JOURNEY from TERM to TERM*PLUS*

Ministry of Meteorology, Energy, Information, Disaster Management,

Environment, Climate Change, and Communications (MEIDECC)

NUKU'ALOFA, TONGA

TERM 2010-2020

Background

Tonga Energy Road Map (TERM) 2010-2020 was a 10-year plan to:

- Improve petroleum supply chain to reduce Tonga's vulnerability to oil price *shocks*
- Increase Tongans access to electricity
- Increase conversion efficiency of fossil-fueled electric-generation
- Reduce transmission and distribution losses
- Increase share of electricity generated from renewable sources,
- Introduce demand-side energy efficiency measures

The TERM 2010-2020 followed a Least Cost Approach and recommended a detailed program of activities to achieve its objectives

Review of the TERM 2010-2020 was part of the Technical Assistance provided by GGGI to support the Government of Tonga in developing TERM*PLUS* for 2021-2035

TERM 2010-2020

TERM objectives:

- Reduced vulnerability to oil price shocks, reducing price and price fluctuation
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- Reduced transmission and distribution losses
- Introduction of demand-side energy efficiency measures

TERM 2010-2020

Objective 1: Reduced vulnerability to oil price shocks, reducing price and price fluctuation of imported petroleum products

Importing oil products directly from Singapore

- Not implemented
- Reduction in fuel costs versus substantial investment for construction of port facilities

Increasing storage for oil products

- Not implemented
- Stock holding is an effective means to respond to physical supply disruptions, but not a tool to reduce oil prices over the longer term

Financial hedging and risk management

- Hedging reduces oil price fluctuations, but it is not an instrument to reduce petroleum prices
- Nationalization of Petroleum Storage and Handling
- MOU is now formulated with PE/TRANS

TERM 2010-2020

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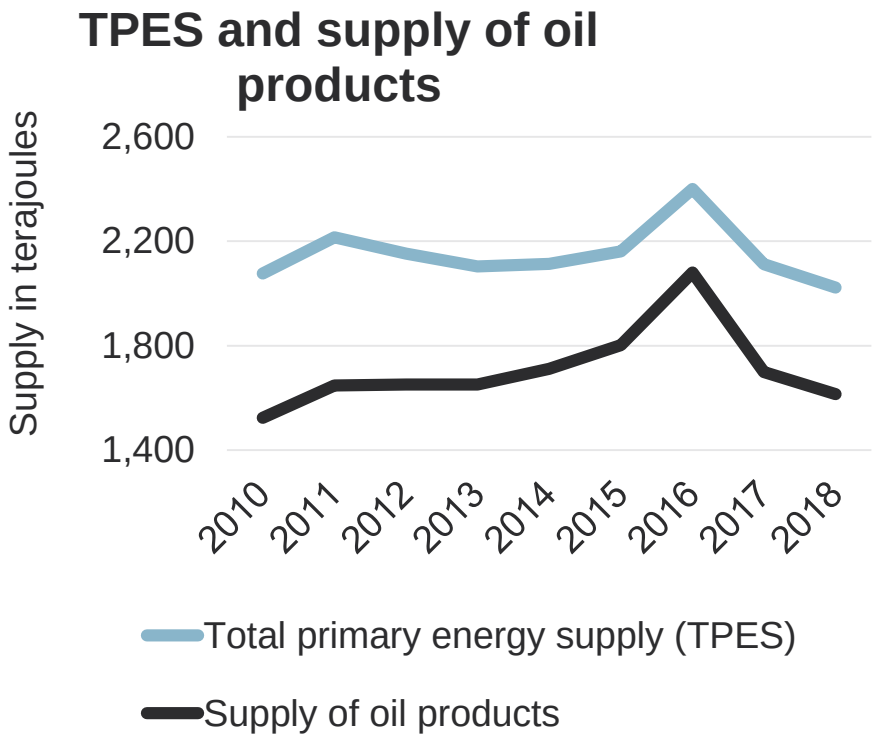
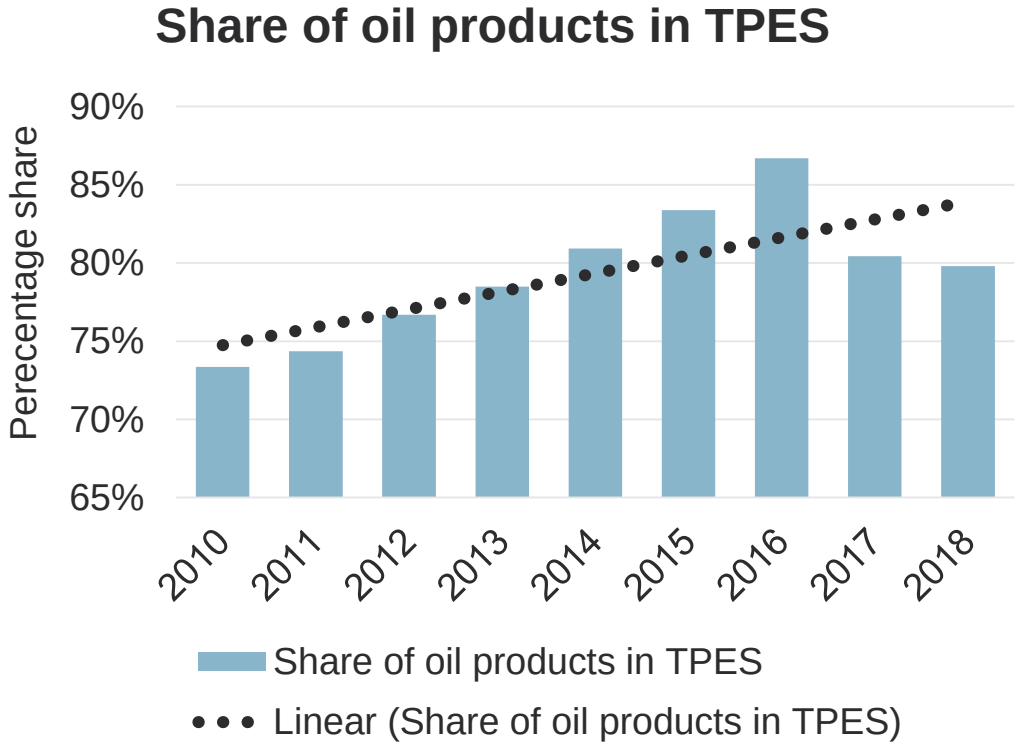
Energy Supply





DPE 2020a

TERM 2010-2020

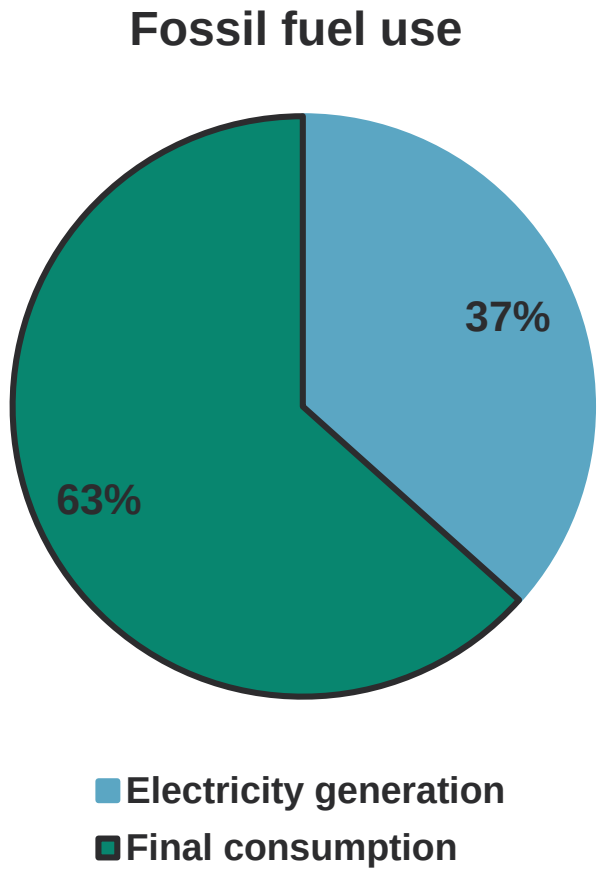
Objective 2: Reduced dependence on fossil fuels

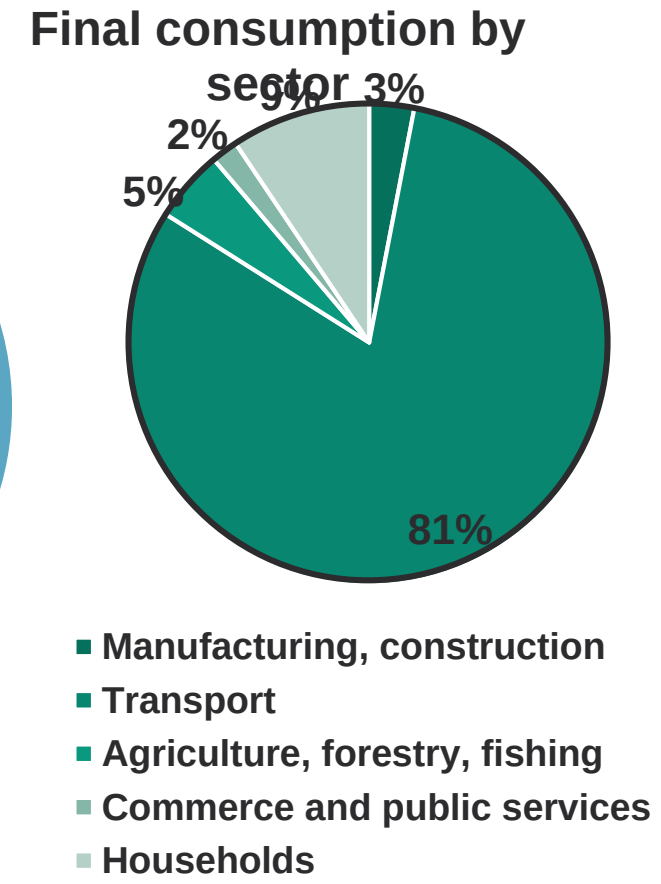
One third of oil supply is used for electricity generation, two thirds are used for direct final consumption

Road transport accounts for 70% of total final consumption

To decrease dependence on fossil fuels:

- Need to generate a higher share of electricity from renewable sources
- Need to reduce oil consumption in transport





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TERM 2010-2020

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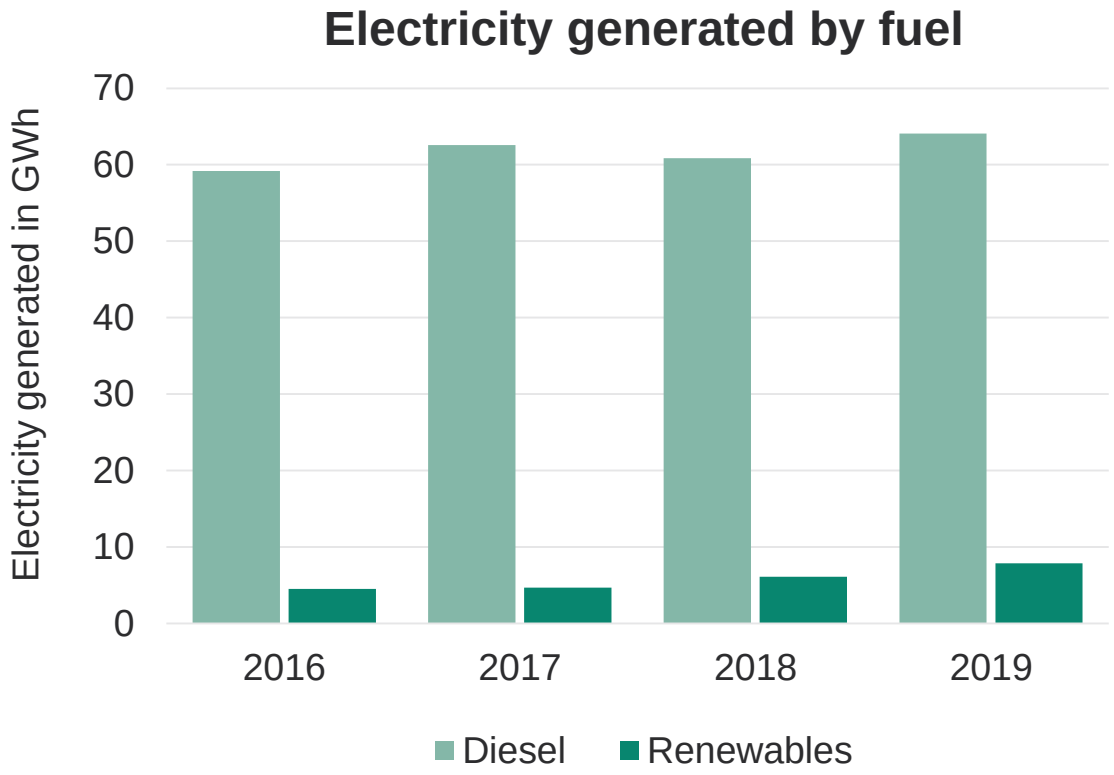
TERM 2010-2020

Objective 3: Increased share of electricity generated from renewable sources

Share of electricity generated from renewable sources and distributed via Tonga's four main networks increased from 0.3% in 2010 to 11% in 2019

Shares differ across networks:

- Tongatapu: 11%
- Ha'apai: 29%
- Vava'u: 3%
- 'Eua: 5%



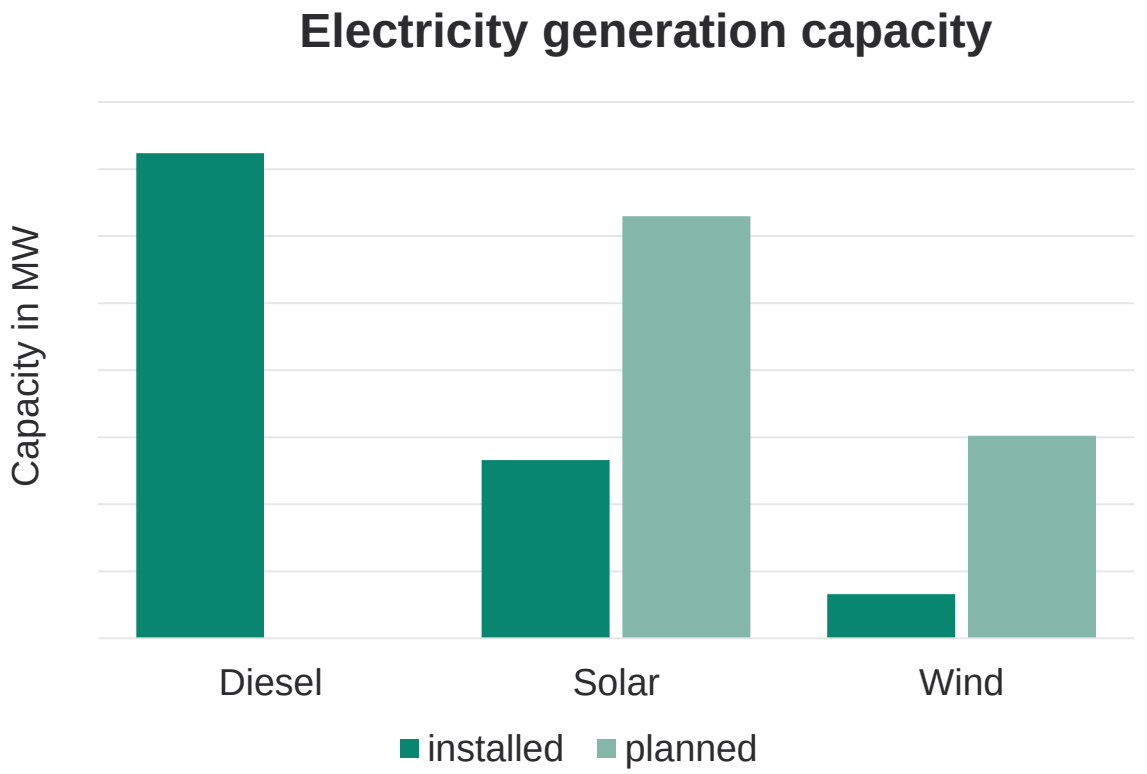
TERM 2010-2020

Objective 3: Increased share of electricity generated from renewable sources

Solar and wind represent 30% of total installed electricity generation capacity

Planned additions will increase the share of renewables to more than 60% of total capacity over the next two years

Share of electricity generated from renewable sources will increase but achieving the target of 50% by 2020 is extremely ambitious



TERM 2010-2020

TERM objectives:

- Reduced vulnerability to oil price shocks, reducing price and price fluctuation
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- **Increased access to electricity**
- Increased conversion efficiency of fossil-fueled electricity generation
- Reduced transmission and distribution losses
- Introduction of demand side energy efficiency measures

TERM 2010-2020

Objective 4: Increased access to electricity

95%-97% of population has access to electricity, with:

- 91%-93% of households connected to the grid
- 5% of households relying on off-grid

Estimate based on	TPL data	2016 census
Number of households in Tonga	**18,005**	**18,005**
Number of domestic TPL customers	**16,315**	**16,662**
Tongatapu	12,277	12,438
Vava'u	2,344	2,426
Ha'apai	757	955
Eua	937	842
Number of households supplied by off-grid systems		**800**
Estimated access rate	**91%**	**97%**

Tonga Statistics Department 2017; TPL 2016a; TPL 2016b

TERM 2010-2020

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TERM 2010-2020

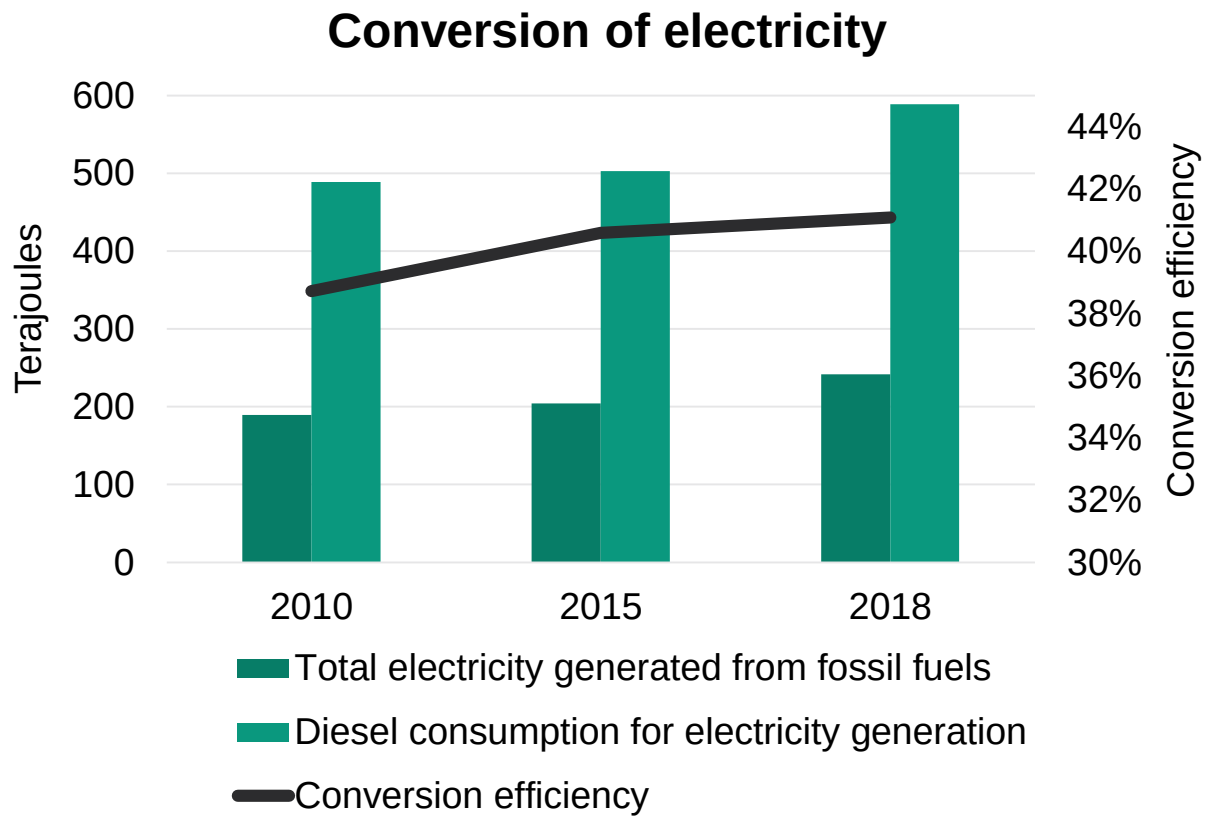
Objective 5: Increased conversion efficiency of fossil-fueled electricity generation

Conversion efficiency for electricity generation from diesel remains at 40%

No data available for disaggregation by network or generation plant

Increasing share of electricity generated from renewable sources requires running diesel generators at load factors below their optimal capacity, which reduces their efficiency

Increase of battery storage needed to increase conversion efficiency



DPE 2020a

TERM 2010-2020

TERM objectives:

- Reduced vulnerability to oil price shocks, reducing price and price fluctuation
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- Increased conversion efficiency of fossil-fueled electricity generation
- **Reduced transmission and distribution losses**
- Introduction of demand side energy efficiency measures

TERM 2010-2020

Objective 6: Reduced transmission and distribution losses

Line losses have been successfully reduced to **below 9% of electricity** generated for all four networks

Result of significant improvements in network infrastructure (technical losses) and introduction of meters (non-technical losses)

Year	Generated electricity (MWh)	Billed electricity (MWh)	Parasitic losses (MWh)	Line losses (MWh)	Share of line losses (%)
2015	56,844	50,730	1,572	4,542	**8.0%**
2016	63,248	56,236	2,308	4,704	**7.4%**
2017	68,040	59,413	2,101	6,526	**9.6%**
2018	66,430	59,231	1,809	5,390	**8.1%**
2019	77,979	69,815	2,265	5,900	**7.6%**

TERM 2010-2020

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TERM 2010-2020

Objective 6: Introduction of demand side energy efficiency measures

No systematic approach towards increasing energy efficiency. For example, there is no overarching policy covering energy efficiency and linking it to other areas

Adoption of Energy Bill in combination with Energy Efficiency Master Plan anticipated to create systematic approach

Several initiatives to increase energy efficiency in specific areas, including:

- Replacement HPS streetlights with LED lights under the PEEP-1
- Replacement of T8 fluorescent lamps with more efficient T5 florescent lamps in residential, commercial and public PEEP-2
- Conducting energy audit trainings
- Conducting studies on consumer behaviour/usage of electricity
- Chinese Climate Change Appliances

TERM-PLUS Framework

Revised following energy stakeholder workshop on 8-9th April 2021

Supply

Target		Means		Requirement
1	Reduce total amount of diesel imports in 2035 by 10% compared to 2015	1.1	30% improvement in fuel efficiency of light duty vehicles in 2035 compared to 2015, through mandatory vehicle standards and/or incentives through tax, fees, import tariffs	Replacement rate of 8% of the total light duty vehicle stock per year Vehicle efficiency increases from an average 10.1 liters/km in 2016 to 7 liters/km in 2030 Alignment of price signals for consumers with targets Public acceptance
		1.2	Displacement of diesel by renewable sources for electricity generation, with 70% of electricity generated from renewables by 2030	Upgrade of network infrastructure Financing
2	Increase security of supply	2.1	Expand petroleum storage	Political decision on stockholding arrangements (i.e. government, agency, industry obligation) Permission to build/upgrade necessary infrastructure Financing
		2.2	Establish direct shipments of oil products via Singapore	Determine price impact on Vava'u and 'Eua, and political decision whether and how to accommodate higher prices Determine layout and capacity of infrastructure Permission to build/upgrade infrastructure Political agreement on financing, ownership, and use of infrastructure

Final consumption

Target		Means		Requirement
3	Limit growth in oil consumption to 1% per year on average for the period 2021-2035	3.1	30% improvement in fuel efficiency of light duty vehicles in 2035 compared to 2015, through mandatory vehicle standards and/or incentives through tax, fees, import tariffs	Replacement rate of 8% of the total light duty vehicle stock per year Vehicle efficiency increases from an average 10.1 liters/km in 2016 to 7 liters/km in 2030 Alignment of price signals for consumers with targets Public acceptance
		3.2	Adoption of a sustainable transport strategy by 2023	Finance for sustainable transport strategy Government Adoption Public acceptance
4	Limit growth in residential electricity end-use to 1% per year on average for the period 2021-2035	4.1	Adoption and enforcement of minimum energy performance standards	Financing (especially for MSMEs and end-users) Alignment of price signals for consumers with targets Public acceptance Enforcement
		4.2	Curtailment of import of non-LED bulbs	
		4.3	Installment of solar water heating systems	
		4.4	Energy efficiency standards for buildings introduced and enforced	
		4.5	Replace biomass for cooking with LPG for households in Tongatapu	

Electricity generation

Target		Means		Requirement
5	70% of electricity generated from renewable sources by 2030	5.1	Combination of electricity generation from solar and wind power	Battery storage and/or back up generation (diesel, biomass) Upgrade of network infrastructure Financing
6	100% of electricity generated from renewable sources by 2035	6.1	Combination of electricity generation from solar and wind power and dispatchable renewable technologies and/or battery technologies	Battery storage and/or back up generation (biomass) Upgrade of network infrastructure Financing
7	Maintain line losses at under 8%	7.1	Adoption of electricity networks to accommodate larger share of intermittent/variable output of electricity from renewable sources	Upgrade of network infrastructure Financing

Cross-cutting

There are no measurable targets for data, climate change and gender, but issues that the TERM Plus will address.

Items		Content	
8	Data	8.1	Guidance on the standardization of procedures and institutional arrangements (in alignment with Energy Bill) for data collection, compilation, management, and dissemination
		8.2	Road map on what information should be collected, how and by whom, and how frequently
9	Climate change	9.1	Infrastructure can be hardened with the aim to withstand the impacts of climate change
		9.2	Infrastructure can be made more flexible by building in redundancies and backups, and preparing for quickly repairing expected damages by having in place the necessary spare parts and contingency plans
10	Gender	10.1	Identify challenges related to gender equality in the energy sector
		10.2	Identify and implement options within the proposed measures to promote gender equality and minimize potential negative impacts of proposed measures on gender equality
		10.3	Create gender monitoring program within GoKT similar to TPL's program Identify the baseline for women's participation in the energy sector, broken down by subsectors, and achieve an increase in women's participation in the workforce

TERM*PLUS* 2021-2035

TERM*PLUS* 2021-2035

Background

Guiding document for development of Tonga's energy sector for 2021-2035:

- Build around a consistent set of (quantifiable) targets;
- Identifying measure and requirements to achieve those targets;
- Alignment with targets set in other official documents
- Includes 5-year, 10-year & 15-year Action Plans

TERM 2021-2035 to cover the entire energy sector:

- Supply
- Final consumption
- Electricity generation and transmission
- Transportation
- Data Collection & Dissemination
- Cross cutting issues (climate change/resiliency, gender-inclusion)

TERM*PLUS* 2021-2035

Recommendations on:

- **Scope and structure**
- **Supply**
- **Final consumption**
- **Electricity generation & distribution**
- **Transportation**
- **Data Collection & Dissemination**
- **Cross-cutting**

TERM 2021-2035

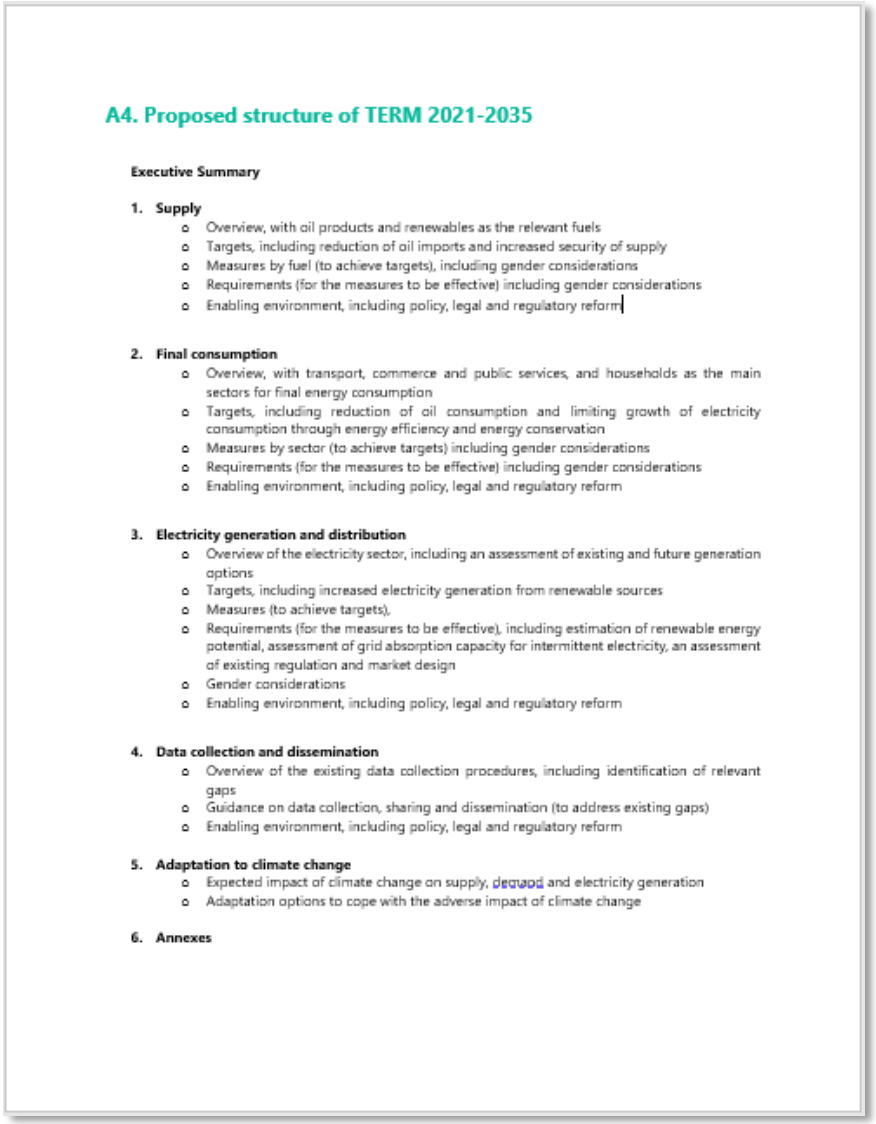
Scope and structure

Clear structure, distinguishing between:

- Supply, final consumption, and electricity generation, transport, data, gender
- Relevant fuels, including oil products, biomass and waste, renewables, and electricity

Some cross-cutting items to be addressed in the above structure, including renewable energy, energy efficiency, policy and regulation

Other cross-cutting items to be addressed separately, including climate change, data collection and gender-inclusion



A4. Proposed structure of TERM 2021-2035

Executive Summary

1. **Supply**
   - Overview, with oil products and renewables as the relevant fuels
   - Targets, including reduction of oil imports and increased security of supply
   - Measures by fuel (to achieve targets), including gender considerations
   - Requirements (for the measures to be effective) including gender considerations
   - Enabling environment, including policy, legal and regulatory reform
2. **Final consumption**
   - Overview, with transport, commerce and public services, and households as the main sectors for final energy consumption
   - Targets, including reduction of oil consumption and limiting growth of electricity consumption through energy efficiency and energy conservation
   - Measures by sector (to achieve targets) including gender considerations
   - Requirements (for the measures to be effective) including gender considerations
   - Enabling environment, including policy, legal and regulatory reform
3. **Electricity generation and distribution**
   - Overview of the electricity sector, including an assessment of existing and future generation options
   - Targets, including increased electricity generation from renewable sources
   - Measures (to achieve targets),
   - Requirements (for the measures to be effective), including estimation of renewable energy potential, assessment of grid absorption capacity for intermittent electricity, an assessment of existing regulation and market design
   - Gender considerations
   - Enabling environment, including policy, legal and regulatory reform
4. **Data collection and dissemination**
   - Overview of the existing data collection procedures, including identification of relevant gaps
   - Guidance on data collection, sharing and dissemination (to address existing gaps)
   - Enabling environment, including policy, legal and regulatory reform
5. **Adaptation to climate change**
   - Expected impact of climate change on supply, demand and electricity generation
   - Adaptation options to cope with the adverse impact of climate change
6. **Annexes**

TERM 2021-2035

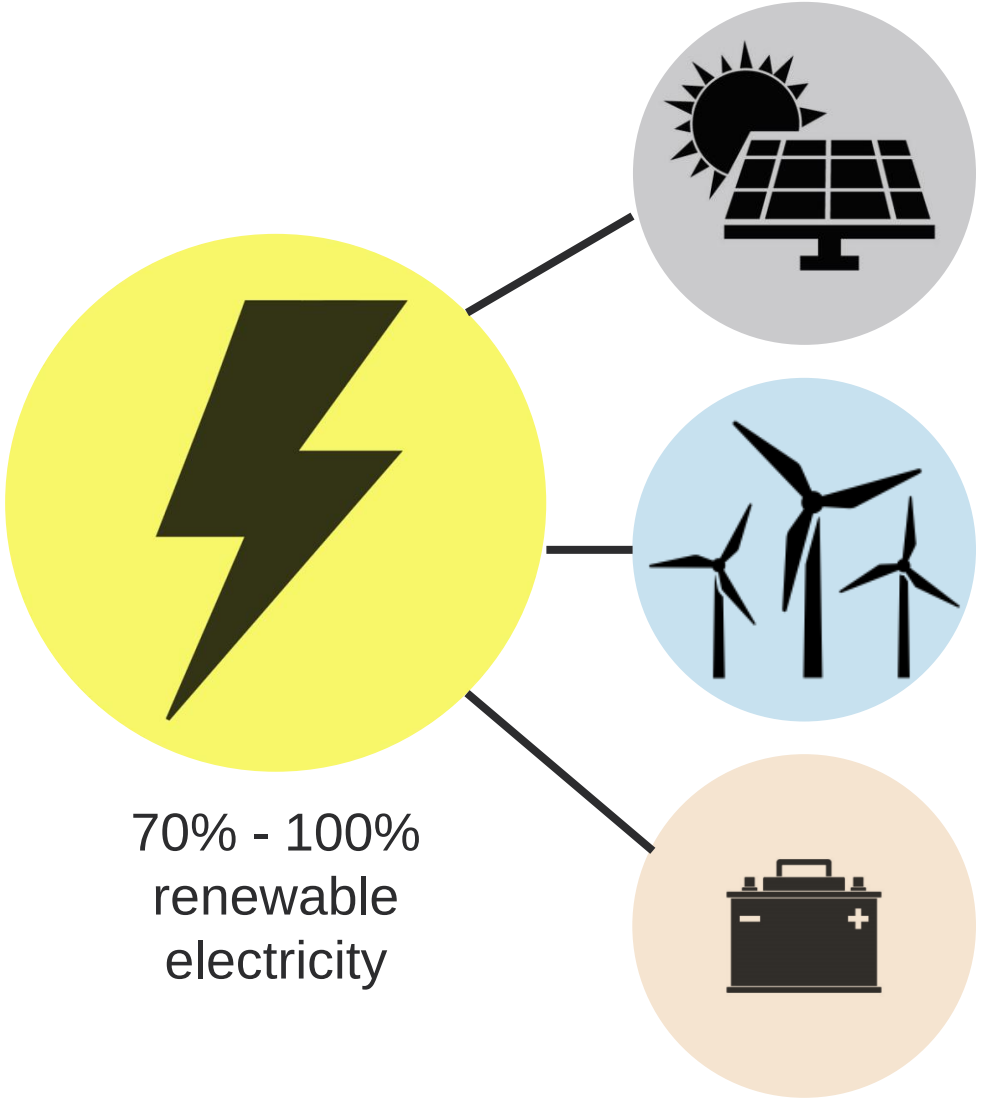
Scope and structure

For TERM 2021-2035 to identify a consistent set of goals and targets that it will help to achieve

For TERM 2021-2035 to be built consistently around these targets, explaining their underlying rationale

For TERM 2021-2035 to identify (possible) measures and means to achieve the agreed targets

For TERM 2021-2035 to identify the underlying assumptions and requirements for the selected measures to be effective



TERM*PLUS* 2021-2035

Scope and structure

For goals and targets stipulated in the TERM*PLUS* 2021-2035 to align with other official documents, such as:

- Energy Bill,
- Energy Efficiency Master Plan,
- SDG 7 Road Map
- TSDF II
- 2020 Nationally Determined Contribution
- Long-Term Low-Emissions Development Strategy

For the TERM*PLUS* 2021-2035 to include additional targets if relevant, consistent with existing targets

TERM*PLUS* 2021-2035

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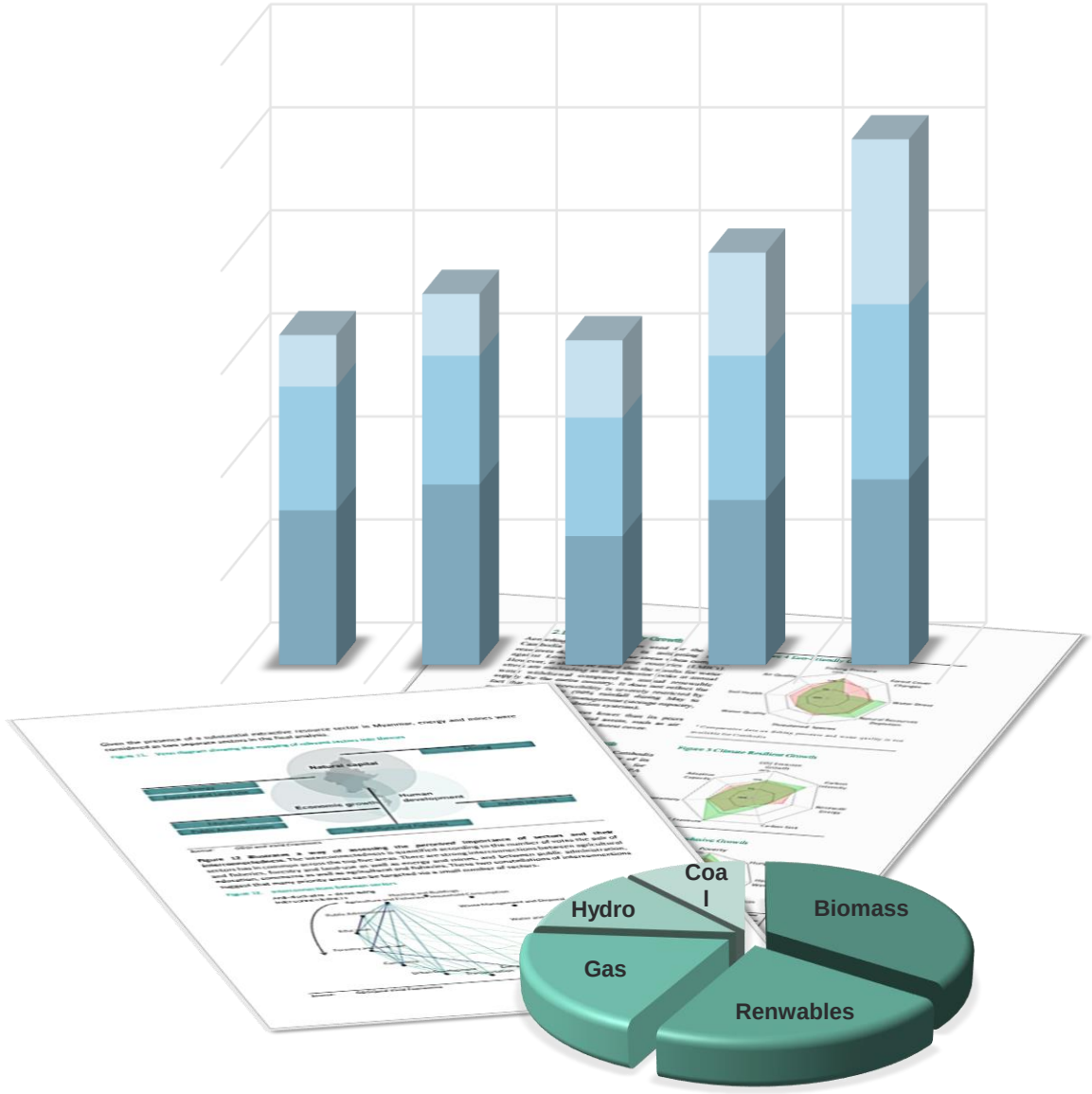
TERM 2021-2035

Cross-cutting: data

Data collection, sharing and dissemination is essential to design policies, interventions, and projects

For the TERM 2021-2035 to provide guidance on the standardization of procedures and institutional arrangements for data collection, compilation, management, and dissemination

For the TERM 2021-2035 to outline what information should be collected, how and by whom, and how frequently



TERM 2021-2035

Cross-cutting: climate change

Climate change can have an impact on supply, final consumption, and electricity generation

For the TERM 2021-2035 to consider how Tonga's energy infrastructure can cope with the adverse impacts of climate change:

- Infrastructure can be hardened with the aim to withstand the impacts of climate change
- Infrastructure can be made more flexible by building in redundancies and backups

TERM 2021-2035

Cross-cutting: gender

For the TERM 2021-2035 to take a gender-responsive approach and consider the impacts of proposed measures on gender:

- Conduct a gender-based assessment and identify challenges related to women's inclusion in the areas of clean energy, energy efficiency and energy access
- Identify and create pathways through education, training and internships for women to develop technical skills needed for the energy sector
- Fund scholarships for women interested in pursuing technical programs and college degrees in the energy sector
- Implement other actions that may be identified in the gender-based assessment

TERM 2021-2035

Cross-cutting: gender benefits

- As an island country with finite resources, Tonga's comparative advantage is its people
- Some projects fail due to a lack of inclusiveness in the approach (UNDP 2016)
- Women bring new perspectives to the workplace, improving collaboration and yielding better performance overall (IRENA 2019; UNDP 2013)
- Engaging women as active agents in deploying renewable energy solutions is known to improve sustainability, maximize socio-economic benefits and increase energy access (IRENA 2019)

Thank You