Vanuatu

Nationally Determined Contributions (NDC) Implementation Roadmap

March 2019

IN CONTRIBUTION TO THE NDC PARTNERSHIP
ACCELERATING CLIMATE AND DEVELOPMENT ACTION
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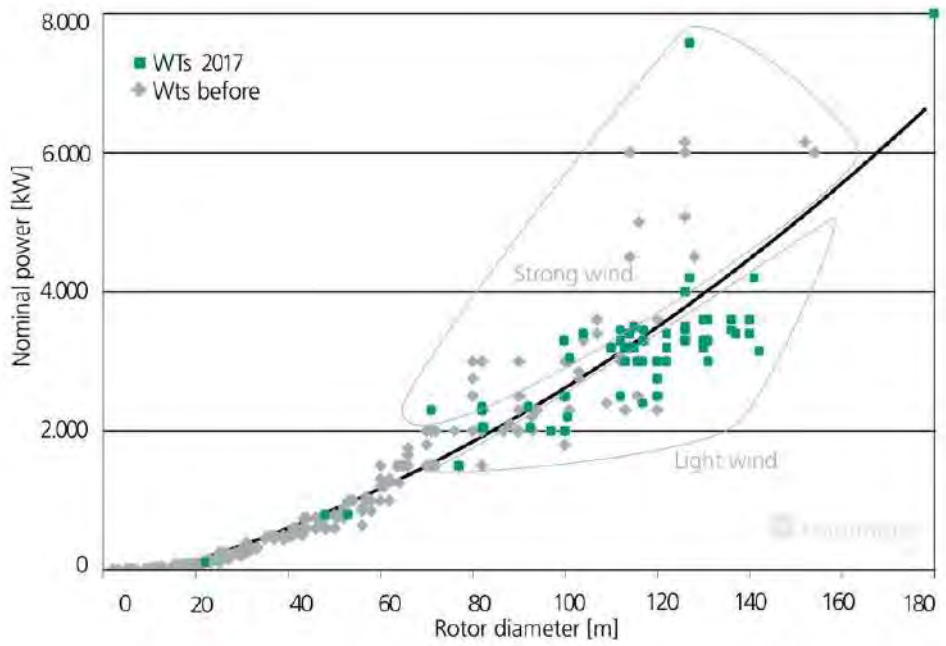

Figure 16: Rated capacity by rotor diameter of different types of wind turbine
Source: Fraunhofer Institute[9]

For the expansion of the existing wind capacity it is advisable to stick to the proven system of dismountable wind turbines in order to prevent potential damage. As a consequence, it will not be possible to lower investment costs per installed MW, as turbine sizes are limited for this specific application.

In the Energy Road Map for Efate provided by UNELCO, total investment costs for 5.1 MW are estimated at 1,480 million Vatu (around USD 13.45 million). This translates to USD 2.64 million per MW.

6.3.4 COCONUT OIL

Contribution of coconut oil

Coconut oil has played a role in providing electricity from renewable energies in Vanuatu for a number of years. In 2013, slightly more than 3 million litres of coconut oil were used on Efate and Malekula, achieving a share of coconut oil of around 15% in total electricity generation. The diesel generators installed on Malekula and Efate are able to be run based on coconut oil. The following figures show the share of coconut oil in electricity generation and the quantity of coconut oil used between 2011 and 2016. Due to low diesel prices, no coconut oil was used in 2017.

[9] http://windmonitor.iee.fraunhofer.de/windmonitor_en/3_Onshore/2_technik/4_anlagengroesse/

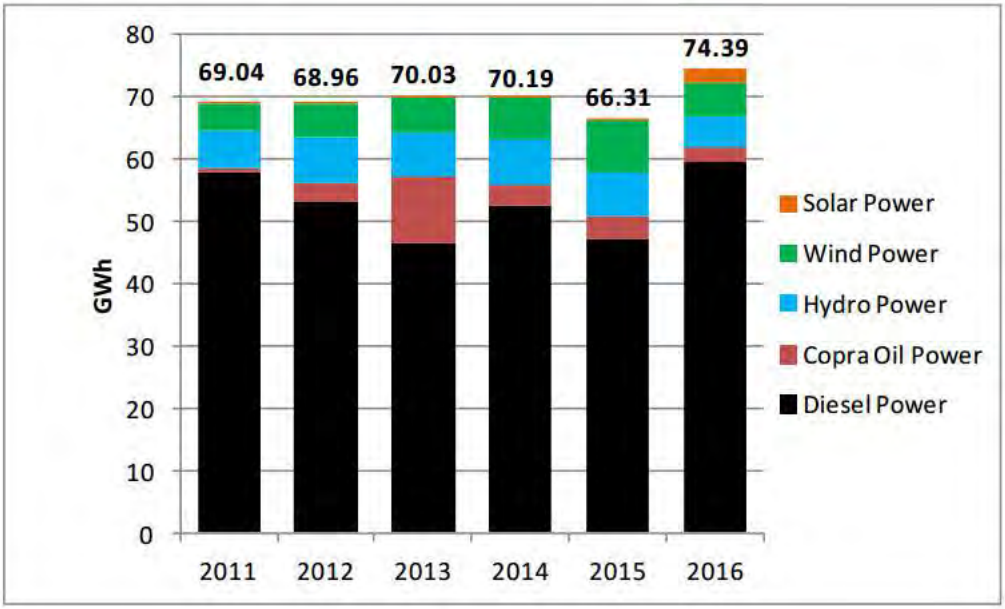

Figure 17: Fuel inputs for electricity generation
Source: URA, Electricity Factsheet 2011-2016

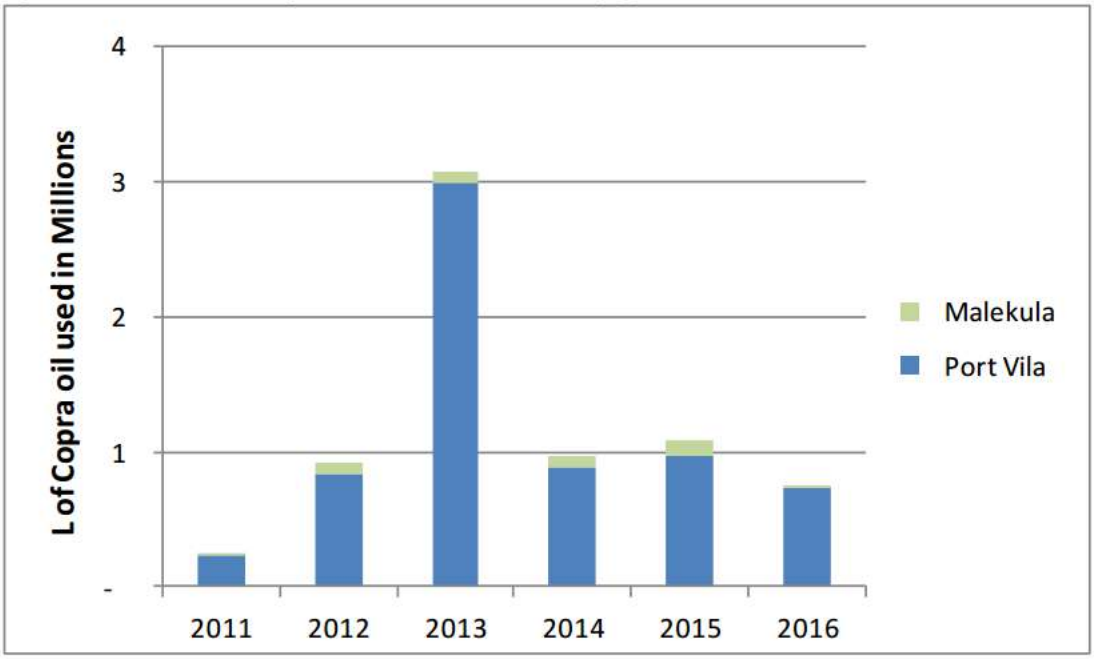

Figure 18: Total litres of copra oil used in electricity generation
Source: URA, Electricity Factsheet 2011-2016

The following figure shows the quantities of copra and coconut oil exported in the period 2008-2013. The low export figure of coconut oil in 2013 coincides with the high use of coconut oil for electricity production.

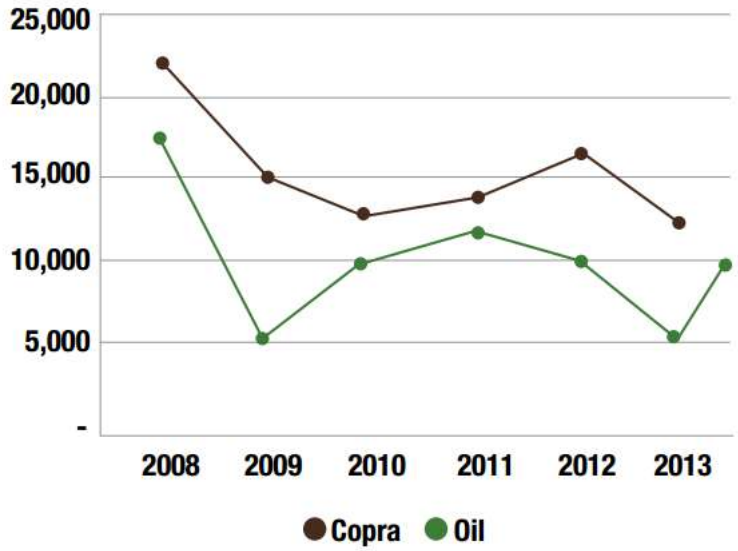

Figure 19: Export of Copra and Coconut Oil
Source: Vanuatu Coconut Strategy 2016-2030. Note: there is no indication in the study on the measurements, it is assumed that figures are tons

The main issues for the use of coconut oil are two factors: the value of copra and coconut oil on the international market and the cost of diesel in Vanuatu. Under the current regulatory framework, utilities are forced to generate electricity on a least cost basis. If imported diesel is cheaper than locally produced coconut oil (the value of which is based on international market prices), utilities are obliged to use diesel for electricity generation.

The following figure compares the price development of coconut oil and diesel between 2010 and 2018. Diesel costs include the statistical import price plus cost components defined in URA's guidance on diesel pricing for electricity services (premium, freight, local charges, excise tax), Coconut oil costs are 90% of world market prices (CIF Rotterdam). In 2013, when electricity generation from coconut oil was at a maximum, coconut oil was considerably cheaper than diesel. In 2016, prices for coconut oil started to increase again, which led to a sharp reduction and finally the stop of generation of electricity from coconut oil.

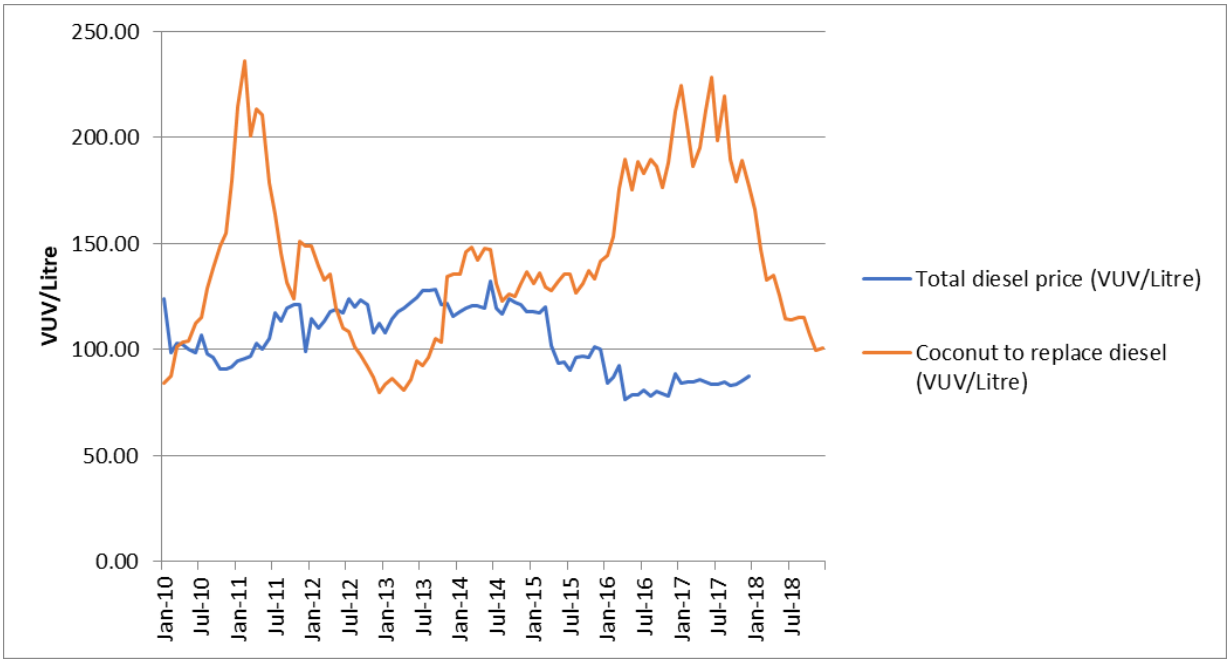

Figure 20: Coconut oil prices 2008-2018 in USD per ton

In 2015, the Government of Vanuatu, led by the Ministry of Agriculture and Rural Development, published the Vanuatu Coconut Strategy 2016-2025. The coconut sector is the most important agricultural sector in the country and is the second largest contributor to foreign exchange earnings after tourism. In 2011, 80% of exports of agricultural products came from the coconut sector, with coconut oil contributing 54% and copra 36%.

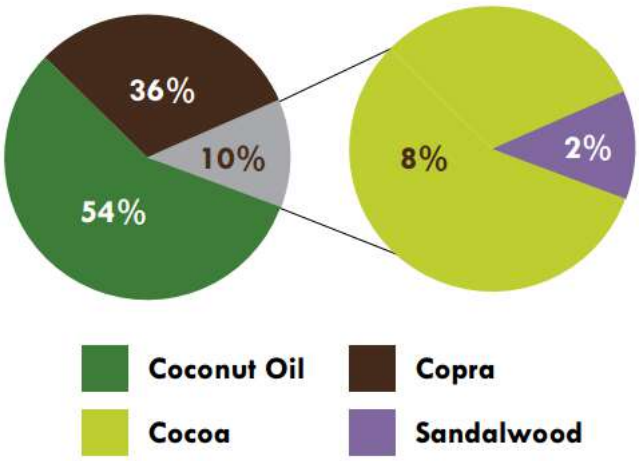

Figure 21: Share of agricultural exports in 2011

The strategy also included a SWOT analysis for coconuts and copra, which is show in the figure below.

Strengths	Weaknesses
- Good genetic materials locally available - Favourable climate - Developing market network - Low maintenance plantation management - Fits in well with existing farming systems	- Limited value-added production, reliance on raw commodities exports to foreign markets for processing - Inadequate infrastructure for manufacture and transport - Lack of finance availability for smallholders - Lack of incentives to replant for future supply - Lack of incentives to diversify into other coconut products
Opportunities	**Threats**
- Target higher value buyers with more value added and convenient products - Improve linkages to tourism sector to tap local market for artisanal coconut products - Improve quality and food safety to meet growing world quality standards - Rich value added product possibilities - Add value across entire product line to motivate replanting - Harvest senile palms for flooring and other timber uses - Coconut oil offers health benefits - Organic certification - Private sector investment - Local market of coconut oil not influenced by world coconut oil price - Significantly improve farmers income	- Aging trees, declining supply - Poor tree management promoting pests and disease - Change in government policy - Rising quality standards of markets and competing countries - Land issues - Impacts of climate change and natural disasters

Figure 22: Copra/coconut SWOT analysis

In relation to the use of coconut oil for electricity production, the SWOT analysis includes the following relevant aspects:

- Weaknesses:
  - Reliance on raw commodities exports for foreign markets for processing: by producing coconut oil locally for electricity generation, this weakness is turned into an asset, as facilities are operational
  - Lack of incentives to replant for future supply: to be able to use coconut oil for electricity production on a larger scale, long-term arrangements need to be made between producers and users. This will give an incentive for replanting and at the same time increase confidence in sustainable, long-term supply.
- Threats:
  - Aging trees, declining supply: this is a key issue which needs to be solved. Production will have to increase in order to be able to supply the quantities necessary to achieving the NDC target.
  - Rising quality standards of markets and competing countries: as coconut oil will be used locally and the quality produces is well-fitting for electricity generation, this will not be an issue.

The coconut strategy has the vision that coconut is the top income earner in Vanuatu's agriculture sector by 2026, this should be achieved by pursuing the following objectives:

1. Establish appropriate administrative and regulatory frameworks to manage the coconut sector.
2. Increase farmer access to improved planting materials.
3. Enhance coconut farming through appropriate information and support.
4. Increase production and quality through good agricultural practices.

5. Introduce incentives for private sector engagement in agro-processing and value adding at all levels of the value chain.
6. Enhance trade and marketing of coconut products in the domestic and export market.

All these objectives are relevant to increase the share of coconut oil as a source for electricity generation. The considerable efforts and costs to ship coconut oil internationally will decrease, which is a benefit for the entire sector.

Based on the plan to reduce generation of electricity from diesel by 10% per annum and taking into account the various capacity additions of renewable energy sources mentioned in the previous chapters, there is a considerable gap which needs to be closed with generation of electricity from coconut oil. The gap increases constantly over the years up to a maximum of around 40 GWh required from coconut oil.

Based on the following specific technical parameters, the required volume of coconut oil has been calculated:

- Efficiency electricity generation diesel: 0.259 litres diesel per kWh
- Efficiency coconut oil vs. diesel: 88%

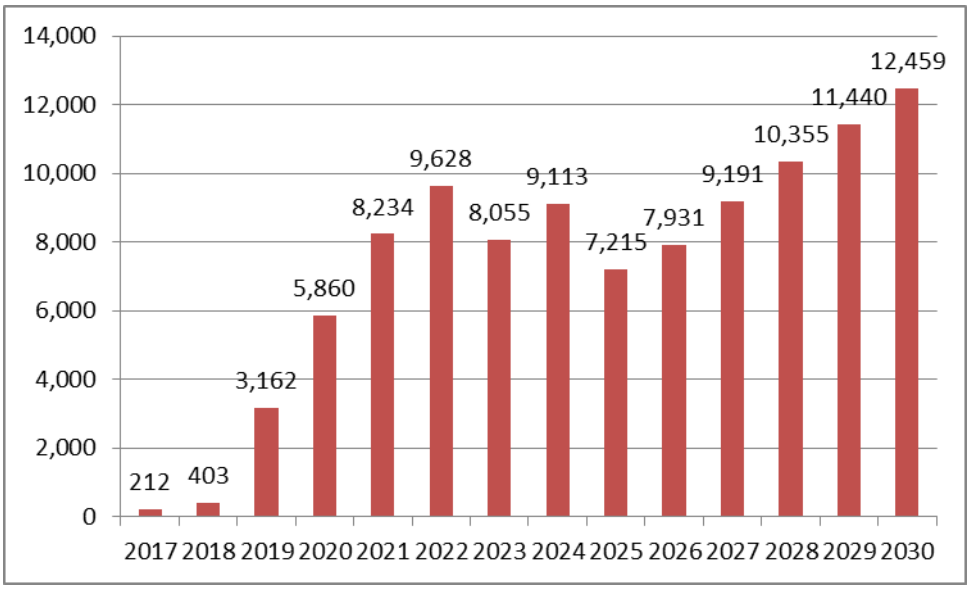

Figure 23: Required quantities of coconut oil in 1000 litres

Demand is increasing steadily to 2024, when more than 9 million liters of coconut oil will be required for electricity generation. As a number of other renewable energy projects will come online in 2025, demand will be reduced in 2025, but then rise further to 12.5 million liters in 2030. With the quantities of coconut oil mentioned in Figure 23 and the contributions of the other renewable energy sources as described in the previous chapters, the NDC target can be achieved.

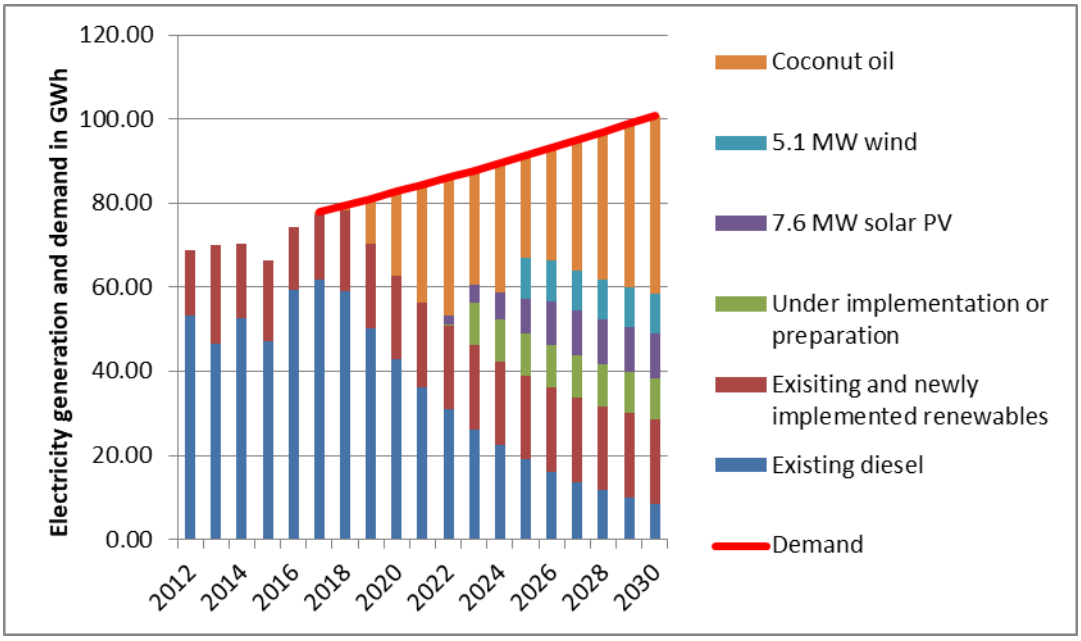

Figure 24: Electricity generation including all renewable energy sources

In the peak year of coconut oil consumption (2013), around 3 million liters were consumed for electricity generation. As seen in Figure 19, total exports of coconut oil were between 5 and 10 million tons between 2009 and 2013. This means that considerable efforts are necessary to secure the local resource for electricity generation.

Coconut oil vs. diesel prices

Despite the numerous benefits of using the local energy source coconut oil for electricity generation, higher costs of coconut oil versus diesel oil were always given as the main argument for the modest and fluctuating contribution of coconut oil in Vanuatu's energy mix. The regulatory framework given by URA binds the electricity price to the price of diesel. Only in periods of time, when coconut oil is cheaper than diesel it is possible to switch.

The key challenge of the current system is that the price of a locally produced energy source is linked both to the international market price of diesel and coconut oil. The linkage to diesel determines that coconut oil can only be used in electricity generation when purchase price of coconut oil is below the price of diesel. Coconut oil market prices also influence the availability of coconut oil for electricity generation, as producers/exports aim at exporting copra/coconut oil in case market prices are favorable. Both factors make it difficult to setup a sustainable delivery mechanism, which guarantees fair and acceptable prices for producers as well as low costs for utilities and finally electricity consumers.

In order to analyze the impact of coconut oil versus diesel prices, 3 different coconut oil pricing models were defined. Based on historic price developments it was analyzed what the impact on total fuel costs for each of the models is. The 3 pricing models were:

- UNELCO flexibility model: coconut oil price is fluctuating over diesel in a bandwith of +/- 20%.
- Fixed price I: a fixed price for coconut oil of 75 VUV/l is paid. This is based on price indications from UNELCO.

- Fixed price II: a fixed price for coconut oil of 90 VUV/l is paid. This is based on the world market price for copra of VUV 65,000/t mentioned in Copra Subsidy above which no subsidy under the Copra Subsidy Scheme is being paid.

The graph below shows the 3 pricing models in the period 2010 – 2018.

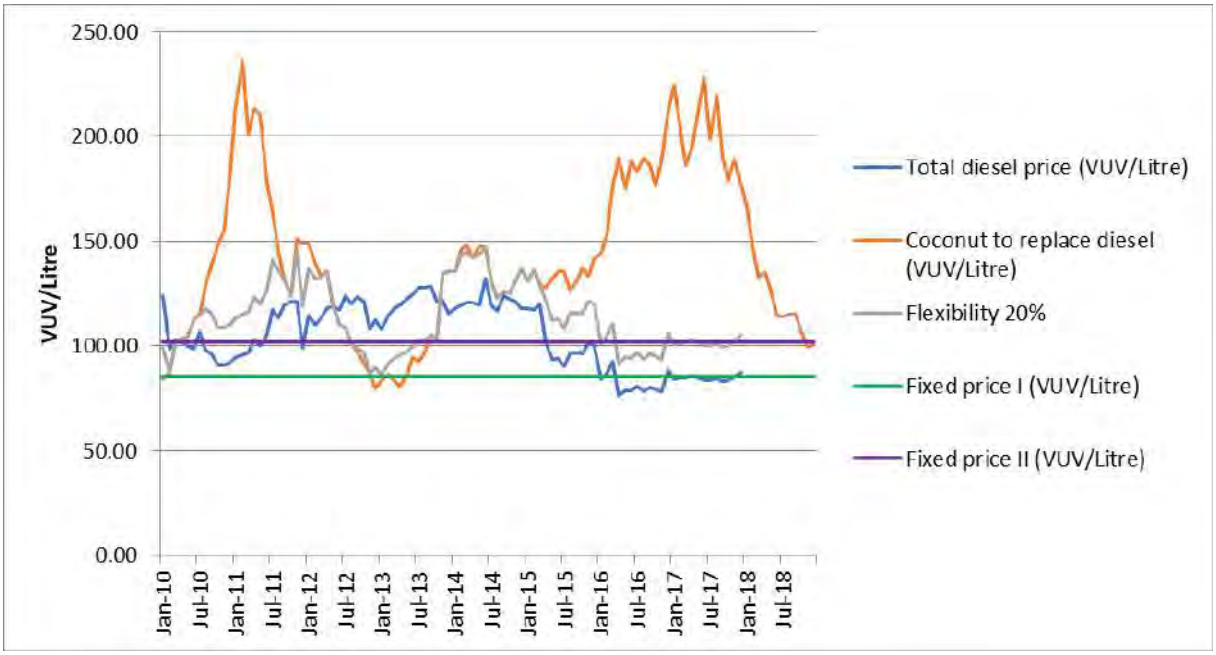

Figure 25: Potential scenarios for coconut oil pricing

For the analysis it was assumed that a total of 700,000 liters of coconut oil per month (8.4 million liters/year) is consumed. This is approximately the average of expected coconut oil consumption in the period 2021-2027. The following conclusions can be drawn from the analysis:

- If the flexibility model would have been applied over the period 2010-2018, electricity costs per kWh would have been on average around 4.5 VUV higher than if only diesel would have been consumed.
- In fixed price model I (price of 75 VUV/litre for coconut oil) electricity costs would have been 0.6 VUV/kWh lower than compared to only using diesel.
- In fixed price model II (price of 90 VUV/litre for coconut oil) electricity costs would have been 2.0 VUV/kWh higher than compared to only using diesel.

Whereas the flexibility model would have led to higher prices of electricity generation, a fixed price between 75 and 90 VUV for coconut oil would have resulted in equivalent costs for electricity generation in the period 2010-2018. It goes without saying that historic price developments give no indication on the development of future world market prices of diesel and coconut oil. However, if the analysis on past costs has shown equivalent costs for coconut oil and diesel, it is justifiable that a fixed coconut oil price is taken as a basis for calculation of electricity costs.

Fixing the price for coconut oil would allow delinking of local production from international market price developments. As local production costs of coconut oil are not being influenced neither by coconut oil nor diesel world market prices, this would be an important step towards building a sustainable, long-term supply oil coconut oil. A fixed price arrangement would allow utilities to sign

long-term (e.g. 10 years) contracts with producers, giving them security of demand and a good basis for ongoing investments (equipment, replanting, etc.).

Coconut for Fuel Strategy

A detailed "Coconut for Fuel Strategy" needs to be elaborated, which needs to include the following components:

- Securing supply: the recent decline in production of coconuts needs to be reversed by new plantations. Long-term contracts need to be signed between coconut oil producers and utilities, giving security on both sides on the volumes of coconut oil to be delivered over longer time periods. Current and future production volumes need to be investigated to understand the long-term perspective.
- Managing production process: it needs to be assured that sufficient capacity is available to manage the production process from harvesting coconuts to delivering coconut oil to the utility.
- Evaluating additional benefits: there are various additional benefits to the growing of coconut trees which need to be evaluated. Examples are:
    - Coconut plantations can be used for additional agricultural purposes, such as kava or grazing of cattle.
    - Copra meal can be used as feedstock for animals, e.g. chicken.
    - A stronger focus on the coconut sector will allow other coconut based projects to grow as well and find their niche markets, such as virgin coconut oil
- Pricing mechanisms: need to be developed making sure that both low costs for consumers of electricity and fair income for coconut producers are considered. This can include for example:
    - Fixed prices with inflation adaptation
        - Pro's:
          Gives planning security to all partners involved.
          Allows long-term investments to increase production of coconuts.
        - Con's:
          Doesn't allow coconut oil producers to benefit from potential increases in market price for coconut oil.
          Will require revision of regulatory framework in case diesel price is below agreed fixed price.
    - Variable prices within a certain bandwidth, linked to international diesel and/or coconut prices
        - Pro's:
          Coconut oil producers benefit (to a limited extent) from coconut oil market price increases
          Electricity consumers benefit (to a limited extent) from decreases of diesel and coconut oil prices
        - Con's:
          If coconut oil price is linked to diesel price, fluctuations in diesel price will impact revenue situation of coconut oil producers
          Electricity consumers suffer (to a limited extent) from increases of diesel and coconut oil prices
- Adaptation of the existing regulatory framework (especially the requirements of URA towards the utilities) to accommodate the agreed pricing mechanism.

Costs of the intervention can only be determined once the pricing mechanism has been agreed upon. Costs will be influenced by the model chosen and the difference between costs of diesel and coconut oil.

The main stakeholders to be involved in the elaboration of the "Coconut for Fuel Strategy" will have to be:

- Ministry of Agriculture and Rural Development: the key role of the Ministry will be to lay the basis for long-term supply of sufficient raw material for the production of coconut oil.
- Ministry of Trade and Finance: will have to focus on a strategy to come up with a financing mechanism to address copra price variations.
- Department of Energy: will have to make sure the strategy is linked with the targets under the NDC.
- Coconut producers: Producers such as Coconut Oil Production Santo Limited (COPSL) will be the partners for the supply of coconut oil to utilities and need to be involved in the decision on contractual arrangements and pricing for delivery of coconut oil.
- Utilities/UNELCO: will be the partners to be involved in the decision on contractual arrangements and pricing for delivery of coconut oil.
- URA: needs to secure that contractual arrangements and pricing are in accordance with current or revised regulation on electricity pricing.

6.3.5 GEOTHERMAL

Vanuatu has been the subject of geothermal prospecting since the 1970's. The biggest potential for use of geothermal energy for electricity generation is seen on Efate where preparatory studies have identified good opportunities at Takara in the Northern part of the island. The plan for the Takara Geothermal Power Plant is to implement the project in 2 stages, each 4 MW installed capacity. The geothermal plant will be able to provide baseload for the Efate grid.

Whereas preparatory studies showed good potential, the biggest risk is in the next step, the exploration drilling. The Government of Vanuatu is receiving funding from New Zealand for the exploration drilling, which is necessary to confirm the technical and commercial viability of the project. It is expected that results are available by 2020.

A first stage of 4 MW would have the possibility to generate between 25 and 30 GWh of electricity per year, thereby contributing between 25% and 30% of total demand in 2030. This would be a considerable contribution to the gap of around 50 GWh. As electricity from geothermal energy would provide a stable baseload, batteries would have to be installed to balance the fluctuations in production of electricity from wind and solar (more details see chapter 6.3.6).

However, as no reliable data both on the resource and commercial aspects are currently available, a decision on a potential contribution can only be taken once robust data and information has been collected. At that point, the levelized costs of generation of various sources need to be compared in order to be able to decide whether geothermal can have a place and what its contribution can be.

6.3.6 BATTERIES

capacity (2.6 MW) is installed. The remaining gap will be covered by coconut oil and a total of around 6 million litres will be required to achieve the target. Total costs of Option 2 are USD 66.5 m (excluding costs for the Sarakata hydro power and the geothermal project as they haven't been determined yet). It is assumed that a pricing arrangement for coconut oil can be found, which is not leading to ongoing operation costs, the costs for carrying out the Coconut for Fuel Strategy are included.

This NDC Implementation Roadmap is a living document. It will be updated once more information and clarity on various opportunities is available. The MRV system to be installed allows tracking of the process and can give feedback on corrective action necessary for achieving the target.

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