

E.1: Infrastructure life-cycle costs

The purchase or construction of an infrastructure asset is one step in the life-cycle of an asset that extends from the initial identification of needs, through to disposal of the asset at the end of its useful life. Figure E.1 shows the steps in the infrastructure asset life cycle.

Figure E.1: The asset life cycle



All of these steps involve costs, such as:

- the cost of planning investigations, developing the design concept, and associated studies such as environmental impact assessments;
- the cost of preparing detailed designs and/or specifications, and the cost of preparing contract documentation;
- the nominal construction/supply cost of the infrastructure, plus allowance for contingencies and cost escalation over the supply period;
- the cost of supervising the contract (technical, financial, legal) to ensure that the work is done to the required standard and in compliance with contract requirements;
- the cost of operating the infrastructure over its useful life (such as labour, energy costs and consumables);
- the cost of maintaining the infrastructure over its entire operating life to keep it in good condition. This includes routine maintenance (small-scale activities undertaken regularly as general upkeep against normal wear and tear) and periodic maintenance (larger scale activities carried out at longer intervals to sustain the infrastructure condition or operational status); and
- the cost of disposal which can include the cost of decommissioning the asset, demolishing/removing it from the current location, and disposing of the waste. This can involve a range of environmental costs associated with disposal. The unused infrastructure should not be just left in place to decay and potentially pollute its surroundings.

In most cases, asset owners are well aware of the construction/supply cost of infrastructure and its ongoing operating costs (such as labour, energy costs and consumables), but are less aware of the extent and scale of other life-cycle costs.

The total life cycle cost can be expressed as:

Life Cycle Cost = [Concept Development & Planning] + [Detailed Design & Documentation]
+ [Construction/Supply including Escalation] + [Contract Supervision]
+ [Operating Cost] x [Asset Life]
+ [Routine/Periodic Maintenance] x [Asset Life]
+ [Disposal/Decommissioning Cost]

Table E.1 shows an example of an infrastructure project with a nominal construction/supply cost of $100 (for ease of calculation) and an assumed operating life of 20 years. It shows some typical rules-of-thumb for the cost of life cycle components.

Table E.1: Indicative analysis of life cycle costs

Stage	Rate [a]	Construct/ Supply Only	+ Other Up-front	20 Year Maintenance
Concept Development and Planning	2-5%		$2-5	
Detailed Design and Documentation	5-10%		$5-10	
Infrastructure Construction/Supply		$100	$100	
Contingency/Escalation	10%		$10	
Contract Supervision	2-5%		$2-5	
Operating Cost	variable			
Maintenance – Routine [b]	0-5%			$0-100
Maintenance – Periodic [c]	5-10%			$10-20
Disposal/Decommissioning	variable			
TOTAL		$100	$120-130	$10-120

Notes:
[a] Based on typical infrastructure costing parameters, derived from literature review and consultation with infrastructure project management specialists.
[b] Varies from minimal routine/periodic maintenance for buried infrastructure (such as water pipes) up to five per cent per year routine and 10 per cent periodic for gravel roads.
[c] Based on 20 year asset life with periodic maintenance every seven years.

This calculation shows that other up-front costs can add 20-30 per cent to the nominal cost of the infrastructure. Over the life of the asset, the total cost of maintenance can be as high as the initial capital cost (depending on the type of infrastructure). In other words, the actual cost of owning the asset over its lifetime (excluding operating cost) can be double the initial quoted construction/supply cost.

This has important planning and budgeting implications for ensuring that sufficient resources are available for the proper planning and design/specification of the infrastructure, and proper maintenance throughout the asset life. The relative size of these components will vary according to the details of the specific infrastructure, but as a general guideline, the following cost allowances should be included in infrastructure budgeting:

- 10-20 per cent up-front allowance for planning, detailed design and documentation, and contract supervision;
- 10 per cent contingency for physical changes to the infrastructure works/specification and cost escalation over the supply period. This is in addition to any contingency already included in the construction/supply cost estimate; and
- a recurrent allowance for maintenance equivalent to one to five per cent of the construction/supply cost for every year of the asset life (depending on the type of infrastructure). Maintenance requirements are discussed in more detail in the next section of this Annex.

Disposal costs are more problematic in terms of budgeting because the disposal/decommissioning may be 20 years or more into the future. However it is important to recognise that there may be significant costs associated with disposal, and as noted earlier, the unused infrastructure should not be just left in place to decay and potentially pollute its surroundings.

Table E.2 provides rough estimates of the life cycle costs of the 13 high priority projects included in this NIIP. It is observable that while the estimated capital costs of these projects is T$172 million, the estimated life cycle costs

drawing on the rules of thumb included in Table E.1, and allowing for 20 years of maintenance costs, totals some T$280 million (T$110 million more than the initial capital cost).

Table E.2: Estimated life cycle costs of NIIP2013 high priority projects (T$ million)

Sector	Projects	Concept Planning & Detailed Design	Capital Cost	Supervision & Contingency/ Escalation	Annual Maintenance	Total 20-year Life cycle
Energy	Outer Islands On-grid Renewable Energy Project	0.9	9.0	1.3	0.2	15.2
	Solar Generation (Tongatapu - additional 1-2 MW)	2.4	24.0	3.4	0.7	43.8
Telecoms	Fibre-optic Cable to Ha'apai, Vava'u	3.0	30.0	4.2	0.2	41.2
	Communications for Early Warning and Disaster Recovery	0.6	6.0	0.8	0.1	9.4
Water	Outer Islands Water Supply Improvements (Vava'u, Ha'apai, 'Eua)	1.5	15.0	2.1	0.4	26.6
	Expand Nuku'alofa Water System to Growth Areas	1.1	11.4	1.5	0.3	20.0
Solid Waste	New Landfill or Transfer Station on Ha'apai	0.4	4.0	0.6	0.1	7.0
Roads	Outer Islands Roads Upgrading Program	1.0	10.0	1.4	0.2	16.4
Ports	Maritime Sector Safety and Resilience Program	2.0	20.0	2.8	0.4	32.8
Airports	Resurfacing Ha'apai Runway, Apron, Taxiway	0.9	9.0	1.3	0.1	13.2
	New Control Tower for Fua'amotu	0.7	7.0	1.0	0.2	12.7
Multi-sector	Disaster Response and Evacuation Infrastructure	1.2	12.0	1.7	0.2	18.9
	Coastal Protection – Eastern Tongatapu	1.5	15.0	2.1	0.3	24.6
	Total	17.2	172.4	24.1	3.4	281.8

E.2: Maintenance spending

As shown in Table E.1, the life cycle maintenance cost of infrastructure can be as high as the initial build/buy cost, and in addition, maintenance also affects operating cost. Insufficient maintenance will tend to adversely affect operating efficiency and increase operating costs. This section of the Annex examines maintenance issues in more detail. In particular, financial analysis was undertaken to assess:

- the extent of actual spending on maintenance and asset renewal;
- whether actual spending is in the right ballpark for sustainable asset management; and
- the maintenance implications of infrastructure projects that are operational, underway, committed, and proposed.

Public enterprises

Public Enterprises are responsible for infrastructure management and service delivery in all areas of the economic infrastructure sector, except roads and outer island ports.

Analysis of the level of spending by Public Enterprises on maintenance and infrastructure renewal is complicated by the way repairs and maintenance are recorded in the accounts. Several Public Enterprises have in-house staff dedicated to maintenance. This means that the accounts will tend to under-represent maintenance because much of the costs are recorded as salary costs. Table E.3 provides more detail of maintenance and capital-related spending based on the annual accounts of Public Enterprises. To provide an overall picture of infrastructure spending, it includes figures for infrastructure asset value, spending on repairs and maintenance, and acquisition of new plant and equipment. The Table also includes the ratio of the total amount spent on repairs, maintenance, and acquisition of new plant and equipment relative to the infrastructure asset base. This is a rough indicator of overall spending on expanding, renewing, and maintaining infrastructure relative to the total size of the infrastructure asset base.

Table E.3: Public Enterprises – maintenance and capital indicators (2011/12, T$ million)

Sector	Agency	Infrastructure Asset Value	Repairs & Mtnce[1]	CAPEX[1]	Maintenance + CAPEX[1]	Capital Sustain Ratio
Energy	Tonga Power Ltd	58.2	2.5	4.4	7.0	12%
Telecoms	Tonga Communications Corp.	36.4	0.6	5.5	6.1	17%
	Tonga Broadcasting Corporation	3.0	0.1	0.1	0.2	6%
Water	Tonga Water Board	16.4	0.2	1.7	1.8	11%
Waste	Waste Authority Ltd	1.4	0.04	0.1	0.1	10%
Transport	Ports Authority of Tonga	18.4	0.5	1.4	1.9	10%
	Tonga Airports Ltd	34.6	0.1	2.3	2.5	7%

Notes: [1] Average over the period 2008/9 to 2011/12, where data available.

This analysis splits the Public Enterprises into three spending bands:

- High: this category contains two quite different businesses. The Tonga Communications Corporation (TCC) is in a fast changing business with private sector competition and must spend on infrastructure maintenance and renewal to keep pace with technology and remain competitive. Tonga Power Ltd (TPL) has inherited a rundown asset base but is successfully re-building the business and spending on infrastructure to rehabilitate the power supply system.
- Medium: this category contains two businesses (Tonga Airports Ltd (TAL), Ports Authority of Tonga (PAT)) that are alike in that their infrastructure is dominated by a small number of large fixed assets (runway, terminal, wharf), and much of their maintenance and capital spending is governed by the need to meet international safety and security standards; and one business (Tonga Water Board (TWB)) which is growing and strengthening in its role as a water utility.
- Low: this category contains two smaller businesses (Tonga Broadcasting Corporation (TBC) and Waste Authority Ltd (WAL)) for which spending on repairs, maintenance, and acquisition of new plant and equipment is low and potentially below sustainable levels.

The adequacy of spending on maintenance is explored further in Table E.4. This Table shows figures for infrastructure asset value, spending on maintenance, an estimate of the required level of sustainable maintenance spending for two scenarios (two per cent and four per cent of asset value), and an overall rating of the maintenance spending gap. The gap is rated Small if actual spending is within the suggested range; Medium if slightly below the two per cent scenario; and High if well below the two percent scenario. The required spending scenarios are based on the rules-of-thumb presented in Table E.1. For an individual item of infrastructure, recommended average annual spending on maintenance is in the range one to five per cent depending on the type of infrastructure, but for an organisation with a diverse infrastructure stock, this will tend to average out and reduce the range.

Table E.4: Public Enterprises – comparison of maintenance needs and spending (2011/12, T$ million)

Sector	Agency	Infrastructure Asset Value	Spending on Mtnce[1]	Required Mtnce 2%	Required Mtnce 4%	Gap
Energy	Tonga Power Ltd	58.2	2.54	1.16	2.33	No Gap
Telecoms	Tonga Communications Corp	36.4	0.61	0.73	1.45	Medium
	Tonga Broadcasting	3.0	0.07	0.06	0.12	Small
Water	Tonga Water Board	16.4	0.15	0.33	0.66	Large
Waste	Waste Authority Ltd	1.4	0.04	0.03	0.06	Small
Transport	Ports Authority of Tonga	18.4	0.46	0.37	0.73	Small
	Tonga Airports Limited	34.6	0.12	0.69	1.38	Large

Notes: [1] Average over the period 2008/9 to 2011/12, where data available.

The analysis of the adequacy of current spending on maintenance again splits the Public Enterprises into three groups:

- *Large Gap*: it appears that these Public Enterprises (TWB, TAL) are not spending sufficient to keep pace with the backlog of required maintenance and as a result have a deteriorating infrastructure stock, although in the case of TAL, it is engaged in an infrastructure renewal process so it has large capital spending some of which is an alternative to maintenance of existing assets;
- *Medium Gap*: the Public Enterprise in this category (TCC) may not be spending sufficient on maintenance, possibly as a result of cost-cutting measures to address declining revenues; and
- *Small Gap*: these are Public Enterprises (TPL, TBC, WAL, PAT) that appear to be spending enough to maintain their infrastructure in good condition.

More detailed analysis of mechanisms for funding infrastructure, and an assessment of the overall financial strength of Public Enterprises, is provided in Annex F of this report.

Based on a combined assessment that considered financial strength (see Annex F), historical spending on maintenance and capital (Tables E.3, E.4), and discussions with operators, an overall assessment has been made of the capacity of Public Enterprises to fund operations, maintenance and capital requirements from their own resources (Table E.5). The assessment rates the capacity of each Public Enterprise on a High/Medium/Low scale relative to its capital base, as follows:

- *High*: indicates a full capacity to self-fund without assistance;
- *Medium*: indicates a partial capacity, whereby the Public Enterprise can self-fund some needs but a backlog will gradually accumulate; and
- *Low*: indicates that the Public Enterprise is effectively unable to self-fund this activity.

Note that for each Public Enterprise, the CAPEX (capital expenditure) scale relates to a *Small*, *Medium* or *Large* individual investment relative to its asset base. A *Small* investment involves routine replacement/upgrading of small equipment and facilities; while a *Large* investment would involve replacement or major rehabilitation of the largest item of infrastructure that the Public Enterprise already owns (such as the airport runway), or the scale of investment required to transform the business (such as an undersea fibre-optic cable). Therefore the dollar value of each level of investment will vary across the range of Public Enterprises according to the type and size of infrastructure in its asset stock.

Table E.5: Analysis of capacity for self-funding infrastructure costs

Sector	Agency	Operations	Maintenance	Small CAPEX	Medium CAPEX	Large CAPEX
Energy	Tonga Power Ltd	High	High	High	High	Medium
Telecoms	Tonga Communications Corp	High	High	High	High	Medium
	Tonga Broadcasting Corp	High	Medium	Medium	Low	Low
Water	Tonga Water Board	High	High	Medium	Low	Low
Waste	Waste Authority Ltd	Medium	Low	Low	Low	Low
Transport	Ports Authority of Tonga	High	High	High	High	Low
	Tonga Airports Ltd	High	High	High	High	Low

The overall assessment of the capacity of Public Enterprises to self-fund infrastructure indicates that:

- TPL and the TCC are quite strong businesses with the capacity to fully self-fund all but the largest infrastructure projects. The TCC is experiencing some decline in revenues as a result of competition, and may need to move beyond internal financing to fund future investments.
- TAL and PAT are also financially stable and can generally fund small-medium infrastructure from their own resources. TAL's financial results are affected by high depreciation expenses on its large asset base, and this limits its capacity to borrow. The challenge faced by these Public Enterprises is that they are custodians of

some very large single items of infrastructure (airport runway, international wharf) that require infrequent but very expensive rehabilitation.

- The financial position of the TWB is improving, with strong growth in revenues due to improved collection. This gives the business the capacity to meet operating and maintenance costs and small capital expenditures, though actual expenditures on maintenance are lagging behind.
- The TBC can meet their operating costs and partially fund maintenance and small infrastructure projects, but does not have the financial strength to renew/upgrade medium-large infrastructure from their own resources.
- Waste Authority Ltd (WAL) requires a Government subsidy to meet its operating costs and remain cashflow positive. It has a low capacity to self-fund maintenance or infrastructure renewal. Revenue collection has been a problem, though arrangements to link billing with the TWB should result in improved performance.

Note that the current Government policy is not to intervene in the commercial operations of Public Enterprises. Generally this means that Government does not provide funding (operating or capital) support for Public Enterprises. The only exception is WAL, and in some cases, Government funds community service obligations (such as street lighting) that are delivered by Public Enterprises. These non-commercial services are explicitly identified in Public Enterprise statements of corporate intent and accounts.

Maintenance spending: Ministry of Infrastructure

For the Ministry of Infrastructure (MOI), funding for maintenance and asset rehabilitation is by Budget allocation. Table E.6 shows Government and development partner spending on the Roads Program and the Marine and Ports Services Program. These are the only economic infrastructure sectors that are Budget funded.
Table E.6 indicates that:

- In the three years to 2012/13, the average budgetary provision for the Roads maintenance program was about T$7.5 million per year, but only about five per cent of this was from Government funds and the remainder from development partners. This can be compared with required spending to sustainably maintain the road network which has been estimated by the TSCP to be around T$6.8 million per year. Thus recent budgetary provisions have been above the sustainable level, but only because of a very high level of funding from development partners.
- Government budgetary provision for maintenance spending on the roads program has been inconsistent, ranging from around T$38,000 in 2011/12 to T$1 million in 2012/13.
- Very little was been provided by Government for outer island port maintenance and upgrading over the three years to 2012/13. With an estimated asset value of more than T$10 million (wharves, channels, navigational aids, shore facilities), this translates into expected annual spending on maintenance of T$200-400,000 using the two to four per cent benchmark described above. Over recent years, spending on maintenance and infrastructure renewal has mostly been at around 20 per cent of the sustainable level. The large capital contributions by development partners over the period 2010/11 to 2012/13 have been for vessels rather than port infrastructure.

Table E.6: Government budgetary provisions for maintenance (T$ '000)

Sector	Agency	Item/Source	Provisional 2010/11	Revised 2011/12	Estimate 2012/13
Roads	Roads Program, MOI	Government			
		- Maintenance	186	38	1,001
		- Capital	0	0	0
		Development partner contribution	3,488	8,283	13,003
		Total	3,674	8,321	14,004
Ports	Marine and Ports Services, MOI	Government			
		- Maintenance	77	23	38
		- Capital	0	0	0
		Development partner contribution	25,046	4	1,654
		Total	25,123	27	1,692

Notes: [a] Excludes salaries, technical assistance and other non-infrastructure expenses

Overview

The overall picture regarding spending on infrastructure maintenance and renewal is mixed:

- Several Public Enterprises (TPL, TCC, PAT, TAL, and TWB) have the financial strength to fully fund routine maintenance and small-medium asset renewal from their own resources, though some of these (TAL and TWB) appear to be under-spending on maintenance. All of these Public Enterprises would struggle to self-fund investments to replace or rehabilitate the largest item of infrastructure that the Public Enterprise already owns (such as the airport runway) or is required in order to transform the business (such as an undersea fibre-optic cable).
- TBC is breaking even financially, and its spending on maintenance is at a reasonable level. However, it does not have the financial capacity to renew assets and to keep pace with developments in technology.
- WAL cannot fully fund the cost of operations and maintenance from its own resources and requires a Government subsidy to remain financially viable.
- Government spending on maintenance and rehabilitation of roads and outer island ports has been patchy and below sustainable levels. A more systematic approach to asset management and a more reliable stream of funding for maintenance is required to break out of the boom-bust cycle. A proposal has been developed with TSCP technical support to introduce a Road Maintenance Fund as part of a drive to strengthen this function, but for outer islands ports, funding for ongoing maintenance is uncertain. New long-term arrangements need to be considered for sustainable funding of outer island port infrastructure maintenance and renewal.

E.3: Maintenance implications of the NIIP infrastructure investment program

The infrastructure program that is already underway or committed, together with the high priority proposed projects, involves investment of T$345 million over the next five years. Projects included in the NIIP2010 which are now operational also need to be maintained. This has significant implications in terms of long term maintenance requirements. To obtain a sense of the scale and allocation of these recurrent costs, an analysis was undertaken of estimated forward maintenance costs using rules of thumb for maintenance requirements of different types of infrastructure as described above.

Table E.7 shows the annual maintenance rates assumed. Infrastructure is classified as fixed or mobile, and as having a short, medium, or long lifespan, and maintenance rates are specified accordingly. It is assumed that mobile infrastructure with a short lifespan requires the highest level of maintenance (3.5 per cent of capital cost per annum), while fixed infrastructure with a long lifespan requires the lowest level of maintenance (two per cent of capital cost per annum, or lower in some cases).

Table E.7: Infrastructure maintenance rates (annual)

Infrastructure lifespan	Type of infrastructure	
	Fixed	Mobile
Short	3.0%	3.5%
Medium	2.5%	3.0%
Long	2.0%	2.5%

Table E.8 applies these maintenance rates to calculate the annual maintenance expenditure requirements at the end of the first five years of the NIIP2013 (2017/18). Lower annual maintenance rates were used for investment in undersea fibre-optic cable (where a rate of 0.5 per cent was used) and overlaying of airport runways (where a rate of one per cent was used), given the nature of these assets. It is evident that T$3.3 million of the total annual requirement of T$14.0 million (or 24 per cent) relates to high priority proposed projects, with the balance relating to projects from the NIIP2010 now operational, and projects already underway or committed.

Table E.8: Annual maintenance expenditure requirements at the end of 2017/18

	Maintenance expenditure requirement 2017/18 (T$ million)
Projects from NIIP2010 now operational	4.9
Projects underway	4.3
Committed projects	1.5
High priority proposed projects	3.3
Total	**14.0**

The total annual recurrent cost of sustainable maintenance after the fifth year of the NIIP2013 investment program would be around T$14.0 million:

- about 76 per cent (T$10.7 million) of this is for projects that are already operational, underway, or committed, and around 24 per cent (T$3.3 million) for high priority proposed projects; and
- 66 per cent (T$9.2 million) of maintenance costs accrue to Public Enterprises across a wide variety of projects, and the balance (T$4.8 million) to Government.

However, not all is 'new' maintenance. Most of this recurrent maintenance cost relates to projects that upgrade existing infrastructure (52 per cent) and a further 16 per cent to projects involving the replacement or repair of existing assets. These projects that repair/replace/upgrade existing infrastructure may lead to a short-term decrease in required maintenance spending (assuming that the maintenance of the old infrastructure was funded). Projects that add new infrastructure to national stock would add around T$4.6 million in required annual maintenance funding.

Table E.9 narrows the analysis down to new projects that are considered to be high priority for this NIIP (see Annex C). These projects have an estimated annual maintenance requirement of T$3.3 million. The Table also provides an assessment of the capability of responsible agencies to self-fund these maintenance requirements, based on the above analysis of the maintenance funding capacity of Public Enterprises and Ministries.

Table E.9: Estimated maintenance requirements of NIIP2013 high priority projects

Sector	Projects	Capital Cost T$m	Est. Annual Mtnce T$m	Capacity to Self-Fund Mtnce
Energy	Outer Islands On-grid Renewable Energy Project	9	0.23	High
	Solar Generation (Tongatapu - additional 1-2 MW)	24	0.72	High
Telecoms	Fibre-optic Cable to Ha'apai, Vava'u	30	0.15	High
	Communications for Early Warning and Disaster Recovery	6	0.12	Low
Water	Outer Islands Water Supply Improvements (Vava'u, Ha'apai, 'Eua)	15	0.38	Medium
	Expand Nuku'alofa Water System to Growth Areas	11	0.29	Medium
Solid Waste	New Landfill or Transfer Station on Ha'apai	4	0.10	Low
Roads	Outer Islands Roads Upgrading Program	10	0.20	Low
Ports	Maritime Sector Safety and Resilience Program	20	0.40	Medium
Airports	Resurfacing Ha'apai Runway, Apron, Taxiway	9	0.09	High
	New Control Tower for Fua'amotu	7	0.18	High
Multi-sector	Disaster Response and Evacuation Infrastructure	12	0.24	Low
	Coastal Protection – Eastern Tongatapu	15	0.30	Low
	Total	172	3.38	

The breakdown by sector and type of project is shown in Table E.10. About 37 per cent of the implied annual maintenance cost for high priority proposed projects (T$1.2 million) is for projects that upgrade/repair/rehabilitate existing infrastructure. These are not 'new' maintenance liabilities and in some cases may lead to a reduction in required maintenance spending. Setting these projects aside, the high priority projects are estimated to add T$2.1 million to the national annual maintenance task.

Overview of maintenance costs

The overall implications of high priority proposed projects for this NIIP are:

- The total annual maintenance cost associated with the NIIP2013 investment plan is estimated at T$14.0 million, of which about 35 per cent (T$4.9 million) is for projects included in the NIIP2010 which are now operational, and 41 per cent (T$5.8 million) is for projects which are underway or committed. Approximately 68 per cent of the total cost is associated with projects that upgrade/repair/rehabilitate existing infrastructure. These are not 'new' maintenance liabilities and in some cases, the project may lead to a reduction in required maintenance spending;
- NIIP2013 high priority proposed projects (13 projects) would add T$3.3 million to annual maintenance liabilities, including about T$2.1 million associated with 'new' infrastructure. Public Enterprises would be responsible for 64 per cent of this additional annual maintenance task, while the Government would be responsible for 36 per cent.

Table E.10: Estimated maintenance requirements of high priority NIIP projects at 2017/18 (T$ million)

Sector	New Infrastructure	Upgrades	Replacement / repair	Total
Energy	0.95			0.95
Telecoms	0.27			0.27
Water	0.29	0.38		0.66
Solid Waste	0.10			0.10
Transport				
- Roads		0.20		0.20
- Ports		0.40		0.40
- Airports			0.27	0.27
Multi-sector	0.54			0.54
TOTAL	2.14	0.98	0.27	3.38

Notes: Row and column totals may not add due to rounding.

Annex F: Funding issues and strategy

This Annex sets out the projected demand for infrastructure related finance; the financial capacity of Government and Public Enterprises to address infrastructure costs; the interventions that Government can make to improve the infrastructure financing environment; and what this all means in terms of an overall strategy for how limited financial resources can be best deployed.

F.1: Demand for infrastructure finance

Demand for infrastructure finance comes from three sources: capital investment in new or upgraded infrastructure; complementary initiatives that support the operation and management of the infrastructure sector; and ongoing maintenance of the infrastructure.

Capital investment

Capital expenditure on infrastructure projects over the period 2013/14 to 2017/18 will be derived from four sources:

- projects that that were identified in the NIIP2010 and whose implementation is currently underway and will continue during the NIIP2013 timeframe;
- projects that that were identified in the NIIP2010 and have committed funding and will commence implementation during the NIIP2013 timeframe;
- high priority projects identified in this NIIP (see Chapter 3 and Annex C); and
- other smaller investments (mostly by Public Enterprises) that are part of their own investment programs and are not captured by the NIIP process. Based on current expenditure patterns (Annex E), this is estimated to total around T$8 million per year.

The contributions from these sources are summarised in Table F.1. If all of the NIIP2013 projects go ahead as planned, then total capital investment over the period 2013/14 to 2017/18 is estimated at T$385 million. To put this level of investment in perspective, this is equivalent to an average annual level of investment over the period of around eight per cent of GDP.

Table F.1: Demand for capital expenditure 2013/14-2017/18 (T$ million)

	Capital expenditure 2013/14-2017/18 (T$ m)
NIIP 2010 Projects underway	100
NIIP 2010 Committed projects	73
High priority proposed projects	172
Smaller self-funded projects	40
Total	**385**

Complementary initiatives

Chapter 3 of this NIIP sets out a range of complementary measures (planning road maps; policy changes; institutional/regulatory/financial reforms; training and capacity building; technical assistance; etc) that support the implementation of the NIIP. At this stage, it is not possible to estimate the cost of these precisely, but Table F.2 lists each complementary activity by sector, together with an indication of what that activity might cost (see legend for explanation of 'cost indicator). In total it is anticipated that all the complementary activities, which mostly involve consulting services, might amount to T$15 million over the five year priority period covered by this NIIP.

Table F.2: Estimated cost of complementary activities by sector

Sector/ Affected Entities	Activities	Cost Indicator
Energy (involving GoT and Tonga Power)	Policy, legal, regulatory reform supporting the Energy Roadmap	3
	Research and feasibility studies of alternative energy sources (wind, wave, coconut oil etc)	4
	Improved fuel supply chain logistics	2
	Other non-infrastructure aspects of the Energy Roadmap (DSM, TGIF etc)	3
Telecoms (involving GoT, TCC & TCL)	Update the access/regulatory regime for telecoms sector	2
	Private sector and Government initiatives (e-Government) that take advantage of opportunities emerging from improved internet access	1
Water (Involving GoT and the TWB)	Prepare a Roadmap for the Water Sector that examines the full water cycle, including sanitation and drainage.	3
Solid Waste Waste Authority	Prepare a sector roadmap that addresses the institutional, financial and operational model for the sector and provides a 5-10 year investment plan	2
Roads	Implement new arrangements for sustainable road maintenance funding and delivery (TSCP)	2
	Develop private sector capacity for road maintenance (TSCP)	2
Maritime MoT/ Tonga Port Authority	Update arrangements for managing and maintaining ports for inter-island shipping	2
	Upgrading and capacity development in maritime safety and pollution response	2
	Update/Upgrade maritime safety and pollution facilities; hydrographical charts etc.	4
	Post harvest facilities for fishing and agricultural produce - handling, storage, processing (initial support provided EU and Australian Aid)	3
Airports Tonga Airports Limited	Upgrading and capacity development in aviation safety	3
	Update the policy environment for domestic aviation	2
	Post harvest facilities (initial support under EU Program)	2
Multi Sector	Institutional reform to clarify and simplify responsibilities across all sectors	2
	Mainstream CCA/DRM into infrastructure planning, design, standards and management	2
	Upgrade meteorological services and capability	4
	Strengthen EIA system and capacity	1
	Develop and implement a national policy and strategy for strategic asset management	1
	Improved arrangements for coordination of major projects with multi-sector implications	1

Legend:
1 Expected to cost up to T$200,000 (all figures are in pa'anga)
2 Expected to cost up to T$400,000
3 Expected to cost up to T$600,000
4 Expected to cost more than T$600,000

Maintenance

The requirements for expenditure on maintenance over the period 2013/14 to 2017/18 will come from three sources:

- maintenance of existing infrastructure, including investments from the NIIP2010 program that were already operational in 2011/12. This is estimated to total some T$10.5 million per year, including T$6.8 million on road maintenance (sustainable maintenance level from Road Fund calculations), around T$0.3 million on maintenance of outer islands ports (see Annex E), and around T$3.4 million by Public Enterprises at a minimum two per cent of asset value (Annex E);
- new maintenance requirements from NIIP2010 projects that are underway and committed. As explained in Annex E, many NIIP projects upgrade/repair/rehabilitate existing infrastructure and so do not produce 'new' maintenance liabilities, and in some cases may lead to a reduction in required maintenance spending; and
- new maintenance requirements from high priority projects proposed by this NIIP (Annex E).

Table F.3 shows the annual maintenance expenditure requirements at the end of the first five years of this NIIP (2017/18), with a breakdown by project status and responsibility.

Table F.3: Annual maintenance expenditure requirements at the end of 2017/18 (TS million)

	Government	Public Enterprises	Total
Pre-existing assets [1]	7.1	3.4	10.5
NIIP investments (underway, committed)	-	2.5	2.5
NIIP2013 high priority proposed investments	-	2.1	2.1
TOTAL	7.1	8.0	15.1

Notes: [1] including NIIP2010 assets operational in 2011/12

Total demand for infrastructure finance

Table F.4 combines the requirements for capital expenditure on infrastructure over the period 2013/14 to 2017/18 with requirements for expenditure on complementary initiatives and the maintenance of infrastructure (including pre-existing assets) to provide a picture of the total demand for infrastructure finance. Total demand from all sources over the five year period amounts to T$470 million.

Table F.4: Total demand for infrastructure finance (T$ million)

	2013/14	2014/15	2015/16	2016/17	2017/18	Total
Capital Investment						
NIIP2010 underway and committed	104	49	7	8	5	173
NIIP2013 high priority	16	62	60	24	10	172
Other smaller items of capital expenditure	8	8	8	8	8	40
Complementary initiatives						
NIIP2013	3	3	3	3	3	15
Maintenance						
Pre-existing assets	10.5	10.5	10.5	10.5	10.5	52.5
NIIP2010 underway and committed	0.5	2.5	2.5	2.5	2.5	10.4
NIIP2013 high priority	0.3	0.8	1.5	2.0	2.1	6.7
TOTAL	142	136	92	58	41	470

F.2: Government finance

Tonga is emerging from a period of high fiscal deficits resulting from a large imbalance between domestic revenues and current expenditures, and a high level of capital expenditure (financed largely from concessional borrowing rather than grants). The fiscal position is summarised in Table F.5. The fiscal deficit was equivalent to roughly six per cent of GDP in 2009/10 and 2010/11, and a projected 2.7 per cent of GDP in 2011/12. Fiscal tightening and access to budget support funding from development partners have enabled the Government to budget for a small surplus in 2012/13, and surpluses in the order of one per cent of GDP are projected in the next three financial years (though this will require ongoing fiscal restraint as debt servicing requirements increase significantly in this period when the grace period for two major loans comes to an end).

Table F.5: Central government fiscal operations (in % of GDP)

	2009/10 actual	2010/11 prelim.	2011/12 projection	2012/13 projection	2013/14 projection	2014/15 projection	2015/16 projection
Revenue	20.7	20.2	18.8	19.0	19.4	19.5	19.6
Cash grants	6.3	6.9	7.2	11.6	6.8	6.3	5.8
Current expenditure	27.7	23.7	21.2	25.5	22.3	21.8	21.5
Capital expenditure	4.0	7.8	5.8	4.5	3.0	3.0	3.0
Net lending	1.3	1.5	1.6	-0.1	0.0	0.0	0.0
Overall balance	-6.0	-5.9	-2.7	0.6	1.0	1.0	0.8
External financing (net)	3.6	6.8	5.2	-0.3	-0.8	-0.8	-0.2
Domestic financing (net)	2.5	-0.9	-2.5	-0.3	-0.2	-0.2	-0.6

Source: IMF, Tonga 2012 Article IV Consultation – Staff Report.

Table F.6 summarises the position of the Government budget over the last three years. It shows that current revenues including taxation have been static, as have expenditures on wages and salaries. There has been growth in other current expenditure (which can be important in maintaining standards of service delivery). Turning the budget around from a position of significant deficit to small surplus has been achieved mainly through a large reduction in capital expenditure (the high level of capital expenditure at the beginning of this period had been financed largely through concessional loans) and growth in budget support grants.

The Budget Estimates for 2012/13 include T$22.5 million in budget support from Australia (T$9.0 million), New Zealand (T$2.5 million), the World Bank (WB) (T$8.5 million) and the European Union (T$2.5 million). The Asian Development Bank (ADB) had provided budget support in 2010/11. Australia, New Zealand, the WB, ADB, and the Government have negotiated a single policy matrix guiding budget support.

Table F.6: Government of Tonga budget (T$ million)

	2010/11 actual	2011/12 est. outturn	2012/13 budget
Total revenues and grants	203.8	215.5	217.8
Current revenue	149.1	147.7	147.0
Capital revenue	2.0	1.6	2.3
Grants (including budget support)	52.8	66.3	68.5
Total expenditure	249.9	230.0	216.1
Wages and salaries	91.8	87.3	90.0
Other current expenditure	83.7	93.8	111.4
Capital expenditure	74.4	48.9	14.7
Lending minus repayments	11.2	9.2	0.5
Surplus/Deficit	-57.3	-23.7	1.2

Source: Government of Tonga Budget Statement for the year ending 30 June 2013, GFS presentation.

The most recent Debt Sustainability Assessment (DSA) undertaken jointly by the International Monetary Fund (IMF) and WB in early 2012 concludes that Tonga remains at a high risk of debt distress. Table F.7 summarises Tonga's public debt position including projections made in the course of the DSA. The rapid growth in public debt in 2008/9 and 2009/10 was associated with two loans from the China EXIM Bank for the reconstruction of Nuku'alofa and road improvements. Public sector debt is projected to remain above the Government's target ceiling of 40 per cent of GDP until 2013/14 and to decline thereafter (though the Government's budget statement for 2012/13 notes that public debt remains well above the lower target ceiling of 30 per cent of GDP recommended by the IMF).

The DSA notes that scheduled repayments on the two loans from the China EXIM Bank may pose a fiscal challenge unless sufficient cash reserves are built up by improving tax collections and controlling current expenditure. The DSA also notes that Tonga's remittance inflows, which are projected to average around 20 per cent of GDP in the medium term, may help mitigate liquidity risks and keep the debt profile manageable. However, that additional new debt in the short term will further worsen the already high risk of external debt distress.

Table F.7: Tonga public sector debt (in % of GDP)

	2008/9 actual	2009/10 actual	2010/11 actual	2011/12 projection	2012/13 projection	2013/14 projection	2014/15 projection	2015/16 projection
Public sector debt[1]	39.3	41.2	41.8	45.4	43.6	40.0	37.5	35.7
Annual change	8.0	1.9	0.7	3.5	-1.8	-3.6	-2.5	-1.8
In foreign Currency	31.7	32.8	36.3	40.8	39.4	36.2	34.0	32.4

Notes: [1] Data cover the gross debt of general government and non-financial public enterprises.
Source: IMF, Tonga 2012 Article IV Consultation – Debt Sustainability Analysis

A further breakdown of the public debt position is provided in Table F.8, which summarises the current level of public sector debt (which grew to T$353.1 million by the end of 2011/12), with 59 per cent of debt accounted for by bilateral

loans and 64 per cent of external debt denominated in Chinese Yuan (resulting in significant foreign exchange risk as this currency has been appreciating and is likely to continue on this path).

Table F.8: Tonga public sector debt (in % of GDP)

	30 June 2011 actual	30 June 2012 actual
Public sector debt	304.3	353.1
Domestic	29.5	29.5
External	274.9	323.6
Multilateral	122.0	115.1
Bilateral	150.9	206.7
Commercial	2.0	1.9
External debt in Chinese Yuan	54.9%	63.9%
External debt in SDR	44.2%	35.4%

Source: Government of Tonga Budget Statement for the year ending 30 June 2013.

This summary of the fiscal and public debt position of the Government supports the conclusion that little reliance can be placed on domestic revenues or public borrowing to finance investment in infrastructure over the course of this NIIP.

F.3: Public Enterprise finance

Most economic infrastructure in Tonga is owned, operated and managed by Public Enterprises. The following Public Enterprises are involved in the economic infrastructure sector in Tonga:

Infrastructure sector	Public Enterprise
Energy	Tonga Power Limited (TPL)
Telecommunications	Tonga Communications Corporation (TCC)
	subsidiary: Tonga Cable Limited (TCL)
	Tonga Broadcasting Corporation (TBC)
Water	Tonga Water Board (TWB)
Solid Waste	Waste Authority Limited (WAL)
Ports	Ports Authority of Tonga (PAT)
Airports	Tonga Airports Limited (TAL)

The financial performance of these Public Enterprises is summarised in Table F.9. Results for 2011/12 are presented, though it is noted that for most enterprises the financial statements for 2011/12 are yet to be audited. Performance varies, with a range from quite small enterprises with limited financial strength, to large and profitable enterprises with significant financial capacity.

Table F.9: Public Enterprises – financial data (T$ million, 2011/12)

Public enterprise	Equity	Revenue	Net profit after tax	EBITDA[1]	Subsidy	Dividend
Tonga Power Limited	47.8	44.2	2.5	9.1	-	0.9
Tonga Communications Corporation	44.2	23.4	1.9	6.2	-	[3]
Tonga Broadcasting Corporation	2.5	2.4	-0.1	0.0	-	-
Tonga Water Board	11.2	6.4	1.2	2.7	-	0.2
Waste Authority Limited	2.0	0.5	-0.8	-0.2	[2]	-
Ports Authority of Tonga	16.7	7.5	1.2	3.3	-	0.4
Tonga Airports Limited	32.9	7.3	-0.9	1.8	-	0.2

Notes: [1] As public enterprise financial statements are not all prepared in the same format, EBITDA is difficult to calculate on a comparable basis.
[2] Waste Authority Limited normally receives an annual subsidy (T$0.50 million in 2010/11) but this was not paid in 2011/12, possibly due to funding being received from aid sources in that year.

[3] Tonga Communications Corporation did pay dividends in the three previous years (T$1.26 million in total for the three years), while Tonga Airports Limited had not paid dividends in the three previous years.
Source: Annual reports of public enterprises

There has been improvement in the performance of Public Enterprises since the NIIP2010 report, with more recording profits and more paying dividends to Government (despite the continuing fragility of the economy and difficult business environment). One encouraging indicator of the health of the Public Enterprise model in Tonga is the availability of annual reports and financial statements (in either draft or audited form) for 2011/12 for all Public Enterprises just a few months after the end of the financial year, with performance monitoring then undertaken by the Ministry of Public Enterprises.

In terms of financial performance, Public Enterprises lend themselves to the following classification:

- *Large and strong*: those with revenues over T$20 million, with significant equity and asset bases, recording profits, and EBITDA (earnings before interest, taxation, depreciation and amortisation) over T$5 million. Tonga Power Ltd (TPL) and the Tonga Communications Corporation (TCC) fall into this category, though it is noted that TCC's revenues have declined in recent years due to competition in the mobile telephone market, and cash reserves have declined as these have been used to finance investment.
- *Medium and capable*: those with revenues in the T$5 to T$10 million range, EBITDA in the T$1 to T$4 million range, and relatively stable performance. Ports Authority of Tonga (PAT), Tonga Airports Ltd (TAL) and the Tonga Water Board (TWB) fall into this category. PAT shows only very modest growth in revenues but remains profitable; TAL is not currently profitable due to high depreciation provisions on a large asset base, while the TWB has moved up to this category since the NIIP2010 analysis due to growth in revenues through improved collection procedures.
- *Small and marginal*: those with revenues less than T$5 million, breaking even at best, with EBITDA near 0. The TBC and Water Authority Ltd (WAL) fall into this category. The TBC shows stable performance and carries out an important social function without Government subsidy, while WAL has experienced difficulties in revenue collection (and receives a subsidy in performing a service with important social and economic benefits to the community).

Table F.10 summarises the current value of infrastructure assets managed by Public Enterprises, and their average level of expenditure on capital and maintenance (averages are used as capital expenditure varies significantly from year to year, while maintenance expenditures are not fully reflected in the financial statements of Public Enterprises and averages may provide more reliable estimates). Over recent years, Public Enterprises have on average spent around T$15 million each year on capital investment (mix of larger and smaller projects), and around T$4 million on maintenance (but this understates actual maintenance spending because maintenance allocations identified in Public Enterprise financial statements normally cover only materials and outsourced services used in maintenance and do not capture other inputs such as in-house labour).

Table F.10: Public Enterprises – infrastructure assets (T$ million)

Public enterprise	Infrastructure assets (2011/12)	Capital expenditure (annual average[1])	Maintenance expenditure[2] (annual average[1])
Tonga Power Limited	58.2	4.4	2.5
Tonga Communications Corporation	36.4	5.5	0.6
Tonga Broadcasting Corporation	3.0	0.1	0.1
Tonga Water Board	16.4	1.7	0.2
Waste Authority Limited	1.4	0.1	0.1
Ports Authority of Tonga	18.4	1.4	0.5
Tonga Airports Limited	34.6	2.3	0.1

Notes: [1] Annual average over the four year period 2008/9 to 2011/12, where available. [2] Maintenance allocations identified in public enterprise financial statements normally cover only materials used in maintenance and do not capture other inputs such as labour.
Source: Annual reports of public enterprises

An indicative analysis of the borrowing capacity of Public Enterprises is shown in Table F.11. Based on these estimates, only TPL, the TCC, and, PAT have capacity to self-fund investments of any scale through commercial finance.

Table F.11: Public Enterprises – indicative borrowing capacity (2011/12, T$ million)

Item			TPL	TCC	TBC	TWB	WAL	PAT	TAL
EBITDA [1]	A		9.1	6.2	0.0	2.7	-0.2	3.3	1.8
Shareholder Funds	B		47.8	44.2	2.5	11.2	2.0	16.7	32.9
Estimated Return on Equity	C		10%	10%	10%	10%	10%	10%	10%
Required Dividend	D	B x C	4.8	4.4	0.2	1.1	0.2	1.7	3.3
Free Funds	E	A - D	4.3	1.8	0	1.6	0	1.6	0
Min Debt Service Cover Ratio [2]	F		1.5	1.5	1.5	1.5	1.5	1.5	1.5
Debt Service	G	E / F	2.9	1.2	0	1.1	0	1.1	0
Interest Rate (No Govt Guarantee)	H		13%	13%	13%	13%	13%	13%	13%
Estimated Debt Carrying Capacity	I	G / H	22.1	9.3	0	8.1	0	8.3	0
Existing Term Liabilities	J		11.1	3.6	0.4	9.3	0.5	4.2	1.7
Indicative Borrowing Capacity	K	I – J	11.0	5.7	0	0	0	4.1	0

Notes: [1] As the accounts of Public Enterprises are not yet fully standardised, it is difficult to calculate EBITDA with confidence, but the information is sufficient to draw some general conclusions regarding debt carrying capacity of the Public Enterprises.
[2] The Debt Service Cover Ratio is the ratio of principal and interest payment divided by cashflow available for debt service. This is an important financial test for banks.

Further analysis of the ability of Public Enterprises to self-fund capital and maintenance expenditures is provided in Annex E dealing with the life cycle costs of infrastructure assets.

F.4: Development partner finance

Assistance from development partners is currently the major source of financing for infrastructure investment. As listed in Table F.12, recent and planned support from major development partners totals around T$380 million.

Table F.12: Development partners involved in infrastructure

Development partner	Programming process	Recent and planned support for infrastructure	Approx. value (T$ million)
World Bank	Country Assistance Strategy (2011-14).	IFC Loan to Digicel Tonga. Tonga Post Tsunami Reconstruction. Pacific Islands Regional Connectivity (Tonga Broadband Connectivity). Transport Sector Consolidation Project (TSCP), and transport follow-up. Tonga Energy Road Map (TERM). Pacific Islands Aviation Investment Program (including funding for Fua'amotu and Vava'u airports).	11 8 17 7 8 47
Asian Development Bank	Country Partnership Strategy (2007-12) and Country Operations Business Plan (2013-15).	Tonga-Fiji Submarine Cable Project. Nuku'alofa Urban Development Sector Project Phase 2. Sustainable off-grid power systems. Renewable Energy Project Phases 1 and 2.	17 10 8 6
Australia	Australia-Tonga Partnership for Development (2009-2015).	Grant co-financing of the WB-led Transport Sector Consolidation Project (TSCP), ADB-led Nuku'alofa Urban Development Sector (NUDS) Project, WB-led Tonga Energy Road Map (TERM) Institutional and Regulatory Framework Strengthening Project, and assistance to TERM Implementation Unit through PIAC. Upgrading of village water supplies.	27
Japan	Project identification within a development assistance framework (current focus on climate change adaptation, disaster management, and the environment).	Replacement inter-island ferry. Vava'u waste management. Small scale village water supplies. Off-grid solar power systems and village power supplies. Expansion of capacity of solar farm and compensation capacity.	25 3 2 12 24
China	Respond to requests from the Government.	Concessional loans for Nuku'alofa Reconstruction (Vuna Wharf component) and Roads Improvement. Vaipua Bridge, Vava'u.	116 8

Development partner	Programming process	Recent and planned support for infrastructure	Approx. value (T$ million)
New Zealand	Tonga-New Zealand Joint Commitment for Development (2011)	Solar generation farm – Tongatapu. Tonga village network upgrade (with World Bank and EU). 'Eua airport runway rehabilitation. Other involvement in infrastructure related activities: - Meridian operating costs (status: active) - Major energy investment (status: proposed) - Ecocare Pacific Trust: solar PV and ICT program for Tongan schools (status: active) - Pacific maritime safety: Manukau Institute of Technology / NZ Maritime School training for FISA crew in Tonga (status: active) - Pacific maritime safety: technical assistance to Tonga MOT (status: active)	14 4 4
European Union	National Indicative Programme (2008-13) linked to allocations under the European Development Fund (currently the 10th EDF).	Sector budget support with renewable energy as the focal sector.	2

Over recent years, development partners have been very supportive in assisting Tonga with investments in the infrastructure sector. Government expects that support will continue to be available, provided that it can be demonstrated that infrastructure investments are well managed and maintained. Beyond current commitments, development partners do not have specific forward allocations dedicated to infrastructure. One opportunity that may emerge is a regional maritime initiative which could fund improvements in port infrastructure.

F.5: Domestic financial institutions

Domestic financial institutions with a current or potential interest in financing economic infrastructure include the commercial banks and the Tonga Development Bank. These institutions already have dealings with some Public Enterprises, and are open to lending for infrastructure projects. However, they are only interested in lending for projects which can establish commercial viability, and not all Public Enterprises have the financial strength to support commercial finance. Public Enterprises had loans totalling T$10.4 million from domestic financial institutions at the end of 2011/12. Commercial banks in Tonga currently charge a base rate of interest for standard commercial loans of nine to 10 per cent, plus a risk premium ranging from zero to seven per cent depending on the nature of undertaking being financed. Larger customers are able to negotiate more favourable rates.

The Tonga National Retirement Benefits Fund (TNRBF) commenced operations in mid-2012 and is a potential future investor in economic infrastructure. Again, this interest would be limited to 'bankable' projects producing an adequate level of returns to fund members. The TNRBF expects to mobilise around T$12 million per year in contributions from employers and employees in the private sector and Public Enterprises. Funds are currently invested in term deposits, pending the adoption of a more comprehensive investment policy. The TNRBF is likely to eventually absorb the Government pension fund, which was reconstituted in 1999 and manages a pool of funds totalling around T$80 million. Public Enterprises had loans totalling T$3.6 million from the non-deposit-taking domestic financial institutions at the end of 2011/12.

F.6: Funding for climate change adaptation and disaster risk management

Due to the high level of climate and natural disaster vulnerability of Pacific countries, the region has been a focus of climate change adaptation (CCA) and disaster risk management (DRM) support for many donors. An inventory of ongoing CCA and DRM projects included in the Strategic Program for Climate Resilience (SPCR)[1] indicates that since 2007, between T$3.5 and T$5.0 million has been provided to Tonga. The majority of this support has been in technical assistance (i.e. policy development, capacity building, and institutional reform) or community level adaptation works.
To date there has been no significant investment support for infrastructure resilience building in Tonga. The recently secured contribution of T$1.1 million from the Global Climate Change Alliance (GCCA) to contribute to the construction of foreshore protection in north-eastern Tongatapu is one of the first such operations. The most significant donors in the CCA and DRM domain over the last five years have been the Asian Development Bank (ADB),

[1] Asian Development Bank, *Strategic Program for Climate Change Resilience for the Kingdom of Tonga* (2012).

Global Environment Facility (GEF), the Australian Agency for International Development (AusAID), and the Japan International Cooperation Agency (JICA). Much of the support has been channelled through regional initiatives coordinated by the Secretariat for the Pacific Community (SPC)/Applied Geoscience and Technology Division (SOPAC), or the South Pacific Regional Environment Program (SPREP).

In recent years the funding available for CCA and DRM activities has increased. Traditional donors are paying greater attention to the mainstreaming of climate issues in their operations and are providing enhanced support for targeted CCA and DRM activities. A number of new funding sources that focus on CCA related interventions have also been created both at the national and international level.

The Pilot Program for Climate Resilience (PPCR) is a multi-donor source of financing, managed by the World Bank (WB). The framework for the PPCR support in Tonga was approved in April 2012 with the endorsement of the country specific Strategic Program for Climate Resilience (SPCR) by the Climate Investment Fund. A provisional budget of T$26 million for PPCR implementation in Tonga was identified, and an additional T$9 million has since been earmarked for Tonga. The SPCR addresses hard and soft climate resilience building activities for the infrastructure sector. Detailed project preparation is expected to commence in early 2013 and discussions with the team responsible for leading this exercise indicate that climate-proofing of infrastructure remains a priority theme of future PPCR support. The NIIP will be used as a point of reference in the identification of specific project interventions.

The Adaptation Fund supports CCA projects in developing countries such as Tonga that are party to the Kyoto Protocol. Since its commencement in 2010, it has approved around 25 projects with an average budget of T$11.6 million. Projects have typically included a community adaptation component and there are numerous examples of activities in coastal and island communities being supported by the Fund. Pacific region countries including Fiji, the Cook Islands, and the Solomon Islands have submitted successful projects to the Fund. The *Joint National Action Plan* (JNAP) Secretariat proposes to target the Adaptation Fund to finance the Ha'apai Community Resilience Project. This approach appears sound given the community-based adaptation nature of the project, its estimated budget of T$11.9 million, and its location in a sensitive coastal zone in a Pacific region of Small Islands Developing States.

The Global Climate Change Alliance (GCCA) is a global platform for knowledge exchange and financial support to climate change initiatives in developing countries. Tonga is already benefiting from support from this fund under the regional SPC led Pacific Small Island States program. Additional support could be sought from this fund for short-term (<1 month), targeted technical assistance activities to support implementation of CCA and DRM projects identified in the NIIP. The types of activities to be supported could include project formulation, policy development, technical advice, feasibility studies, or compliance with climate funding requirements.

Future calls for proposals under other funds such as the German International Climate Initiative (e.g. for support foreshore protection works or water resource management works involving ecosystem based elements for a median project financing envelope of T$1.5 million) or the ACP-EU Natural Disaster Risk Reduction (NDRR) Program (e.g. for institutional or minor investments works related to DRM capacity with a general project financing envelope of T$0.4 to T$1.75 million) could be suitable for the financing of CCA and DRM activities contained in this NIIP, and will require monitoring. Evolution of the global Green Climate Fund will also require monitoring as this could become a significant source of adaptation funding in coming years. Many donors and funds are likely to give preference to regional initiatives and Tonga's continued active involvement in regional forums on climate change issues will allow future regional opportunities to be identified.

CCA and DRM activities are expected to remain high on the agenda of all multilateral and bilateral donors active in Tonga. The upcoming PPCR appears to be the main vehicle of support for CCA specific initiatives by the ADB, WB, and the Australian Government. JICA has indicated its willingness to consider CCA and DRM projects on a case-by-case basis and is now considering two such projects - T$11 million for the eastern Tongatapu coastal protection project, and T$5.2 million for tsunami evacuation infrastructure. Based on the outcomes of discussions, donors in Tonga are expected to look favourably upon infrastructure projects that integrate climate and natural disaster resilience.

Contingency funds and insurance schemes are important for providing rapid access to finance for post-disaster response and rehabilitation. Tonga, with the support of the Japanese Government, is a pilot country in the WB led regional Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) risk insurance scheme that would support post-disaster rehabilitation costs for infrastructure and other sectors. The Tonga National Emergency Fund, established in 2008, is a solely Government financed fund that aims to allow rapid access to financing in the event of a disaster. Strengthening of the operation of the Fund through the creation of formal procedures and an independent Fund Board would allow this fund to be used as a consolidated vehicle for donor contributions to post-disaster

support, and would enhance harmonisation and coordination in the use of donor and Government funds in the event of a disaster.

Table F.13 summarises the sources of funding available or potentially available to Tonga to finance investment in climate change adaptation and disaster risk management (see Annex D for more details).

Table F.13: CCA and DRM funding options for Tonga

Source	Financing available or potentially available	Feasibility to contribute to NIIP priority project funding
ACP-EU Natural Disaster Risk Reduction (NDRR) Program	None to date.	Potential source of funding for institutional strengthening and policy activities. Feasibility of accessing funds will depend on timing and priorities of future calls for proposals. Project financing generally of T$0.4 to T$1.75 million.
Adaptation Fund	None to date.	Eligible activities include institutional, community and infrastructure vulnerability reduction measures. Potential source of future financing for both climate proofing of infrastructure and enabling environment improvements. Average project financing T$11.6 million.
Asian Development Bank	Participation in regional knowledge generation activities. Contributing to PPCR grant.	The PPCR PPTA and implementation is programmed in the ADB's Country Operations Business Plan for 2013 – 2015 and is likely to represent the major national level support for CCA in the near future. Scope for inclusion in future regional TA activities on climate change.
AusAID	Participation in regional knowledge generation activities. Contributing to PPCR grant.	AusAID is contributing to the PPCR program through the ICCAI; discussions with staff in Tonga indicate that while this is likely to be the main source of CCA funding for Tonga in the future, one-off proposals for other activities included in the JNAP will be considered for financing.
Global Climate Change Alliance	SPC-GCCA Pacific Small Island States (regional) & GCCA Pacific Islands Forum support programme (regional)	Tonga does not have a GCCA national programme. Future support possible through regional initiatives or customized short-term technical assistance.
Green Climate Fund	None	Established under auspices of UNFCCC as a major international adaptation fund but not yet operational.
International Climate Initiative (ICI) Germany	Tonga is a partner country in the Pacific Mangrove Initiative that is being financed until 2013 by the ICI Germany	CCA support is targeted towards ecosystem based adaptation measures but projects involving financing and insurance pilots, data management and water resources have also been financed. New projects are selected through a two-stage procedure that takes place once a year. Median financing envelope of T$3.4 million.
JICA	Numerous projects including training and capacity building activities with TMS, rural DRM activities, and earthquake observation assistance.	JICA is currently considering proposals submitted by JNAP Secretariat for funding of the eastern Tongatapu coastal protection and part of the tsunami evacuation plan road infrastructure. A decision on these projects is expected in early 2013. JICA has indicated that it will seek to ensure that climate resilience is taken into account in future infrastructure investments.
National Emergency Fund	Use for post-emergency relief.	The Fund was established by the Government and is available to fund post-disaster spending with the approval of Cabinet. The potential for this fund to be used as a vehicle for donor support to disaster relief activities could be investigated in the future subject to the development of procedures for fund use and establishment of a Board.
Pacific Disaster Risk Financing and Insurance Program (PCRAFI)	None. Fund is in initial stages of establishment.	Tonga is part of a two-year pilot regional risk insurance scheme. The Government of Japan is supporting the insurance scheme premium payment. Funds would be available to contribute to disaster relief in the event of a tsunami, earthquake or cyclone. Funding from the Pacific Disaster Risk Financing and Insurance Program could be channelled through the national emergency fund if appropriate governance structures are put in place.
Pilot Program for Climate Resilience – PPCR	None to date.	The approved SPCR document (April, 2012) identifies climate proofing of infrastructure and improvements to the enabling environment for PPCR financing. Project preparation will commence in early 2013 and draw on findings of NIIP to set priorities. Provisional budget of ≈ T$35 million (USD 20 million).
World Bank	Contributing to PPCR grant.	Climate adaptation funding envisaged in current Country Assistance Strategy.

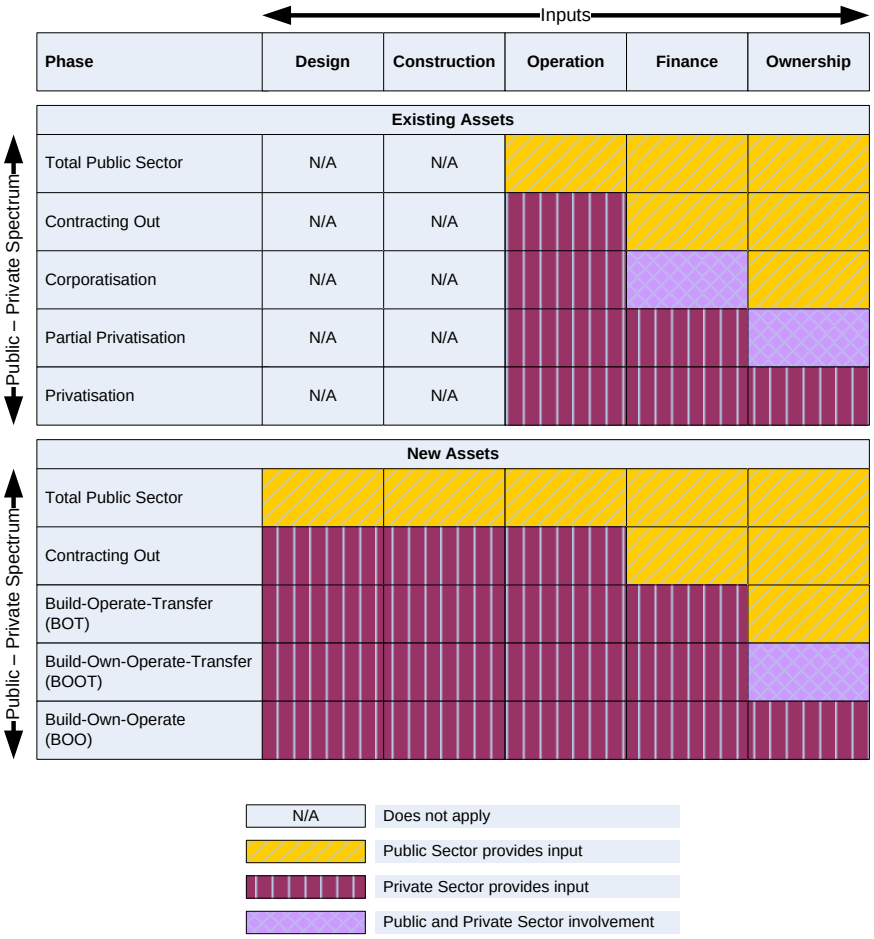
F.7: Private sector involvement

Inputs in the provision of infrastructure range from *design* to *construction* to *operation* to *financing* to *ownership*. The spectrum of public sector/private sector involvement in the provision of these inputs is shown in Figure F.1, which considers the situation for both existing assets (where design and construction are already complete), and new assets. In relation to existing assets, this spectrum can involve retention by the public sector, contracting out, corporatisation, partial privatisation, or full privatisation. In relation to new assets, the spectrum can involve delivery of all inputs by the public sector, contracting out, build-operate-transfer (BOT), build-own-operate-transfer (BOOT), or build-own-operate (BOO) at the fully private sector end of the spectrum. At this point, the only fully private sector provision of major economic infrastructure in Tonga involves the operation of Digicel in the telecommunications sector.

One of the key enabling themes of TSDF 2011-14 is "continuing progress to a more efficient and effective government by focusing on its core functions; improving coordination, service delivery and optimising use of resources". Within this enabling theme the Government envisages transferring a range of functions to the private sector via outsourcing, public-private partnerships (PPP), and privatisation, or by taking the intermediate step of transferring them first to Public Enterprise status. The Government recognises that for this approach to work, the capacity of the private sector will need to be enhanced.

Private sector involvement in the implementation of this NIIP is likely to focus on design and construction, outsourced operations and maintenance, and specialist technical services. More complex arrangements involving expansion in private sector operation and ownership of infrastructure are unlikely to be realistic prospects during the term of this NIIP, but have potential for the future.

Figure F.1: Range of private sector options for existing and new infrastructure assets



F.7: Overall funding strategy

Potential funding modalities and sources for the high priority proposed projects included in this NIIP are set out in Table F.14. Given the fiscal constraints on the Government in relation to funding investment from domestic revenues or concessional borrowing, and the constraints facing most Public Enterprises in self-financing investment, support from Development Partners in the form of grants will be needed to assist with financing most of the high priority investment projects. The control tower at Fua'amotu International Airport and the expansion of the Nuku'alofa water system are two projects that could involve at least partial self-financing by the Public Enterprise responsible, in this case, TAL and the TWB.

Table F.14: Potential funding modalities and sources for high priority proposed projects

Sector	Ref.	Project	Capital cost (T$ million)	Potential funding modality
Energy	E16	Outer Islands On-grid Renewable Energy Project	9	Grant from DP
	E11	Solar Generation (Tongatapu - additional 1-2 MW)	24	Grant from DP
Telecommunications	T9	Fibre-optic Cable to Ha'apai, Vava'u	30	TBD[2]
	T10	Communications for Early Warning and Disaster Recovery	6	Grant from DP
Water	W3	Outer Islands Water Supply Improvements (Vava'u, Ha'apai, 'Eua)	15	Grant from DP
	W4	Expand Nuku'alofa Water System to Growth Areas	11	Grant from DP and/or PE self-finance
Solid waste	S6	New Landfill or Transfer Station on Ha'apai	4	Grant from DP
Roads	R10	Outer Islands Roads Upgrading Program	10	Grant from DP
Maritime	P9	Maritime Sector Safety and Resilience Program	20	Grant from DP
Aviation	A11	Resurfacing Ha'apai Runway, Apron, Taxiway	9	Grant from DP
	A12	New Control Tower for Fua'amotu	7	Grant from DP and/or PE self-finance
Multi-sector	M4	Disaster Response and Evacuation Infrastructure	12	Grant from DP
	M2	Coastal Protection – Eastern Tongatapu	15	Grant from DP

Maintenance of existing and new infrastructure is a high priority. As noted above, Government policy is that the cost of operations and maintenance of economic infrastructure should be funded from user charges wherever possible. Government intends to work closely with Public Enterprises, the private sector, and development partners to lift the overall performance of the infrastructure sector, and as a minimum, achieve self-funding of operations and sustainable maintenance by Government and Public Enterprises. In particular, appropriate maintenance expenditure levels need to be established, which means having effective asset management plans in place and then ensuring that service prices include provision for maintenance. Improvements in asset management systems are being trialled at the TWB and WAL under the Nuku'alofa Urban Development Sector Project (NUDSP), and the intention is that these improvements may be expanded to other Public Enterprises. Stronger Public Enterprises such as TPL already have effective asset management systems, and TPL is considering further investment in this area to better integrate asset management and financial management systems.

Taking these factors and the above analysis of potential funding sources into account, an indicative funding strategy has been developed. Table F.15 shows the total demand for infrastructure finance and an indicative projection of the sources of finance over the five year period 2013/14 to 2017/18. The analysis is based on the following key assumptions:

- All of the underway, committed, and proposed high priority investment projects and complementary initiatives go ahead as planned. As shown in Tables F.4 and F.15, this will involve around T$385 in new investments, T$15 million in complementary initiatives, and around T$70 million in maintenance of new and existing assets over the five year period.

- Improving Budget conditions should enable Government to make a small contribution to infrastructure investment, estimated at around T$1 million per year; and to increase spending on maintenance of outer islands ports to sustainable levels, either through direct Budget allocation and/or improved cost recovery. Investigation of improved mechanisms for management and financing of outer islands ports is a planned complementary initiative of this NIIP.

- The Road Fund is phased in as approved and as an interim measure, some top-up funding will be available from Budget or other sources during the phase-in period. When fully functional, the Road Fund is expected to contribute around T$6-7 million in dedicated funding for road maintenance. However, during the phase-in period, there may be some increase in the road maintenance backlog (estimated at T$5-9 million) that would be progressively cleared in later years.

[2] The financing modality of this project will be determined whether or not this project will be linked to the proposed extension of the fiber-optic cable from Tongatapu to Samoa.

- Public Enterprises continue strengthening their financial performance, and cover required maintenance and make infrastructure investment from their own resources. Based on current levels of expenditure (see Annex E) and assuming some strengthening in financial resources, Public Enterprises should be able to lift spending on infrastructure, and contribute around T$35 million of spending on required maintenance; and around T$80 million to financing capital expenditure in infrastructure over the five year period. This includes contributions to NIIP2013 high priority projects, to major investment projects already underway or committed, and to planned smaller investments that are part of the Public Enterprises' own investment program.

- Funding from Development Partners for economic infrastructure continues at around recent levels, but the mix of sources may change. As shown in Table F.12, development partners are contributing roughly T$380 million to recent and planned infrastructure projects. If a similar (or slightly lower) level of funding is maintained, it is of the right order of magnitude to assist with financing capital expenditure under NIIP2013. With Government's 'no new loans' policy in place, this may require an increase in grant finance to make up for lower utilisation of concessional loan finance, and a greater contribution from new sources, including regional and global funds, such as growing support for CCA/DRM activities. Government will take a lead role in facilitating CCA/DRM investments, a key emerging priority in the NIIP process.

Table F.15: Indicative infrastructure budget for 2013/14 - 2017/18 (T$ million)

		Funding Source		
	Demand for Funding	**Government**	**Public Enterprises**	**Development Partners**
Capital Investment	385	5	80	300
Complementary Initiatives [1]	15	-	-	15
Maintenance	70	35 [2]	35	-
Total	470	40	115	315

Notes: [1] Complementary initiatives will also require significant in-kind support from Government and Public Enterprises.
[2] Possible areas of shortfall here as the Road Fund is phased in.

Annex G: Review of the outcome and impact of the NIIP 2010

This Annex provides a review of the implementation and outcomes of the first NIIP that was prepared 2010, in particular, the status of prioritised investments and complementary measures, in terms of financing and implementation; the Government's capacity to implement the committed/funded priority projects under the NIIP; how maintenance has been addressed by the Government and/or development partners; how project costs were linked to the Government's budget framework; the extent to which NIIP priority projects have incorporated climate change adaptation (CCA) and disaster risk management (DRM) initiatives/strategies; an assessment of the success and impact of the NIIP in terms of what worked well and what has not; and how is the plan being used. For convenience, the first NIIP is referred to as NIIP2010 in the following discussion.

G.1: Summary of NIIP2010 priority initiatives

The priorities to emerge from the NIIP2010 planning process are summarised in Tables G.1 and G.2. The first provides a list of the twelve 'high priority' proposed projects for the period 2011-15; and the second puts these investment projects into the context of a broader integrated framework of priority investments and complementary initiatives is the essence of the NIIP. The framework is structured in terms of four ideas that in 2010 were Government's priorities themes for development of economic infrastructure over the next five years: *Greener Energy and more Stable Prices*; *Better Access to Markets*; *Better Management of the Water and Waste Cycle*; and *Better Asset Management*.

Table G.1: Summary of high priority investment projects

Sector	Ref	Project	Estimated Cost (T$million)	2011-2015
Energy	E11	Solar generation (Tongatapu - Additional 1MW)	14.0	
	E12	Renewable energy pilots (Coconut Oil/land fill gas)	3.0	
	E13	Energy Roadmap TGIF Projects	tbd	
Telecoms	T5	Upgrading of TBC Radio Towers	1.5	
	T6	International Fibre-Optic Cable	60.0	
		+ T7 Local Reticulation of High Speed Internet	8.0	
Water	W2	Upgrade Tongatapu (wells, storage, distribution)	6.5	
Solid Waste	S3	Vava'u Semi-Aerobic Landfill Facility	4.0	
Ports	P9	Inter-island port and terminal upgrades	10.0	
Airports	A8	Resurfacing of Fua'amotu runway, apron, taxiway	28.0	
	A10	Resurfacing of Vava'u runway, apron, taxiway	4.0	
	A11	Resurfacing Ha'apai runway, apron, taxiway	7.0	
		Total – high priority proposed projects	146	

Table G.2: Summary of NIIP2010 priority projects and complementary initiatives by theme

Theme	Sector	Priority Investment Projects	Complementary Initiatives
Greener Energy and more Stable Prices	Energy	Energy Roadmap implementation ▪ Renewable energy installations (solar T$14m) and pilot plants (biogas, coconut T$3m) ▪ Infrastructure components of the Energy Roadmap demand-side management program ▪ Tonga Green Incentive Fund (infrastructure components)	Energy Roadmap implementation ▪ Technical assistance for policy, legal, regulatory adjustments ▪ DSM and other non-infrastructure aspects of the Energy Roadmap ▪ Tonga Green Incentive Fund (other components) ▪ Improved fuel supply chain and price stability (e.g. hedging, upgrade tank farm, etc)
Better Access to Markets	Telecoms	▪ Under-sea optic fibre cable linking Tonga with international networks (T$60m) ▪ Upgrading of TBC AM radio transmitter (T$1.4m)	▪ Local reticulation of high speed internet by appropriate technology (such as cabling) ▪ Private sector and Government initiatives that take advantage of opportunities emerging from improved internet access (such as the E-Government Initiative)
	Ports	▪ Rehabilitate outer island ports to improve safety/reliability/ efficiency and support economic development (follow-up to immediate works to reconfigure ports for the new ferry) (T$10m)	▪ Develop post harvest facilities (handling, storage, processing) in conjunction with inter-island and international ports so that fishing and agricultural produce can be prepared, processed and stored for export and domestic markets. (initial support by EU)
	Airports	▪ Resurface airport runways (Tongatapu T$28m, Ha'apai T$4m, Vava'u T$7m)	▪ Update the policy environment for domestic aviation (study supported under the TSCP program). Government's response to the TSCP recommendations may require the support of specialist technical assistance. ▪ Develop post harvest facilities (handling, storage, processing) in conjunction with airports (initial support by EU)
Better Management of the Water and Waste Cycle	Water	▪ Accelerate the existing program to rehabilitate and upgrade water supply systems (especially Nuku'alofa) to increase efficiency, reduce losses etc. (T$6.5m)	▪ Prepare a roadmap for the Water Sector that examines the full water cycle, including waste water and drainage. The roadmap should address (a) institutional responsibilities in the water and waste sectors, including an organisational and business model for managing urban drainage (b) the TWB financial and pricing model and revenue collection; (c) drainage plan for Nuku'alofa; (d) a water and drainage investment plan for the next 10 years.
	Solid Waste	▪ Delay new infrastructure investments, pending the results of the proposed sector roadmap ▪ New semi-aerobic landfill at Vava'u, depending on the outcome of the sector roadmap (T$4m) ▪ Other recommendations of the sector roadmap	▪ Prepare a sector roadmap that addresses current issues and required improvements to the institutional, financial and operational model for the sector and provides a 5-10 year investment plan.
Better Asset Management	All Sectors		▪ Institutional reform to clarify and simplify institutional responsibilities across all sectors. ▪ Develop a national policy for strategic asset management, that promotes asset management as a core function of agencies and incorporates a longer-term view of infrastructure needs and asset management. ▪ Investigate the potential for establishing a multi-sector regulatory regime that reviews and make recommendations regarding pricing of common-user services (power, water, waste, telecom wholesaling)
	Roads	▪ No additional priority projects over the next five years. The priority is to complete the projects already underway or committed	▪ Implement new arrangements for sustainable road maintenance funding and delivery (study supported under the TSCP program). Government's response to the TSCP recommendations may require the advisory support of specialist technical assistance.
	Domestic Ports		▪ Implement new institutional/financial arrangements for sustainable management and maintenance of domestic ports.

G.2: NIIP2010 project status

Substantial progress has been made on implementation and financing of the NIIP2010 priority initiatives. This section provides an overview of progress, including the stage of implementation as at late 2012, source and type of funding, and noting any changes to the project concept, cost, or implementation.

Priority investment projects

The current status of priority investment projects is shown in Table G.3. For each project, the Table shows:

- the original and updated cost estimate
- progress of implementation, classified as:
  - Feasibility: projects for which sufficient pre-feasibility or feasibility analysis has been undertaken to identify the investment requirements and likely cost.
  - Approved: the project has been considered by the Government of Tonga (GoT) or Board of the relevant Public Enterprise and approved as a priority project, but funding is not yet confirmed.
  - Committed: funding has been identified and confirmed for the investment and there is a high probability that it will proceed, but the timing may change.
  - Underway: project implementation has already started.
  - Operational: project implementation is completed and it is operational.
- source and type of funding; and
- notes on implementation activities.

The overall picture is of a high success rate in terms of attracting funding and moving forward with implementation:

- Eight of the 12 priority projects have committed funding and are at various stages of implementation.
- Tonga Energy Road Map (TERM) projects are taking longer than expected to start implementation, but are still in the pipeline.
- The Inter-island Port and Terminal Upgrades project has not progressed as envisaged under NIIP2010, but other activities are underway to address many of the urgent infrastructure issues. This includes basic upgrades that were undertaken to accommodate the new ferry with funding from the Government of Tonga. Urgent safety-related deficiencies (especially navigational aids) are being addressed under the World Bank (WB)-funded Transport Sector Consolidation Plan (TSCP). Further upgrades may occur as part of a proposed WB-funded regional maritime safety and investment project that is currently under discussion.
- Only the Resurfacing Ha'apai Airport Runway project has not progressed. This project was considered under the WB-funded Pacific Aviation Investment Plan (PAIP), but could not be accommodated within the available funding envelope, and as a domestic airport, Ha'apai does not have a regional aviation role.

Completing the implementation of these projects is a high priority, but overall it means that a largely new set of priority investment projects can be expected for the NIIP2013.

Table G.3: Summary of status of high priority investment projects

		Status									
Sector	**NIIP2010 Priority Project (Responsible Agency)**	**Estimated Cost (T$ million 2010)**	**Updated Cost (T$million 2012)**	**Feasibility**	**Approved**	**Committed**	**Underway**	**Operational**	**Source of Funding**	**Type of Funding**	**Notes**
Energy	Solar power generation (Additional capacity ~1MW) (TP, TERM)	14.0	6.4	☑	☑	☑	☑		UAE	Grant	Second array (0.5MW) underway on Vava'u with grant funding from UAE (Abu Dhabi).
			24.0	☑	☑						Additional 1-2MW of solar arrays on Tongatapu are under discussion with JICA and other Development Partners. Possible 2013/14 start.
	Renewable energy pilots (Coconut Oil/ landfill gas) (TERM)	3.0	3.0	☑	☑						Research and feasibility studies underway. Possible 2013/14 start
	Energy Roadmap TGIF Projects (TERM)	tbd	tbd	☑	☑						Research and feasibility studies underway for establishment of the TGIF. Possible 2013/14 start.
Telecoms	Upgrading of TBC Radio Towers (TBC)	1.5	1.0	☑	☑	☑	☑	☑	ICU/ Korea Broadcasting Commission	Grant	Completed 2011
	International Fibre-Optic Cable (TCL, TCC)	60.0	53.0	☑	☑	☑	☑		ADB, World Bank, TCC	Grant, Equity	Expected completion 2013
	+ Local Reticulation of High Speed Internet (TCC)	8.0	Conf.	☑	☑	☑	☑		TCC	Self-funded	Progressing in advance of Cable completion.
Water	Upgrade Tongatapu (wells, storage, distribution) (TWB)	6.5	8.0	☑	☑	☑	☑		ADB/AUSAID	Grant	Nuku'alofa Urban Development Sector Project
Solid Waste	Vava'u Semi-Aerobic Landfill Facility (MLECCNR)	4.0	3.0	☑	☑	☑	☑		JICA	Grant	Project changed to upgrading of existing landfill instead of new landfill
Ports	Inter-island port and terminal upgrades (MOI, PAT)	10.0		☑	☑				Not funded, but some basic upgrades have been implemented		Basic upgrades were undertaken to accommodate the new ferry and urgent safety-related deficiencies are being addressed under TSCP. Further upgrades expected to be grant funded by a WB Regional maritime safety and Investment project that is currently under discussion. Additional CCA-related investments may also be funded under an ADB-administered PPCR project.
Airports	Resurfacing of Fua'amotu runway, apron, taxiway (TAL)	28.0	38.0	☑	☑	☑			World Bank/IDA	Grant	Part of PAIP (Pacific Aviation Investment Program)
	Resurfacing of Vava'u runway, apron, taxiway (TAL)	4.0	11.0	☑	☑	☑			World Bank/IDA	Grant	Part of PAIP (Pacific Aviation Investment Program)
	Resurfacing Ha'apai runway, apron, taxiway (TAL)	7.0	9.0	☑	☑				Not funded		No funding source currently identified.

The breakdown of funding sources for NIIP2010 priority investment projects is shown in Table G.4. The main features of the funding split are:

- grant from Development Partner is by far the major source of funding for all projects, except local reticulation of high-speed internet access which is being self-funded by the Tonga Communications Corporation (TCC) and others from internal resources. This highlights the success of the NIIP2010 in terms of facilitating dialogue with Development Partners;
- the TCC also has a significant equity shareholding in the International fibre-optic cable project; and
- other inputs from the Government of Tonga and Public Enterprises are small and generally in the form of in-kind support or revenue-forgone in taxes.

This is consistent with the NIIP2010 funding strategy and the Government's financial position.

Table G.4: Source of funding for priority investments

		Development Partners				
Project	**Internal Finance**	**GoT Budget**	**CAPEX Grant**	**Concessional Loan**	**TA & Other**	**Commercial Finance**
Solar generation (Tongatapu)		1	3			
Coconut Oil/waste Pilot Plant						
Implementation of Energy Roadmap (TGIF)						
Upgrading of TBC Radio Towers		1	3			
International Fibre-Optic Cable	2	1	3			
Local reticulation of high speed internet	4					
Upgrade Tongatapu water supply	1	1	3			
Vava'u Semi-Aerobic Landfill Facility		1	3			
Outer-island Port Upgrades		1	1			
Resurfacing of Fua'amotu runway, etc	1	1	3			
Resurfacing of Vava'u runway, etc	1	1	3			
Resurfacing Ha'apai runway, etc						
Sole source of finance	4					
Principal source of finance	3					
Medium source of co-financing	2					
Smaller source of co-financing	1					
Not a source of finance	-					

G.3: Complementary measures

The current status of NIIP2010 complementary measures is shown in Table G.6. The overall picture is mixed.

- TERM initiatives and reforms in ports and road maintenance outsourcing and funding are underway, but progress is slower than expected.
- There is good recognition of the need for a greater focus on asset maintenance and there is committed funding under the Asian Development Bank (ADB)-funded Nuku'alofa Urban Development Sector Project (NUDSP) to develop asset management systems in urban utilities by the end of 2013, but no material progress on a broader approach.
- Some progress has been made on sector plans under the TSCP and further progress will be made under the NUDSP, but there is still work to be done to produce detailed sector roadmaps that complete the national framework that links the TSDF with sector plans and corporate plans.

It is likely that many of the complementary initiatives in NIIP2010 will continue to be strong candidates for priorities in NIIP2013.

Table G.5: Status of NIIP complementary initiatives

Sector	Complementary Initiatives	Progress
Energy	**Energy Roadmap implementation** ▪ Technical assistance for policy, legal, regulatory adjustments ▪ DSM and other non-infrastructure aspects of the Energy Roadmap ▪ Tonga Green Incentive Fund (other components) ▪ Improved fuel supply chain and price stability (e.g. hedging, upgrade tank farm, etc)	▪ Underway. TA resources provided by PIAC, ADB, WB and others ▪ Underway. TA examining technical and institutional options is underway as part of an ADB regional Energy Efficiency project. ▪ Underway. Research TA is underway examining options for establishment of the TGIF. Possible 2013/14 start for the Fund. ▪ Underway. Cabinet has established a WG to research and analyse options; test the market; and recommend a preferred model. Work is well advanced but no timeframe for implementation of reforms.
Telecommunications	**Building on the High Speed Internet Opportunities** ▪ Local reticulation of high speed internet by appropriate technology (such as cabling) ▪ Private sector and Government initiatives that take advantage of opportunities emerging from improved internet access (such as the E-Government Initiative)	▪ Underway. Investment project self-funded by TCC (see investments Table) ▪ Partial progress. E-Government initiative is building momentum, but little sign of private sector initiatives outside of the internet/mobile phone market. Private sector appears to be adopting a wait and see approach.
Water	**Sector Roadmap** ▪ Prepare a roadmap for the Water Sector that examines the full water cycle, including waste water and drainage.	▪ Partial progress. Groundwork was undertaken for water supply roadmap during preparation of the ADB NUDSP and is expected to be completed during NUDSP implementation starting 2012. No progress on waste water and drainage.
Solid Waste	**Sector Roadmap** ▪ Prepare a sector roadmap that addresses current issues and required improvements to the institutional, financial and operational model for the sector and provides a 5-10 year investment plan.	▪ Partial progress. Groundwork was undertaken for reform roadmap during preparation of the ADB NUDSP and is expected to be completed during NUDSP implementation starting 2012. No progress on waste water and drainage.
Aviation	**Policy Environment** ▪ Update the policy environment for domestic aviation (study supported under the TSCP program). Government's response to the TSCP recommendations may require the support of specialist technical assistance. ▪ **Post-Harvest Facilities** ▪ Develop post-harvest facilities (handling, storage, processing) in conjunction with airports (initial support by EU)	▪ Completed. Aviation Sector Study, including recommendations about the policy environment and sector reform was completed under TSCP in early 2012. ▪ Partial progress. Attention has focused on post-harvest facilities at sea ports, see below.
Roads	**Road Maintenance Funding** ▪ Implement new arrangements for sustainable road maintenance funding and delivery (study supported under the TSCP program). Government's response to the TSCP recommendations may require the advisory support of specialist technical assistance.	▪ Underway. TSCP has prepared options for establishment of a Road Fund which is the approach favoured by Government. An Government WG has been established (with support from TSCP) to prepare options and mechanisms for establishing a Road Fund. The target is to have the Fund in operation by 2013/14.
Ports	**Institutional Arrangements** ▪ Implement new institutional/financial arrangements for sustainable management and maintenance of domestic ports.	▪ Underway. The Government Working Group on Government Structural Reform has indicated that the primary role of MOI is policy, planning and regulation and service functions should be transferred or outsourced. The MOI reform review undertaken by the TSCP Change Management consultant has recommended that all domestic ports should be transferred to Ports Authority Tonga (PAT), but the option of community ownership of some outer islands ports has been raised as alternative to PAT.

Sector	Complementary Initiatives	Progress
	Post-Harvest Facilities ▪ Develop post-harvest facilities (handling, storage, processing) in conjunction with inter-island and international ports so that fishing and agricultural produce can be prepared, processed and stored for export and domestic markets. (initial support by EU)	▪ Underway. Improved post-harvest processing and storage facilities for agricultural produce (cooling, blast freezing and storage) have been constructed at Nuku'alofa and Vava'u ports with assistance from EU and additional inputs from AusAID.
All Sectors	**Streamlining Government Systems** ▪ Institutional reform to clarify and simplify institutional responsibilities across all sectors	▪ Underway. The Government WG on Government Structural Reform has delivered recommendations on streamlining the institutional structure of Government. These reforms were approved by Cabinet in October 2011 and implementation is underway.
	Asset Management Policy ▪ Develop a national policy for Strategic Asset Management, that promotes asset management as a core function of agencies and incorporates a longer-term view of infrastructure needs and asset management.	▪ Partial. Committed. Effective and appropriately funded maintenance and asset management is recognised in the TSDF as core function and key outcome objective. The ADB NUDSP starting late 2012 includes Technical Assistance for building capacity to develop and implement urban infrastructure asset management plans. It includes targets that preparation of asset management plans is mandatory for all public urban services providers by March 2013 and demonstration asset management plans (TWB, WAL) will be prepared and implemented by July 2013.
	Multi-sector Regulator ▪ Investigate the potential for establishing a multi-sector regulatory regime that reviews and make recommendations regarding pricing of common-user services (power, water, waste, telecom wholesaling)	▪ Not Adopted. GoT plans for regulatory reform have moved away from this concept.

G.4: Project sustainability

As described above, the NIIP2010 has been successful in terms of the high success rate in attracting funding and moving forward with implementation of priority investment projects and complementary measures. This section examines the sustainability of the initiatives in terms of capacity to implement, finance, and maintain the priority initiatives, and from the perspective of long term climate change (CC) and disaster risk management (DRM) implications.

Management capacity to implement the priority initiatives

Responsibility for infrastructure development and operation is currently split between Government and Public Enterprises. The overall picture in terms of management capacity to implement NIIP priority initiatives is mixed:

- Government's capacity for implementation of complex projects of the scale of NIIP priority investment projects is generally weak. In particular, the Ministry of Infrastructure (MOI) is growing into the role of the central agency for infrastructure policy, planning, regulation and management, but its capability is currently weak:
  - most MOI staff are unqualified and currently engaged in service delivery rather than MOI core functions of policy, planning, contract management and regulation;
  - only a small number of staff have graduate or higher degrees, and the MOI only has a handful of qualified engineers;
  - the age profile of the MOI staff is skewed, with around two-thirds of staff older than 40 years and around 40 per cent older than 45 years;
  - there is limited in-house experience in planning, developing, and managing implementation of projects of the size and complexity of most NIIP priority projects; and
  - reforms, restructuring, and cultural change currently underway will address many of these issues, but it will be a gradual process of the MOI growing into its new role. Addressing these issues is a focus of the MOI establishment and change management process, with assistance under the TSCP.

- Public Enterprises have more experience and generally greater capability in implementing major infrastructure projects
  - The TCC, TPL, TWB and TBC have good in-house capability and considerable experience in implementing technology change projects in partnership with foreign equipment suppliers.
  - TAL has in-house technical expertise, but is receiving technical, procurement and contract management support under the TSCP and PAIP.
  - The longer established PEs have built their technical and contract management experience over many years, and usually with the support of Technical Assistance (TA) related to past major aid-funded projects.
  - However, introduction of new technologies in association with major investment (such as the undersea telecommunications cable project) continue to be undertaken with outside TA.

Overall, there are pockets of expertise in investment project development, contracting, and management, but most major investment projects, especially those involving new technologies or methods, are likely to continue to be implemented with TA support from development partners or equipment suppliers.

Financial capacity to implement the priority initiatives

As noted above, most of the NIIP2010 priority projects have been financed by grants from Development Partners, or partly or fully funded by stronger PEs (notably TCC) from internal resources. This largely reflects the level of available financial capacity to implement the priority projects:

- The Government's budget position and financial position is weak
  - Since the NIIP2010, GDP growth has been flat, overall public debt has grown, and a policy of no new loans has been adopted (2012/13 GoT Budget).
  - The capacity to invest in infrastructure projects is highly constrained, with grants from Development Partners being the most common and preferred mechanism.
  - The capacity to finance sustainable maintenance is also Budget constrained, with spending on the maintenance and rehabilitation of roads and outer island ports continuing to be patchy and below sustainable levels (see below).

- In contrast, on the basis of preliminary analysis and interviews undertaken with PE managers, it appears that the financial performance of several (maybe most) Public Enterprises is improving.
  - TCC, TPL, TAL, and PAT are relatively strong and generally sustaining or improving their financial performance, with capacity to self-fund routine maintenance and small-medium-sized infrastructure.
  - The TBC and TWL have sufficient cash-flow to cover routine operations and minor maintenance, but continue to struggle financially and have a limited capacity to self-fund infrastructure development.
  - WAL is still financially weak (requiring subsidy from the Government Budget) but appears to have turned the corner following recent reforms and will receive assistance to further improve its performance under the NUDSP.

Overall, a preliminary assessment of financial capacity to implement the NIIP2010 priority initiatives indicates that:

- The Government continues to have very limited capacity to finance significant infrastructure investment and loans continue to be not a viable option.
- PE financial capacity appears to have improved, but the overall assessment from NIIP2010 is unchanged.
  - The stronger PEs have effective maintenance programs in place and can fully fund routine maintenance and small-medium asset renewal from their own resources.
  - All PEs would struggle to self-finance investments required to replace or rehabilitate the largest item of infrastructure that the Public Enterprise already owns (such as the airport runway) or is required in order to transform the business (such as an undersea fibre-optic cable).
  - The weaker PEs struggle to sustain financing of regular maintenance and any new investment.

Maintenance implications of priority investments

The maintenance implications of the NIIP2010 priority investments vary, as shown in Table G.6. The key findings are:

- Most NIIP2010 priority projects are managed by PEs and are not part of the Government Budget. The only on-Budget maintenance liabilities are for
  - road maintenance;
  - maintenance of outer islands port facilities; and
  - solid waste disposal facilities for outer islands.

- Many of the NIIP2010 priority projects are upgrades to or rehabilitation of existing infrastructure. In these cases, investment leads to reduced maintenance cost in the short-medium term. Other projects, such as the Undersea Communications Cable and local distribution networks and solar power arrays, are new infrastructure but of a type that has low short-medium term maintenance costs, especially during the initial period when service arrangements are still in place under supply contracts.

- NIIP2010 found that Government spending on infrastructure maintenance under its management was patchy and well below sustainable levels. Based on a preliminary analysis of 2012 and 2013 Government Budget figures, this situation does not appear to have changed.
  - In recent years, road maintenance funding has been reliant on assistance from development partners, notably under the TSCP and the China Road Program. The Government has allocated around T$1 million in 2012/13 for road maintenance, in part as a precursor to the operation of the proposed Road Fund. According to figures prepared for the Road Fund Working Group, the funding requirement for routine/periodic maintenance to sustain Tonga's roads in good condition is around T$6.5 million per year.
  - Budget funding for maintenance of outer island port infrastructure continues to be very small and mostly on a reactive basis.
- In response to this situation, the Government is exploring alternative funding mechanisms. The establishment of a Road Fund has been approved by Government and will be phased in from late 2013. Options for other sector-specific funding mechanisms will be explored in more detail in the NIIP update.

- It is also important to note the maintenance implications of the NIIP2010 priority investments that have <u>not</u> been addressed. In general, they involve a high and increasing maintenance burden. For instance, the delayed rehabilitation of the Ha'apai airport runway and outer islands wharves leads to increased short-medium term maintenance and operating costs.

Overall, it is likely that the short-medium term implication of the NIIP2010 priority investment package is a small reduction in the cost of required sustainable maintenance. However, it is important to distinguish between required spending for sustainable maintenance versus the amount actually spent. In most sectors, actual historical spending has been below the sustainable level. Reduced maintenance requirement in the short term provides breathing space in which to address asset management issues and maintenance budgets, and put in place financial and technical mechanisms for sustainable long term maintenance. Options for sector-specific funding mechanisms for sustainable maintenance will be explored in more detail in the NIIP update.

Table G.6: NIIP2010 maintenance implications

Sector	Project	Updated Cost T$ million 2012	Committed	Underway	Operational	Notes
Energy	Solar generation (Tongatapu - Additional 1MW)	6.4	☑			Completion planned for 2013. Routine maintenance costs are generally small. Maintenance costs self-funded by TPL.
	Renewable energy pilots (Coconut Oil/land fill gas)	3.0				Research and feasibility studies underway. Possible 2013/14 start. Maintenance implications will depend on results of the feasibility studies.
	Energy Roadmap TGIF Projects	t.b.d.				Research and feasibility studies underway for establishment of the TGIF. Possible 2013/14 start. TGIF involves grants to the community and private sector who will then be responsible for maintenance.
Telecoms	Upgrading of TBC Radio Towers	1.0	☑	☑	☑	Upgrading completed in 2011. Significant reduction in maintenance costs in the short-medium term. Routine maintenance self-funded by TBC.
	International Fibre-Optic Cable	53.0	☑	☑		Completion planned for 2013. Maintenance costs are included in overall business plan and cable supply/maintenance contract. Maintenance self-funded by TCL.
	+ Local Reticulation of High Speed Internet	Conf.	☑	☑	☑	Underground cabling with minimal maintenance required in the short-medium term. Routine maintenance self-funded by TCC.
Water	Upgrade Tongatapu (wells, storage, distribution)	8.0	☑			To be implemented under the ADB NUDSP. Significant reduction in maintenance costs in the short-medium term.
Solid Waste	Vava'u Semi-Aerobic Landfill Facility	3.0	☑	☑		Increased maintenance and operational cost due to increased complexity of the landfill structure and operation.
Ports	Inter-island port and terminal upgrades	10.0				No funding identified or timeframe for the proposed port upgrading, but discussions are underway to include some components in a future regional maritime safety program (World Bank). Increasing maintenance required in the short term. Budget funding currently inadequate. In the longer term, it is expected that the outer islands ports will be transferred to PAT, then maintenance will be self-funded by PAT.
Airports	Resurfacing of Fua'amotu runway, apron, taxiway	38.0	☑			Pavement rehabilitation expected to be completed in 2013, then significant reduction in maintenance costs in the short-medium term. Routine maintenance self-funded by TAL.
	Resurfacing of Vava'u runway, apron, taxiway	11.0	☑			Pavement rehabilitation expected to be completed in 2013, then significant reduction in maintenance costs in the short-medium term. Routine maintenance self-funded by TAL.
	Resurfacing Ha'apai runway, apron, taxiway	9.0				No investment funding identified or timeframe for the pavement resurfacing. Increasing maintenance cost in the short term due to deteriorating condition of the runway. Routine maintenance self-funded by TAL.

Climate change adaptation and disaster risk management

The best available scientific advice[63] indicates that Tonga's climate is changing and is expected to continue to change. Key aspects of latest projections relevant to infrastructure sustainability include:

- Annual average air temperature and sea surface temperature will increase and by 2030, under a high emissions scenario, this increase in temperature is projected to be in the range of 0.3–1.1°C. This will be accompanied by a rise in the number of extreme hot days and warm nights and a decline in cooler weather.
- Trends in rainfall are less certain, however, projections generally suggest a decrease in dry season rainfall and an increase in wet season rainfall over the course of the 21st century. Extreme rainfall days are likely to occur more often.
- There is likely to be a decrease in the number of tropical cyclones by the end of the 21st century, but cyclones are likely to be more intense (increase in the average maximum wind speed and rainfall intensity).
- Sea levels are expected to continue to rise so that by 2030, under a high emissions scenario, the rise in sea level is projected to be in the range of 3-17cm.

The greatest risks to infrastructure result from the increase in extremes: more very hot days, increased rainfall intensity, and more powerful cyclones. Coupled with sea level rise, this creates significant challenges for the future of infrastructure planning, development, and management. This has important implications for the NIIP process and highlights the need for a greater emphasis on climate change adaptation (CCA)/disaster risk management (DRM) issues in the NIIP2.

The remainder of this section provides an evaluation of the degree to which DRM and CCA issues were considered, either implicitly or explicitly, in the development and implementation of the NIIP2010. The evaluation is based on a review of the NIIP2010 documentation, discussions with stakeholders involved in NIIP2010 development and implementation, and field visits to selected NIIP2010 infrastructure projects that are under development or that have been completed.

The NIIP2010 contains very limited reference to DRM or CCA issues. There is reference to the multi-function role that some infrastructure can play in responding to natural disasters (e.g. the importance of AM radio communications for early warning systems (EWSs), or the dual use of roads for evacuation), however the potential dual-use function of infrastructure is not carried forward into the analysis or development of priority projects. There was also no explicit consideration of DRM or CCA issues in the multi-criteria analysis (MCA) that was used to prioritise projects. The climate change mitigation benefits of potential projects are considered in a qualitative manner in the MCA, but there is no link made to CCA. Furthermore, the NIIP2010 contains no explicit consideration of the risks to infrastructure or the ways in which infrastructure investments could be rendered more climate resilient.

The NIIP2010 recognised that the *Joint National Action Plan on DRM and CCA for 2010 to 2015* (referred to as JNAP) preparation process was being carried out in parallel to its development, and recommends that future revisions of the NIIP address DRM and CCA issues. It contains reference to an unidentified, un-costed climate change adaptation project to be implemented in the medium term, and envisages that future versions of the NIIP will include a priority theme related to DRM and CCA that will be closely aligned with the recommendations of the JNAP.

Discussions with Government stakeholders involved in the development and implementation of NIIP2010 revealed a generally high level of awareness of issues related to climate change and natural disasters, but a relatively low awareness of Government policy to address climate change, or of practical solutions to address climate change and natural disaster risks in infrastructure planning and development. Stakeholders indicated that there was no legal obligation for the treatment of climate and natural disaster risks in infrastructure development, and technical capacity to carry out such work was low within sector agencies and Public Enterprises. Stakeholders indicated that the integration of measures into NIIP2010 projects was carried out on a case-by-case basis and was influenced by the skills of the implementing body, and in some cases, the requirements of donors or of international financial partners. Stakeholders indicated that there was no clear framework or systematic approach for climate risk analysis or resilience building in the sector.

The survey of selected projects implemented under the NIIP2010 confirmed the findings of the stakeholder consultation in relation to the inconsistent integration of resilience building measures. For example, the AM radio receiver located near Popua on Tongatapu (NIIP2010 Priority Project T5) was reconstructed in the same location

[63] Pacific Climate Change Science Program, *Current and Future Climate of Tonga* (2011), www.pacificclimatechangescience.org.

despite flooding, tsunami, and storm surge risks and despite the recognised DRM function of this infrastructure. The fibre-optic cable landing station (NIIP2010 Priority Project T6) also located in a zone subject to flooding, wind damage, erosion, and tsunami risk, yet in this case specific measures were integrated into project design including elevation of sensitive equipment and back-up energy supplies, and integration of cyclone-resilient building design (see Case Study 1). Although no explicit CCA/DRM features have yet been designed into the Tongatapu water supply upgrading project (NIIP Priority Project W2), an ongoing program is underway to monitor salinity levels in underground water and climate change impacts on the well-field (see Case Study 2).

Stakeholders indicated a lack of specific technical skills relating to climate resilience building for large-scale economic infrastructure. All stakeholders welcomed the opportunity to include DRM and CCA issues in the updating of the NIIP both as a means of identification of pragmatic and cost-effective measures to address climate change and natural disaster risks in the infrastructure, and as an important step in mainstreaming such issues into Government sector policy.

Case Study 1: Cable Landing Station

The Tonga Cable Ltd (TCL) landing station for the Tonga-Fiji undersea communications cable is located on Vuna Rd at Sopu in Nuku'alofa. It is around 50m from the sea shore high tide level and estimated elevation of only around 1m or less above sea level. Although it appears to be in a high risk location, it is the result detailed planning and consideration of CCA/DRM and cost factors.

The site is behind an existing seawall and is also protected from storm surge or tsunami by around 500m of reef and by offshore islands. This provides an initial layer of protection. The TCL building also includes many design features to mitigate damage in the case of flooding. It is constructed from thick concrete slabs and columns to safeguard against building collapse, and is slightly raised on strong foundations. Offices and other expendable functions are located on the Ground floor; while critical communications equipment is located in the upper floor around 8 metres above ground level. Backup power supply is located in a separate strengthened building behind the main building, with generators raised about 1.5m above floor level. The cable connection between the TCL building and the undersea section is underground and water-proofed.

Case Study 2: Nuku'alofa Water Supply

The Tonga Water Board (TWB) draws water for the Nuku'alofa reticulated supply from underground reserves located on the outskirts of Nuku'alofa. Apart from small water tanks serving individual homes/premises, this well-field is the only source of water in Nuku'alofa. TWB is highly aware of climate change issues and has participated in climate change-related projects with agencies such as Sopac. TWB has/is putting on place a range of measures to monitor possible climate change impacts and improve the resilience of the water supply system, in particular:

- TWB has a water testing program that is regularly monitoring and mapping salinity levels in each well in the supply area. This provides ongoing monitoring of possible incursion of saline water and impact on water quality. TWB has also identified another location for development of a well field for future needs and backup.

- TWB has installed diesel-powered backup generators to provide continuity of water supply in the case of loss of electricity, especially during cyclones and other disasters that may affect the mains electricity supply.

G.5: NIIP2010 impact

The impact of the NIIP2010 can be assessed on several levels, including its success as a facilitator for project investment and complementary initiatives; its formal adoption and success as a guiding document for the infrastructure sector; its broader impact in terms of awareness; and its use in the infrastructure planning and development process.

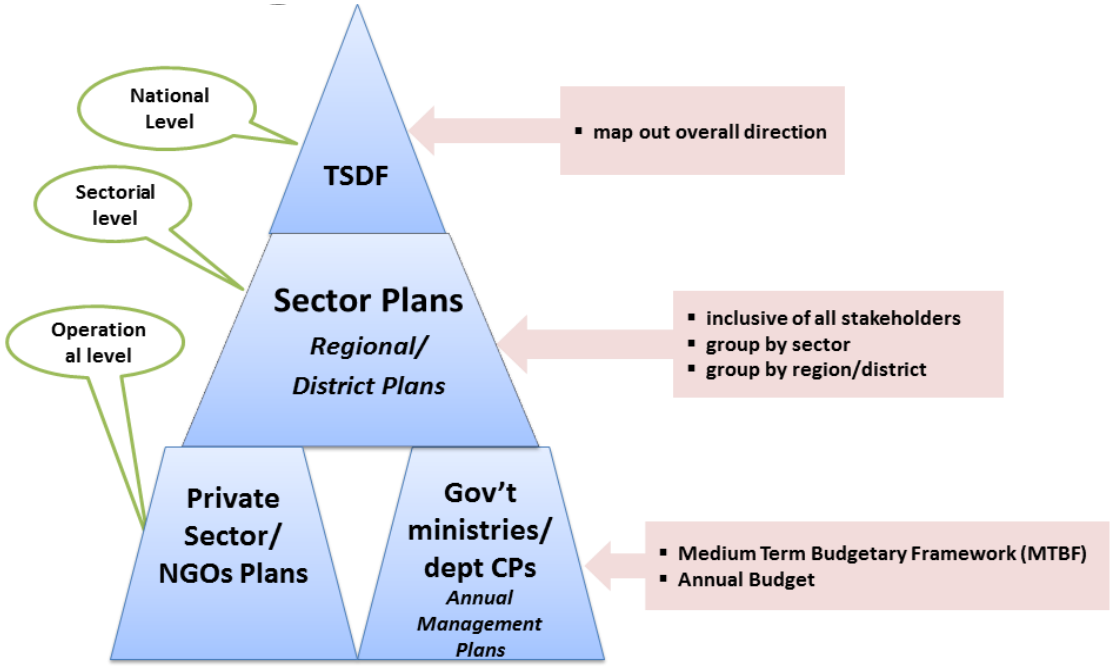
Policy and project impact

NIIP2010 has been successful in terms of:

- Obtaining formal support and endorsement from the Government.
  - The NIIP2010 was formally adopted as Government policy in late 2010.
  - The NIIP is highlighted in the Tonga Strategic Development Framework (TSDF) as the guiding document for the infrastructure sector and implementation of the NIIP is a key output objective of the TSDF.
  - The Government of Tonga's Budget Strategy for 2012/2013 – 2014/2015 states that "[c]apital investments may be made only on items identified within and consistent with the Government National Infrastructure Investment Plan (NIIP) and this plan is already due for updating".
  - The NIIP has a unifying role in the middle level of the Government planning triangle (Figure G.1).
- Its role in the dialog with sources of project finance (especially Development Partners), as reflected in the high success rate in securing funding for priority projects.

Based on the observed outcomes of the NIIP2010 and interviews with stakeholders, it appears that the main uses of NIIP2010 have been as a facilitator for the dialog with Development Partners and as a tool for MFNP in screening proposed projects for possible Government support. The NIIP2010 appears to have had less impact as a tool for guiding day-to-day planning and management in each of the infrastructure sectors. In part, this can be attributed to a lack of long-term strategic planning being undertaken within Government infrastructure agencies and some PEs, and of a general lack of awareness of the NIIP2010, as discussed below.

Figure G.1: Structure of government planning processes



Broader awareness and penetration

The following assessment of the level of broader awareness of NIIP2010 and its penetration into the routine infrastructure planning and management process is based on interviews with stakeholders from Ministerial to officer

level in Government; and representatives of the private sector, non-government organisations (NGOs), and community. The overall picture from these interviews is of a level of awareness and penetration that diminished with time since the adoption of the NIIP2010 and with distance from MFNP:

- There is strong awareness within relevant areas of the MFNP and the NIIP provides a useful screening tool for MFNP for proposed projects.
- Senior staff of agencies outside the MFNP generally have a lower level of awareness of the NIIP, and generally the NIIP has little impact at that level.
- Ministers/members in the current Government are generally aware of the NIIP but not familiar with its content in detail and its significance in infrastructure planning.
- NGOs and private sector are generally unaware of the NIIP. The Chamber of Commerce is aware of the NIIP but that awareness does not seem to have penetrated more widely in the private sector.
- Awareness of the NIIP2010 by the general population is difficult to judge, but appears to be very low, with the exception perhaps of individuals with a direct interest in infrastructure development.

In part, this situation can be linked to a range of factors including availability, access, scope, format, and ownership of the NIIP:

- The NIIP2010 was prepared in mid-2010, finalised and adopted by Government in late 2010 then endorsed by the new Government. Awareness of the NIIP would have peaked during this period and appears to have diminished over time.
- The NIIP2010 document is not currently available on Government websites, including the MFNP website. The NIIP2010 is available electronically on the PRIF and AusAID websites, but a web search provides no other links to access the NIIP2010 document.
- The NIIP document is available electronically on the MFNP servers, but this is not widely known within MFNP and the NIIP document is less available in other agencies.
- Hard copies of the NIIP document are rare and difficult to find. Restructuring of Government agencies and staff changes at senior levels appear to have contributed to this situation.
- The NIIP is a large and somewhat intimidating document, and although there is a brief Executive Summary that captures the key priorities and messages, there is no widely available abbreviated version of the NIIP that is targeted at a broad audience.
    - For the TSDF there is a 'booklet; version which is simply a statement of the vision, outcome objectives and supporting themes of the TSDF.
- The content of the NIIP2010 document was generally seen as appropriate in terms of scope and depth, but the view was also expressed during interviews that while material in the NIIP2010 Annexes provides valuable background detail, it is of limited interest/relevance to Government officials in terms of applying the NIIP.
    - This indicates a need to balance the interests/requirements of different audiences in framing and structuring the NIIP document
- The MFNP is generally seen as the 'owner' of the NIIP. The NIIP2010 was developed within the MFNP structure and the MFNP is responsible for overall national planning. However, infrastructure is just one of many sectors and macro-economic issues that fall within the responsibility of the MFNP and it appears that the Ministry has not actively promoted the NIIP to a broader audience. With changes in Government structure, in particular the creation of a MOI, there is an opportunity to clarify ownership of the NIIP and allocate responsibility for driving NIIP2013 awareness and implementation.

G.6: Implications and expectations for the NIIP update

The success of the NIIP2010 in terms of formal adoption by Government, facilitating dialog with Development Partners, and facilitating funding for priority projects and initiatives, suggests that the NIIP2010 got it just about right in terms of capturing the prevailing key themes and priorities for the infrastructure sector. But the NIIP2010 has been less successful in terms of achieving broad and lasting awareness, and impact at a working-level in Government and the broader community.

The NIIP update should build on the successes of the NIIP2010, but at the same time, needs to be shaped to generate greater and more lasting awareness and relevance at all levels of Government. In addition, in the time since the NIIP2010 was prepared, there has been a change of Government, the TSDF 2011/14 has been adopted, and priorities have evolved. There is an expectation that the NIIP will provide a systematic statement of priorities that reflects the current Government priorities. There are also a range of areas that have been identified where the scope of the NIIP could be strengthened to provide a better coverage of key issues and have a greater impact within the infrastructure

sector. This section highlights expectations for the NIIP update and areas where the coverage and impact of the NIIP process may be strengthened.

Themes and priorities

Based on this review of NIIP2010 and interviews with key stakeholders, there are a number of areas that could be given greater prominence in the NIIP update to increase its overall relevance to GoT national priorities and its impact on the infrastructure sector. These areas include:

- The importance of infrastructure as both:
  - a facilitator to economic development, especially exports (and equally of inadequate infrastructure as a brake on development), and highlighting the important role that the NIIP can play in this process; and
  - an enabling foundation for vibrant and healthy communities.

- Prioritising investments and supporting initiatives that improve the everyday lives of people and lower the cost of business in line with TSDF outcome objectives, in particular:
  - Objective 3: appropriate, well planned, and maintained infrastructure that improves the everyday lives of the people and lowers the cost of business, by the adequate funding and implementation of the National Infrastructure Investment Plan (NIIP)
  - Objective 7: cultural awareness, environmental sustainability, disaster risk management, and climate change adaptation, integrated into all planning and implementation of programmes, by establishing and adhering to appropriate procedures and consultation mechanisms.

- Strengthening the alignment between the NIIP and the other national and corporate planning documents. This also includes embedding the NIIP more fully into Government project planning and prioritisation systems.

- Strengthening the linkage between demand for infrastructure investment and the underlying drivers of demand (such as population growth, urban drift, national and international safety/ environmental standards, gaps in services, etc). This clarifies the rationale for investment and the short and long-term development objectives/imperatives driving the need for investment.

- Emphasising the importance of sustainability of investments in the infrastructure sector in a multi-dimensional sense, including:
  - The financial sustainability of the current and planned investments (affordable, maintainable), especially in terms of greater recognition of 'whole of life' planning and costing in infrastructure decision making and budgeting, and strategic asset management. As far as possible, this should involve applying adequate user fees as a fair way to charge the costs of infrastructure to those who actually use it, taking into account ability to pay of poorer sections of society.
  - Environmental sustainability from local and global impact perspectives.
  - Operational sustainability from asset management, maintenance, and CCA/DRM perspectives. The NIIP2 provides an opportunity to highlight key issues of CCA/DRM in the infrastructure planning, investment, and management process.
  - Institutional sustainability in terms of the necessary skills and frameworks to successfully plan, implement, and manage the investments. As described above, capability is generally weak in these areas.

- Taking a broader and less project-oriented view of infrastructure development, including strengthened coverage of cross-sectoral and other cross-cutting issues, such as:
  - Linkages between projects and sub-sectors in meeting national goals (such as supporting an upgraded port, or bridge, or airport with good road access).
  - Urban planning and the impact of urban growth on demand for transport and utilities.
  - Land issues, since access to land is a prerequisite for most major infrastructure investment.
  - Demand-side management, which involves initiatives to reduce demand for infrastructure, such as energy efficient lighting, water-saving plumbing fittings, reuse/recycling, etc.

On the whole this means that in the NIIP update, the focus ought to be on the supporting framework for infrastructure investment and management and complementary initiatives that support long term sustainability

(financial, environmental, operational, institutional). The review of the status of NIIP2010 projects also indicates that many of the large priority projects in the NIIP2010 are already at various stages of implementation. The implementation process for these already funded and underway projects will extend over several years and will occupy a high level of available resources (financial, institutional). Briefly, this means that the NIIP update is likely to have a balance of new investment projects and a consolidation of the impact of past investments; and an increased focus on complementary measures that support the long term sustainability of infrastructure investment.

Format and process

The consultation and review process has also identified expectations regarding the format of the NIIP update and areas where impact of the NIIP process may be strengthened. In particular, this involves adapting the NIIP document to be as relevant as possible to the needs of Government and development partners, and user-friendly for senior Government staff. Areas where the NIIP document may be refined to maximise its impact and awareness (especially within Government agencies and PEs) include:

- Keeping the core NIIP document short, to the point, and self-contained, with technical issues expressed in terms of clear, simple, and direct messages (but not over-simplified). Supporting technical material should be located in the Annexes.
- Including a monitoring and evaluation framework for the NIIP that includes a summary consultative table showing priority initiatives, costs, and responsibilities for implementation. This clearly bears relevance to specific agencies in terms of their implementation responsibilities.
- Including greater use of graphics to the extent possible to 'show' the infrastructure challenges and priority responses. This type of 'at a glance' presentation can help connect the NIIP messages with Government officers at all levels in the agencies.
- Reviewing the Annexes regarding their content and relevance to different audiences, with the aim of strengthening their relevance and impact.
- When the NIIP update is finalised, preparing a 'brochure' version that can be distributed to a wide audience inside and outside Government.

Another key aspect of the NIIP process is 'ownership of the NIIP process and document. With changes in Government structure, in particular the creation of a Ministry of Infrastructure (MOI), there is an opportunity to clarify ownership of the NIIP and allocate responsibility for driving NIIP awareness and implementation. The 'ownership' of the NIIP process and responsibility for implementation will be discussed with the Government and resolved as part of the NIIP update preparation. Other related issues, such as the frequency for updating NIIP, will also be addressed as part of the NIIP update preparation.