

VANUATU RENEWABLE ENERGY SERIES



COPRA FOR ELECTRICITY

Vanuatu's silver bullet to ensure its energy transition and sustainably improve the local social and economic conditions



VANUATU: A quick reminder

Highly Fragmented: 83 islands

Highly Dispersed Archipelago: 12,200 sq.km land in a 680,000 sq.km maritime zone

Limited wealth: 3,300 USD/capita

Low population density: 18 persons per sq.km

High exposure to natural hazards: cyclones, earthquakes, volcanoes, tidal waves, landslides, ...

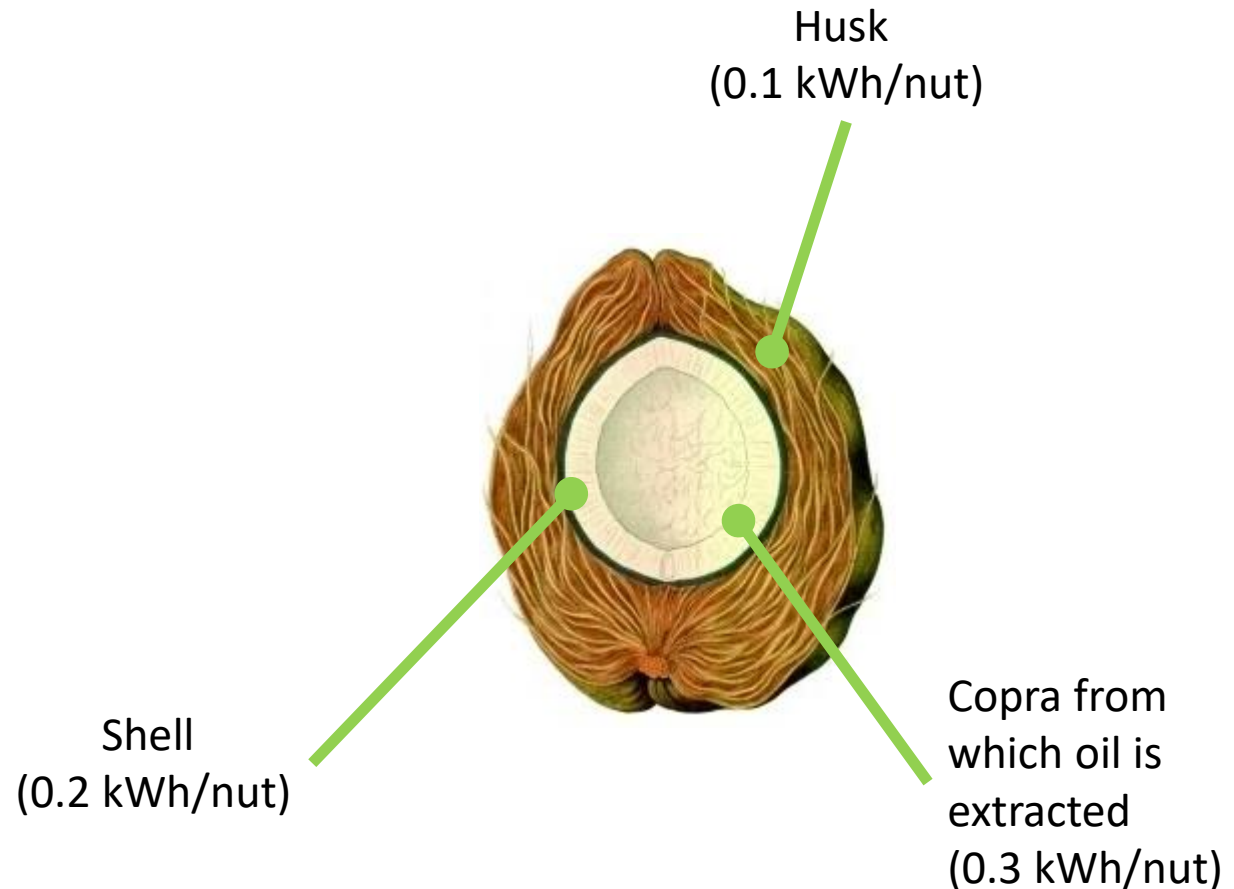
But also ...

- ❖ History and base for **copra production** (119.000 ha of coconut plantation)
- ❖ **Multiple natural resources depending on island:** Sun, Water, Biomass, Geothermal, ...
- ❖ One of the **happiest countries on earth**

... and **UNELCO** has been a partner of Vanuatu since **1939**

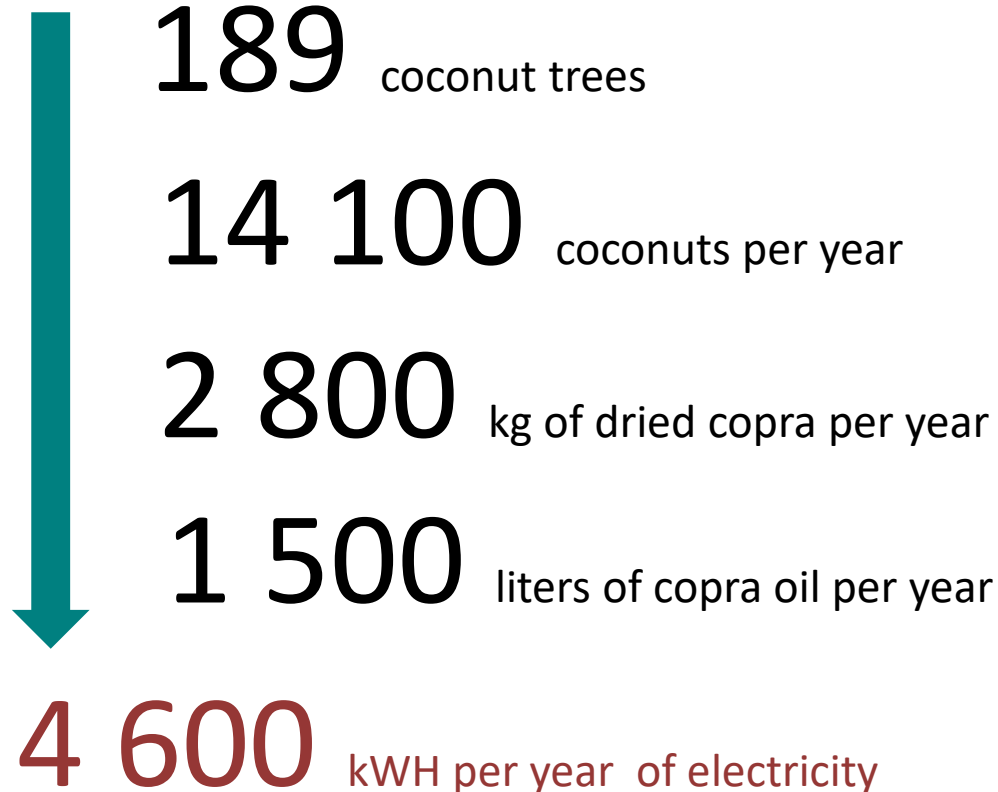


Coconuts offer several sources of energy: the husk, the shell and copra oil. There are strong synergies between the use of copra oil as liquid fuel, the shell & husk for biomass & other commercial activities...



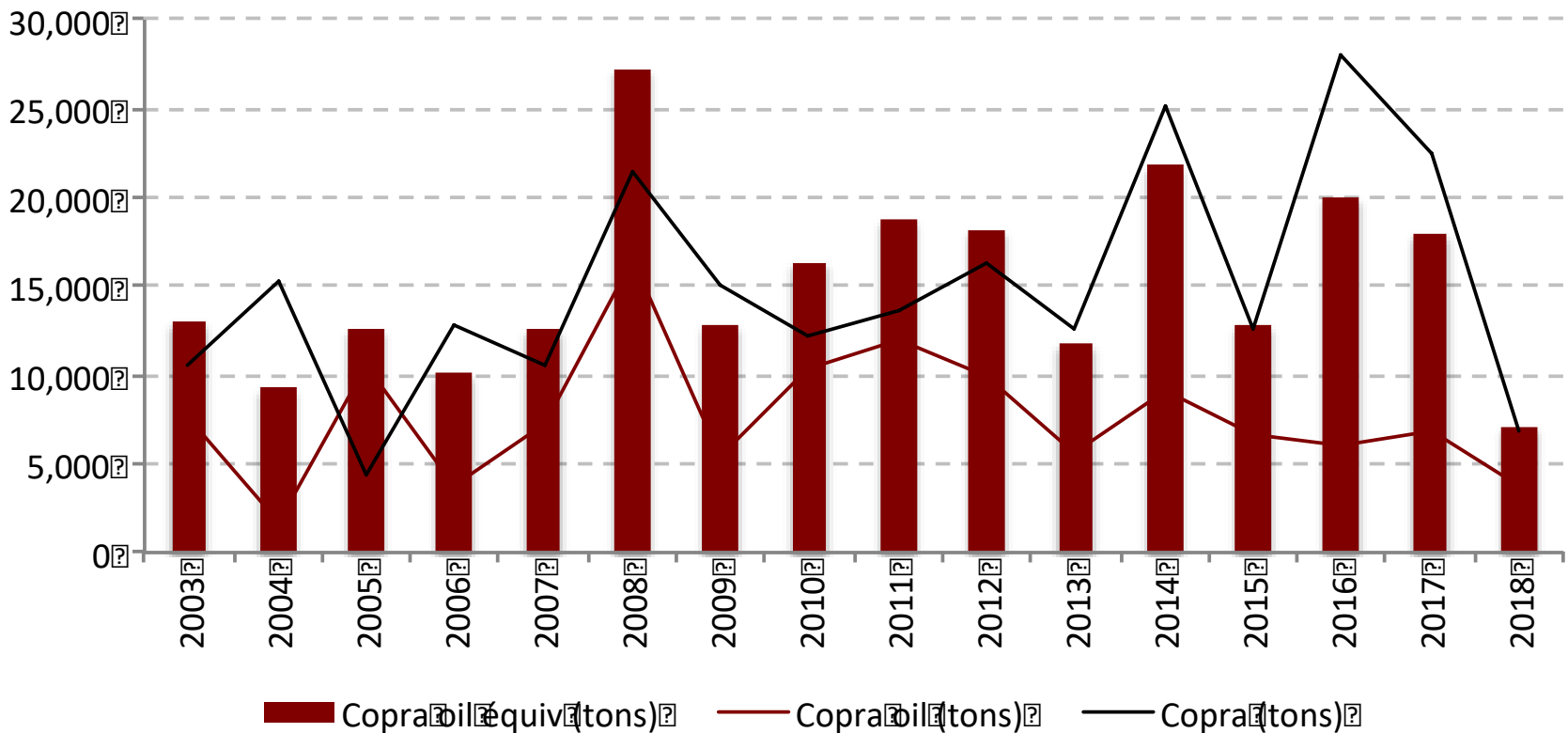
... from 1 hectare of coconut plantation, 4 600 kWh of renewable energy can be generated every year, for at least 60 years (productive years of a well managed coconut plantation) ...

1 Hectare of coconut plantation



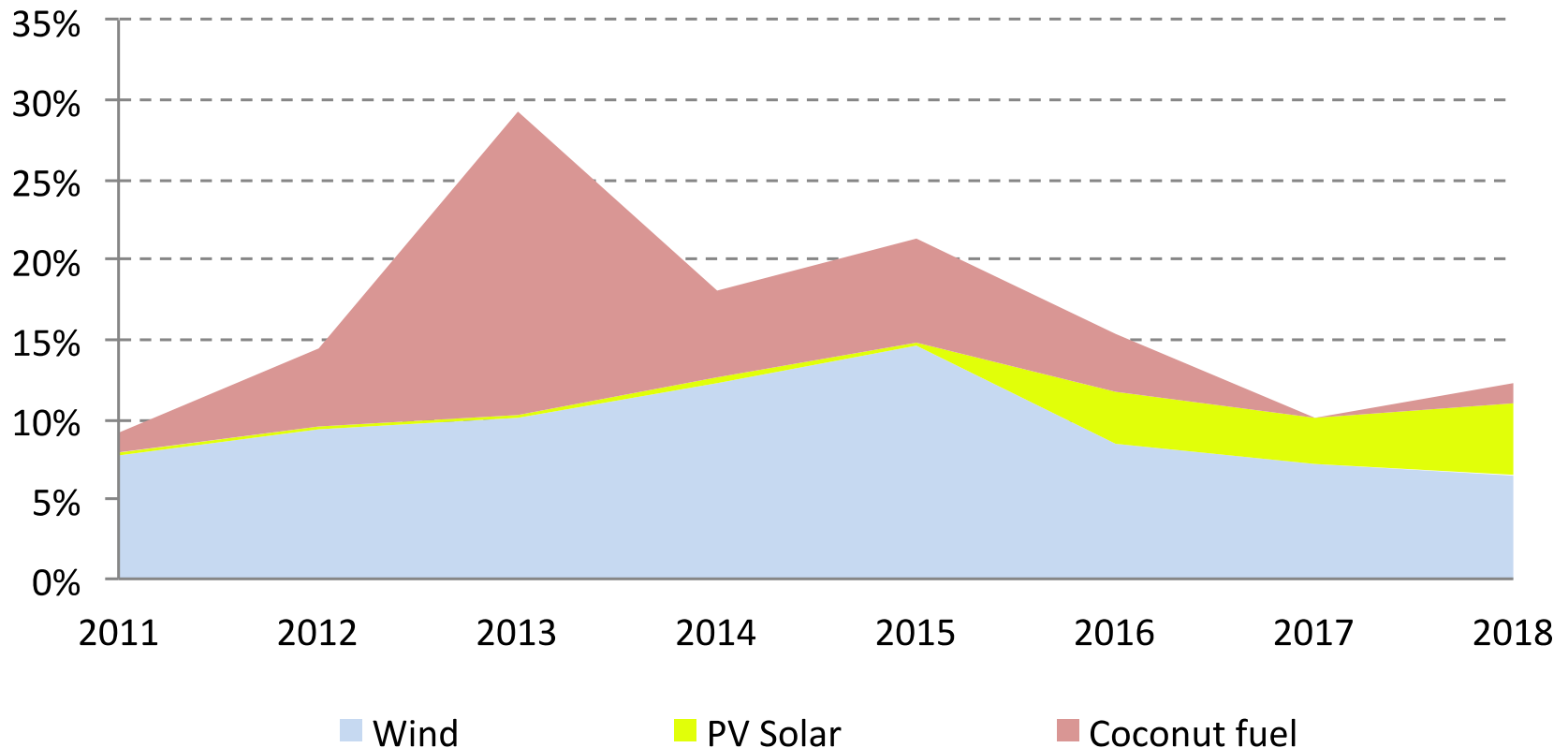
... existing copra cultures in Vanuatu can already support the production of approximately 20 million litres of copra oil per year ...

Quantities of copra oil and untransformed copra exported from Vanuatu the copra oil equivalent of all copra were transformed prior to export 2003-2018 (tons)



... from 100% dependency on fossil fuel generation a few years ago, Efaté (Vanuatu's main island) benefits from 10 to 25% green energy supply - depending on renewable fuel/energy availability each year - in particular variations in copra oil...

Evolution of renewable energy's contribution to Efaté's energy mix from 2011 to 2018 (% of kWh generated)



... the use of copra oil for energy has varied in Vanuatu over the year because of its price variations. While the international price of copra oil has faced significant volatility over the past 12 years (a ratio of 1 to 3 in price) ...

Evolution of International Coconut Oil Price

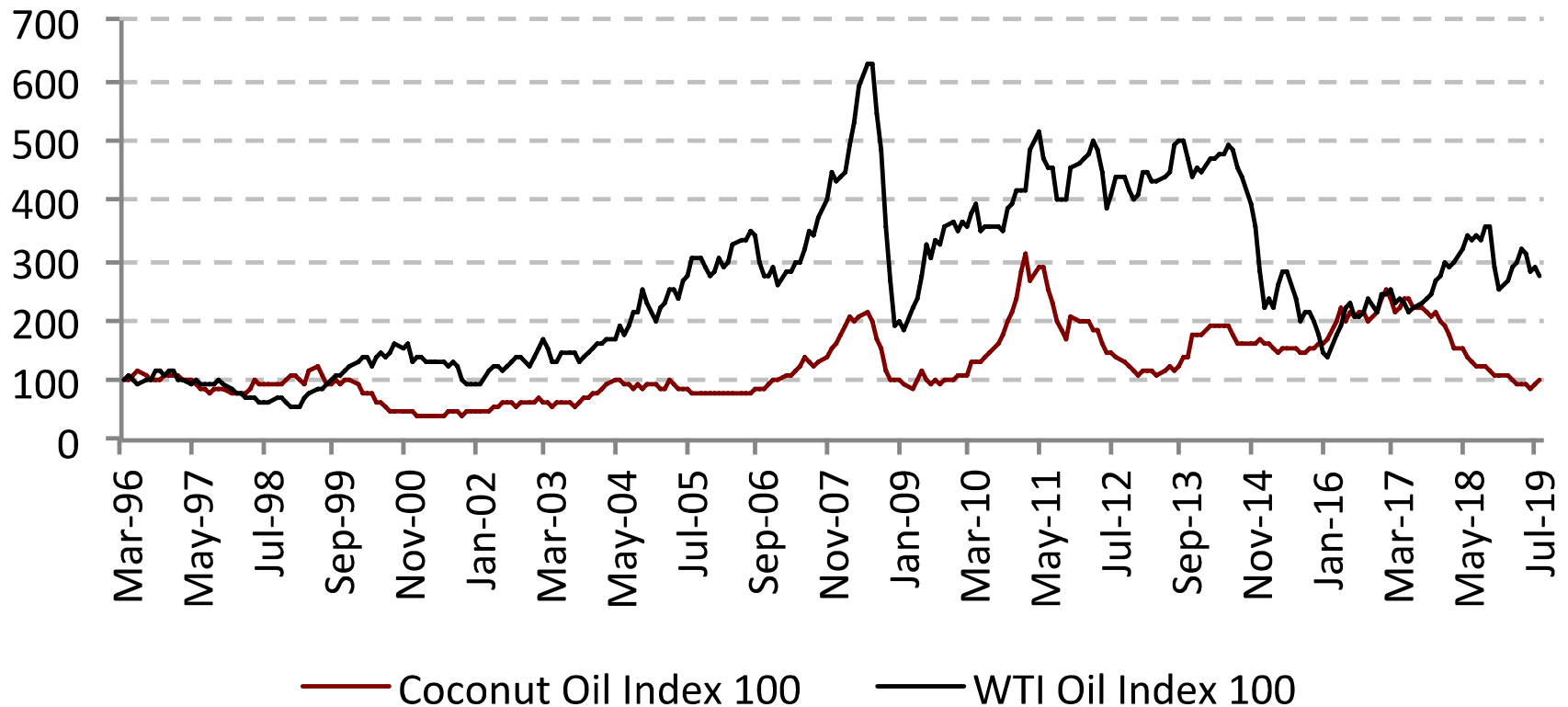
(Philippines, 2007-19, USD per ton)



... in comparison to the international market price of crude oil, the copra prices have been significantly less volatile, and have now returned to 1996 levels ...

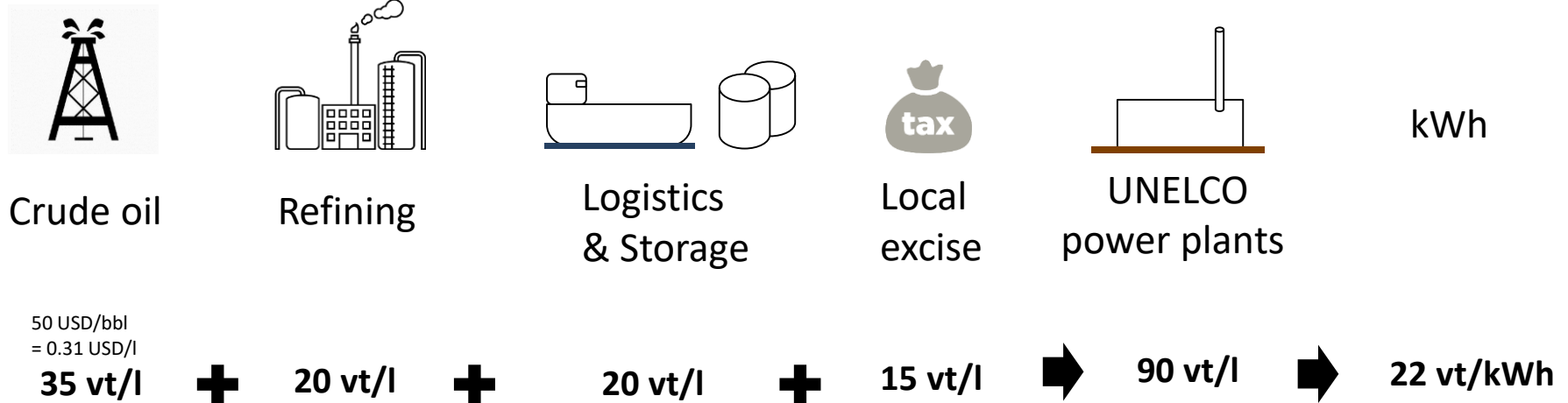
Evolution of Coconut Oil Index v. WTI Index

(Index 100 = March 1996, in USD)



... the breakdown of the cost components of diesel arriving in Port Vila, demonstrates that upwards of 80% there expenses immediately leave Vanuatu, increase trade deficit and do not contribute on local social and economic development ...

Example of typical fossil fuel price components arrived at a Vanuatu power plant when Crude Oil (WTI) is at 50 USD per bbl



... while the copra oil value chain, for the final cost per kWh, reinjects more than 80% of the expenses back into the local economy ...

Example of the components of locally produced copra oil delivered to an Efaté power plant



Dried copra
26 000 vt/ton

=

52 vt/l



Inter-island
Logistics & storage

16 vt/l



Oil
processing

12 vt/l



UNELCO
power plants

80 vt/l



kWh

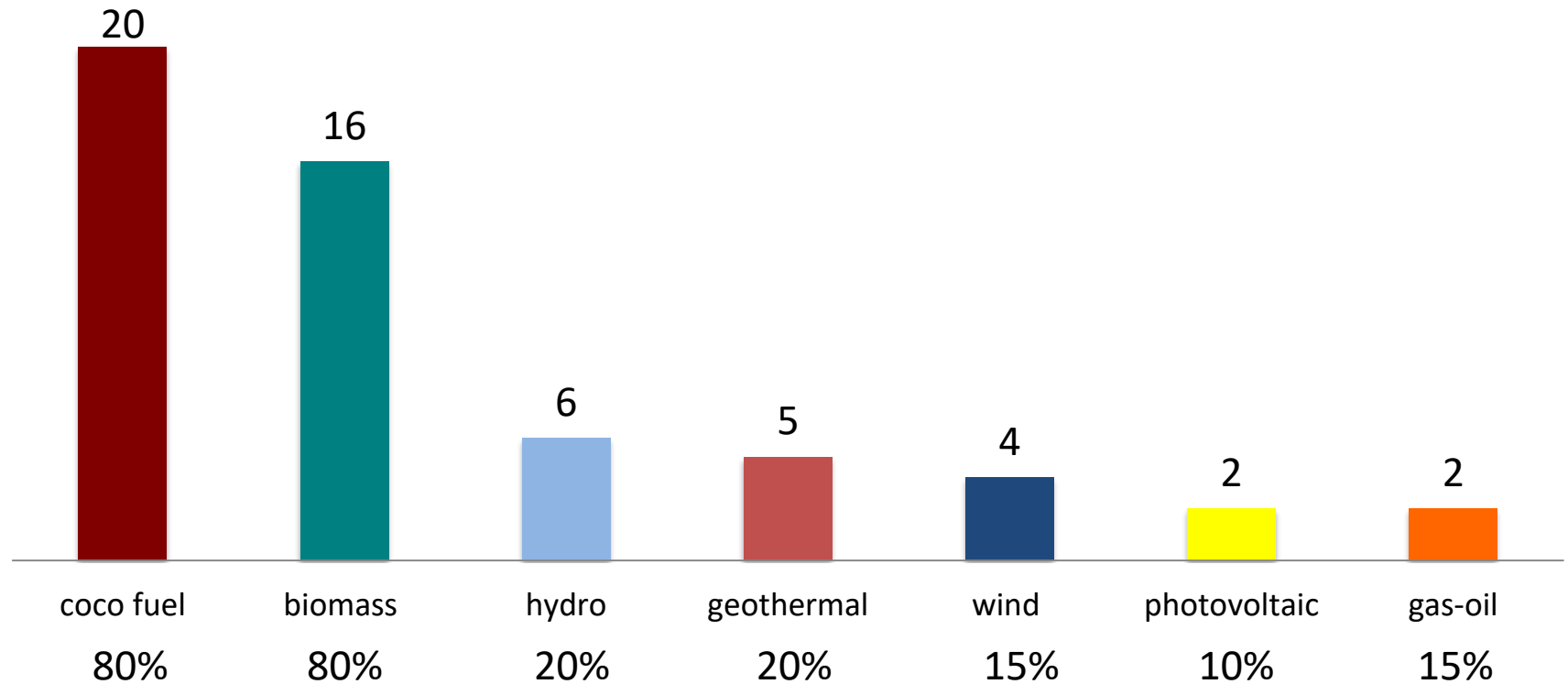
22 vt/kWh

... a comparison of the different energy sources illustrates the fundamental direct and indirect economic benefit of coconuts for Vanuatu, as almost all the expenses are recycled into the local economy with a very high multiplier effect ...



Estimate of the Amount Reinjecting into the Vanuatu Economy

(US cents per KWh and % of cost reinjected into local economy)



... when the international price of crude oil is around 50 USD per barrel, it supports a dried copra purchase price of approximately 26 000 vatus per ton, while maintaining the same affordability for the final electricity customers ...



**26 Vatus per kg of
Vanuatu beach price
dried copra**

=

**80 vatus per litre of
copra oil in Efaté**

=

**22 vatus per kWh of
electricity generated**

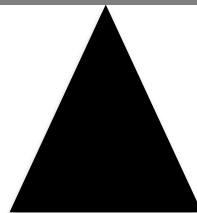
**50 USD per barrel of
international crude oil (WTI)**

=







**90 vatus per litre of diesel
fuel in Efaté for power
generation**

=

**22 vatus per kWh of
electricity generated**










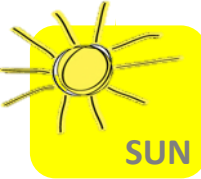










... a closer look at the technical characteristics of copra oil as a fuel for energy demonstrates that it surpasses all the other renewable energy alternatives available in Efaté ...

TECHNICAL		
Resource availability	Tech. Maturity	Dispat- chable
	●	●
 	◐	◑
 	◐	◑
	◐	●

- Coco fuel resource availability is high, in fact current copra production would be enough to reach 100% renewable energy target (and potential to double that production with supporting market conditions)
- Copra oil to electricity uses specific but traditional generators; it is a highly mature technology
- Copra oil can be used like any fossil fuel and therefore capable of producing electricity as required (as opposed to wind and PV solar for example)

... and from an integrated planning, financial and overall value (including environmental, social and economic) produced for Vanuatu, it also trumps all the other renewable alternatives...

	ECONOMIC		
	Option value	Value 4 Vanuatu	Affordability
			
 			
 			
			

- Coco fuel has a very high “option value”; that is, the utility is not locked into the technology by high upfront investment (as is the case in wind, solar, hydro and geothermal). If there are technological advances or market price changes, the utility can swap to another technology with very low cost.
- The value for Vanuatu, as seen previously, is very high as all the costs are recycled to stimulate the local economy
- Copra oil is currently the most cost competitive generation technology (vs. wind with storage, sun with storage, biomass and diesel)

... the overall value for Vanuatu is not only environmental, and energy independence, and long-term economic benefits; there are also many employment opportunities and substantial agriculture synergies ...

EMPLOYMENT OPPORTUNITIES

- Outer island jobs
- Employment all along the value chain from planting to oil



ENERGY SYNERGIES

- Biomass production from coconut shells & husk
- Bio-charcoal from shell

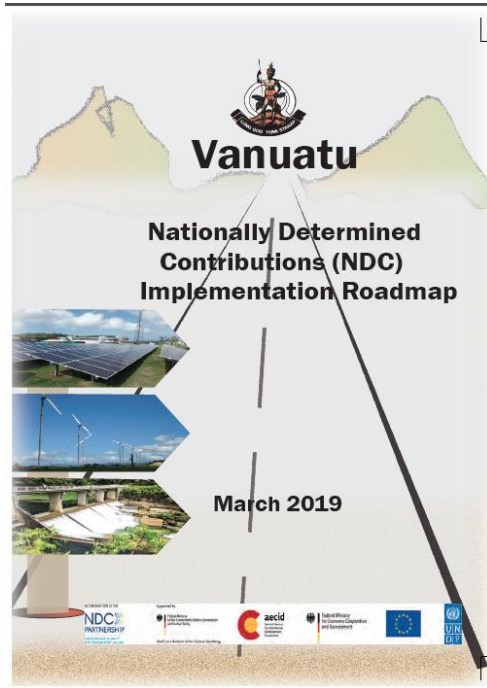
AGRICULTURAL SYNERGIES

- Opportunity to rehabilitate thousands of acres of abandoned farm land
- Interstitial cropping and grazing land for cattle
- Food for cattle from copra milling by-products
- Substrate from husks for hydroponic agriculture

LONG TERM ECONOMIC BENEFITS

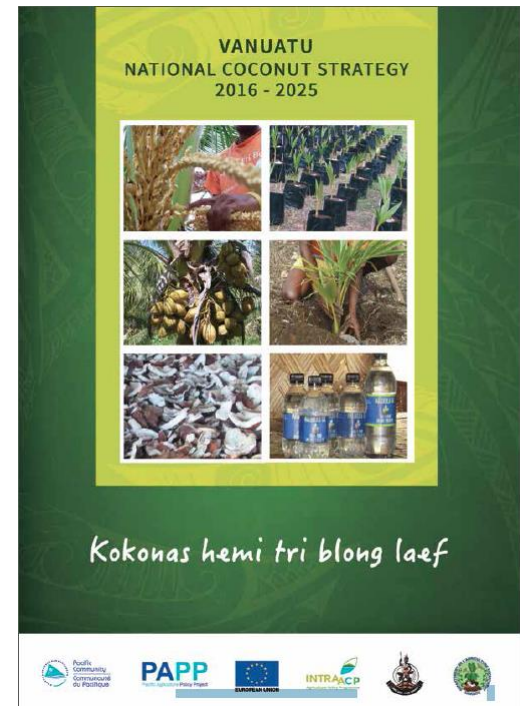
- Very important multiplier effect because of type of jobs created and their location
- Key tool to encourage outer island economic development
- Decreases the trade reliance and trade deficit
- All the funds spent stay in the local economy
- Opportunity for regional trade of any surplus + becoming a showcase example of tailored energy transition

... copra oil's all around value compelling value proposition for Vanuatu has made it the reference energy endorsed by the Government of Vanuatu for achieving its Nationally Determined Contributions (for CoP21) ...



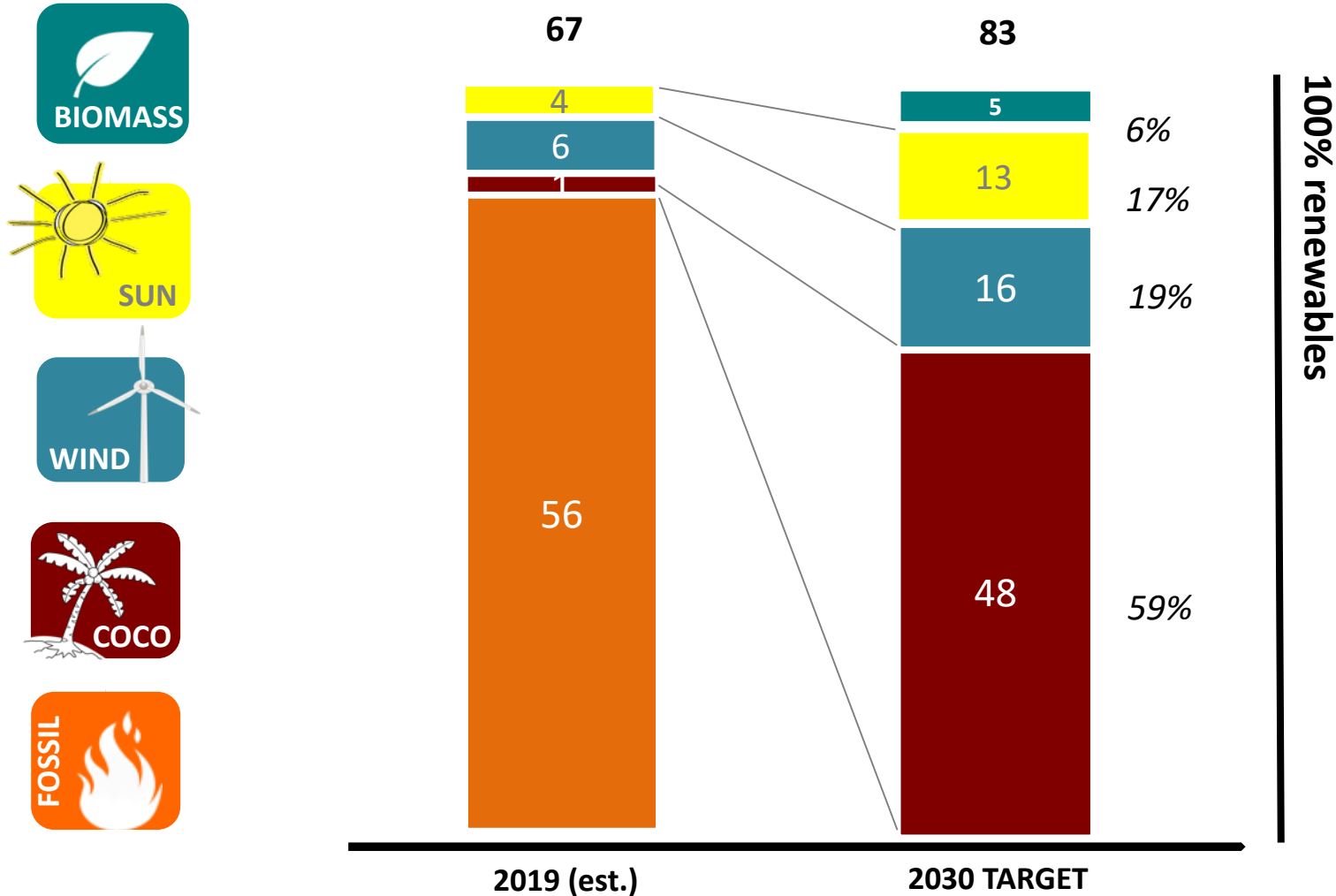
The March 2019 Vanuatu Nationally Determined Contributions (for the realisation of the CoP21 carbon abatements – Paris Agreement), endorses Copra oil as the energy that must provide more than 50% of electricity by 2030

The Vanuatu National Coconut Strategy 2016-25 also lays down some of the fundamental steps that must be taken to improve and develop the coconut production in Vanuatu



... Vanuatu's commitments to CoP 21 (Paris Agreement) are to 100% renewable energy by 2030. Based on the nationally determined contributions, copra oil is slated to contribute the majority (59%) of that energy ...

Generation Energy mix (GWh; %, 100% basis scale)



... this represents 14 millions litres of copra oil (well within Vanuatu's existing production and potential), which itself represents a 1.2 Billion Vatu per year local market, 4 000 jobs, 9 000 hectares of multi-use agricultural land ...



**14 Million litres
of copra oil for energy
per year**

1.2 Bil Vatus/y

reinjected into the local economy, in particular in outer islands.
Improvement of national balance of payment and energy independence from fossil fuel volatility

4 000+ jobs

created, in the particular in the outer islands. A good mix of low qualification jobs (as required) plus higher skilled jobs in the transformation process

9 000+ hectares

of agricultural land put to sustainable use (+ and a demand driven trend to rehabilitate abandoned farms); making valuable acreage available for interstitial cropping and cattle grazing.
2007 agricultural census gives a total of 119 000 ha of coconut plantation in Vanuatu)

-33 000 tons CO₂/y

not emitted; thereby single-handedly fulfilling the largest part of Vanuatu's greenhouse gas emission commitments at CoP21

... challenges remain to achieve this objective, in particular price volatility and continuity of copra supply. The acknowledgement of coco-fuel as a strategic asset for Vanuatu, and adapting policies to reflect this status will make a difference ...



1

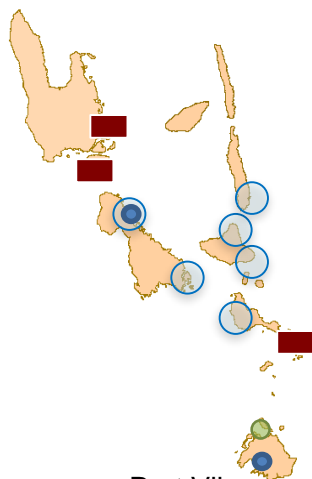
Multiplying and diversifying resource supply sources

- Rehabilitation and development of local coconut farms
- Procure at **different stages of transformation**
- **Procure from many islands**
- **Entering into the value chain** to hedge against third party risk: own plantation, own oil transformation, ...

2

Entering into enforceable long term supply contracts

- Choosing and promoting the emergence of **reliable counterparts**
- Providing **appropriate incentives** to suppliers



Port Vila

- Copra suppliers
- Third party oil
- Own oil refinery
- Own Plantation

... and UNELCO is committed to working with both the Government and the other stakeholders of the copra value chain to begin laying all the foundations necessary to achieve the 2030 objective.



3

Increasing UNELCO's own oil storage and refining capacity to decrease exposure to price volatility and temporary supply disruptions



214 000 l storage capacity

700 000 l/m refining capacity

4

Working with the Government of Vanuatu to align laws, regulations, economic and fiscal policies with long term interests of promoting sustained use of copra oil for energy in Vanuatu

Thank you for your attention



VANUATU RENEWABLE ENERGY SERIES

Q&A – Is copra oil as environmentally friendly compared to other renewable energy options ?

- Bio oil is basically emission neutral because all the carbon atoms released into the atmosphere when it is burned to make electricity was previously captured from the atmosphere by the coconut tree.
- Coconut farming in Vanuatu is a highly manual process which therefore doesn't have any significant side emissions. Culture is also light/to pesticide free. Most of the logistics is ocean based, one of the lowest emission modes of transport per ton, and short distance (only between outer islands and Efaté). Intercropping will allow vegetable & fruit gardening improving food security.
- Unlike wind or solar for example, which require heavy industrial processes (which have their own carbon footprint and use of non-renewable resources); and which will eventually need to be replaced, coconut farming is truly self-regenerating.
- Unlike other bio-oils, such as palm oil, and the associated deforestation practices in other countries, the coconut plantations have been established in Vanuatu for a long-time; a large portion has simply been abandoned since independence and must simply be rehabilitated (no net loss of biodiversity)

Q&A – What will happen to Vanuatu energy supply if a natural disaster were to wipe out a large part of the coconut production ?

- Unlike many other trees and plants that have been imported into the islands, Coconut trees are quite resilient in the face of climate events. While damage cannot be excluded, from cyclones, tsunamis or pests in particular; recovery is in general relatively short
- The advantage of Vanuatu's copra production is that it is spread out over several islands which limits the risk that a single event will impact all coconut plantations at once.
- From the utility perspective, copra oil use has a very high option value; that is, should there be any disruption in the copra market, either because of supply issues, or prices, the utility can, without investment and immediately, substitute copra oil for another bio-oil or even fossil fuel until the event is resolved.
- The other advantage of copra vs. most renewable technologies is that copra oil is a liquid fuel and can therefore be stored. While storage is not a long term solution (with risks of acidification in particular), a strategic reserve can buffer any temporary disruptions to the supply chain

Q&A – How can Development Agencies help Vanuatu in achieving the ambitious copra 4 energy targets ?

Development Agencies generally rightly favour long-term solutions and investments (capex) over subsidies and opex. There are several areas they could help the local copra value chain:

- Provide investment to rehabilitate and replant coconut trees on abandoned (or aging) plantations. The counterpart for the recipient of this aid would be a commitment to sell copra locally at a very competitive pre-determined cost for at least 15 years
- Provide investment to rehabilitate and/or create new modern copra oil mills. The counterpart for the recipient of this aid would be a commitment to process copra for a pre-determined cost and sell it locally for at least 15 years
- Provide investment to create logistics pathways for copra from the coconut farms to the oil mills and then to the consumption centres.
- Provide assistance in drafting any required regulations and laws that “reserve”, for strategic purposes (energy independence etc.), a portion of copra for the national energy market.