



UNELCO



ENGIE

Efaté Energy Road Map 2018-2030

Pathway to Achieving the Renewable Energy Commitments and Other Wider Sustainable Development Goals for Vanuatu

UNELCO in Efaté today ... in brief

Installed grid-connected capacity in Efaté (Sept. 2018)



3.5 MW



2.4 MWc



Up to
8 MW



Up to
21 MW

ÉFATÉ



Electricity
And Water

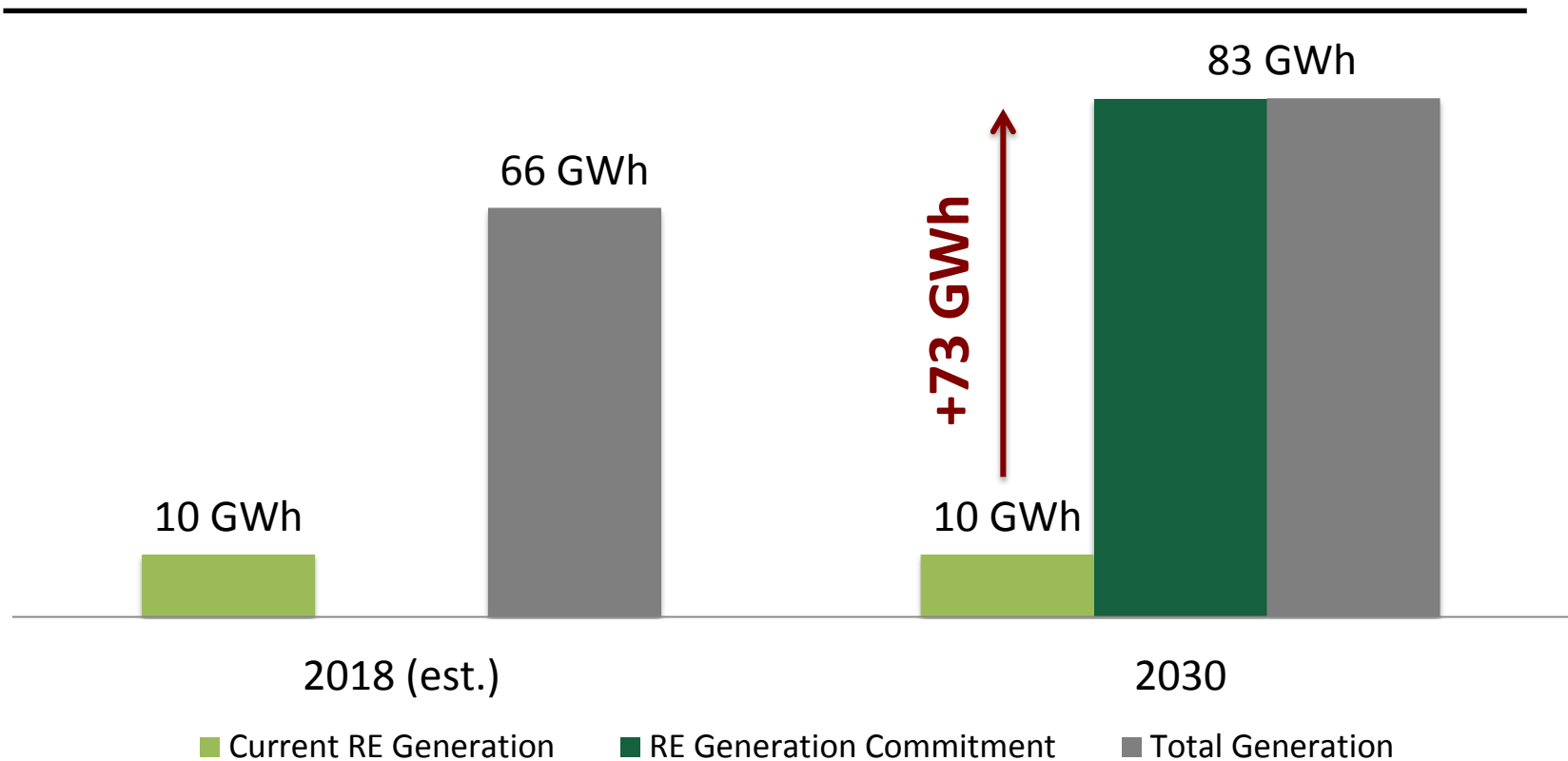
Customers: 16 000

Peak elec demand
12 MW

Generation: 66 GWh

The CoP21 agreement and the National Determined Commitments (NDC) require 100% Renewable Energy (RE) by 2030; which implies an increase RE generation of 73 GWh by 2030...

Current RE Generation and Total Generation; 2030 Total Generation and NDC RE Commitment (GWh)



... achieving these ambitious RE objectives will require not one but a mix of renewable technologies; there are a handful of renewable resources available in Efaté ...

CONFIRMED & ABUNDANT LOCAL RESOURCE



Bio-fuels Sufficient copra production in Vanuatu today to already meet 100%+ of Efaté's power generation needs



Wind Strong potential of small scale (cyclone resistant) wind power generation. Approximately 1 860 h per year local resource



PV Solar Strong potential. Approximately 1 380 h per year local resource

CONFIRMED BUT LIMITED LOCAL RESOURCE



Biomass/Incineration Strong synergies with copra oil but scope of biomass for energy potential is overall limited

SPECULATIVE AND UNCONFIRMED RESOURCE








Geothermal Potential may exist but has never be confirmed. A Development Agency would need to finance bore holes to confirm technical and commercial feasibility

... individually, each RE technology has a unique set of technical, social, environmental, and economic characteristics which must be taken into consideration...

RE CHARACTERISTICS MAPPING CRITERIA

Availability	Is the RE resource readily available locally in Efaté (and within a general technical and commercially viable range) ?
Technical maturity	Is the technology reliable, mature, suited for an insular environment (with the associated constraints) ?
Dispatchability/Intermittency	Is the technology capable of producing: (1) a dependable power output (or is it intermittent), (2) a load following power output (or is it base load)?
Basic cost competitiveness	How does the technology currently compare to fossil fuels (LCOE) from a basic cost competitiveness standpoint (ie. without considering social and other economic induced externalities) ?
Flexibility value	If you invest in this technology, are you committed to it and to its cost for a short or long period. Does choosing this technology, because of minimal sizing requirements, limit the options for other technologies in the future ?
Value for Vanuatu (“V4V”)	Beyond the environmental benefit (assumed equivalent), what is the overall long-term social and economic value of the technology for Vanuatu and its people ?

... all renewable technologies have their pros and cons, and the answer to meeting the renewable challenge will not be an “either/or” but rather an evolving “energy mix” ...

	TECHNICAL			ECONOMIC		
	Resource availability	Tech. Maturity	Dispat- chable	Option value	V4V	Cost Compe- titivness
	●	●	●	●	●	◐
	●	◐	◐	◐	◐	◐
	●	◐	◐	◐	◐	◐
	◐	◐	●	◐	●	◐
	?	◐	◐	○	◐	?

... while wind, solar and biomass are well-known, a deeper dive is important to understand why “Coco-4-Energy” is Vanuatu’s silver-bullet to achieving the CoP21 Commitments and achieving many other benefits for Vanuatu as well ...

EMPLOYMENT OPPORTUNITIES

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

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

ENERGY SYNERGIES

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

TRULY SUSTAINABLE

- Unlike wind or solar, which require industrial processes and will eventually need to be replaced, coconut farming is truly self-regenerating
- Farm-land already exists (no depletion of natural forests)
- Milling infrastructure already exists

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

... overall, in determining the components and weights of the different technologies in the Efaté energy mix several other facts, imperatives and objectives must be taken into account ...





FACTS AND CONSIDERATIONS

- **Grid Stability:**
 - Grid stability study has shown that the Efaté network has reached its technical limit to absorb direct-to-grid intermittent energy sources.
 - The intermittency and the generation patterns of PV Solar and Wind are different
- **Affordability:** If UNELCO finances all the required investments itself, which it could do, the capital and depreciation would weigh on the customer tariff
- **Aid Required:** Vanuatu's CoP 21 commitment to achieving 100% RE is **CONDITIONAL**. It is conditional upon obtaining appropriate international aid.
- **Least-cost:** Because of the increasing storage requirement, the marginal cost of adding 1 GWh of intermittent increases as the penetration % increases

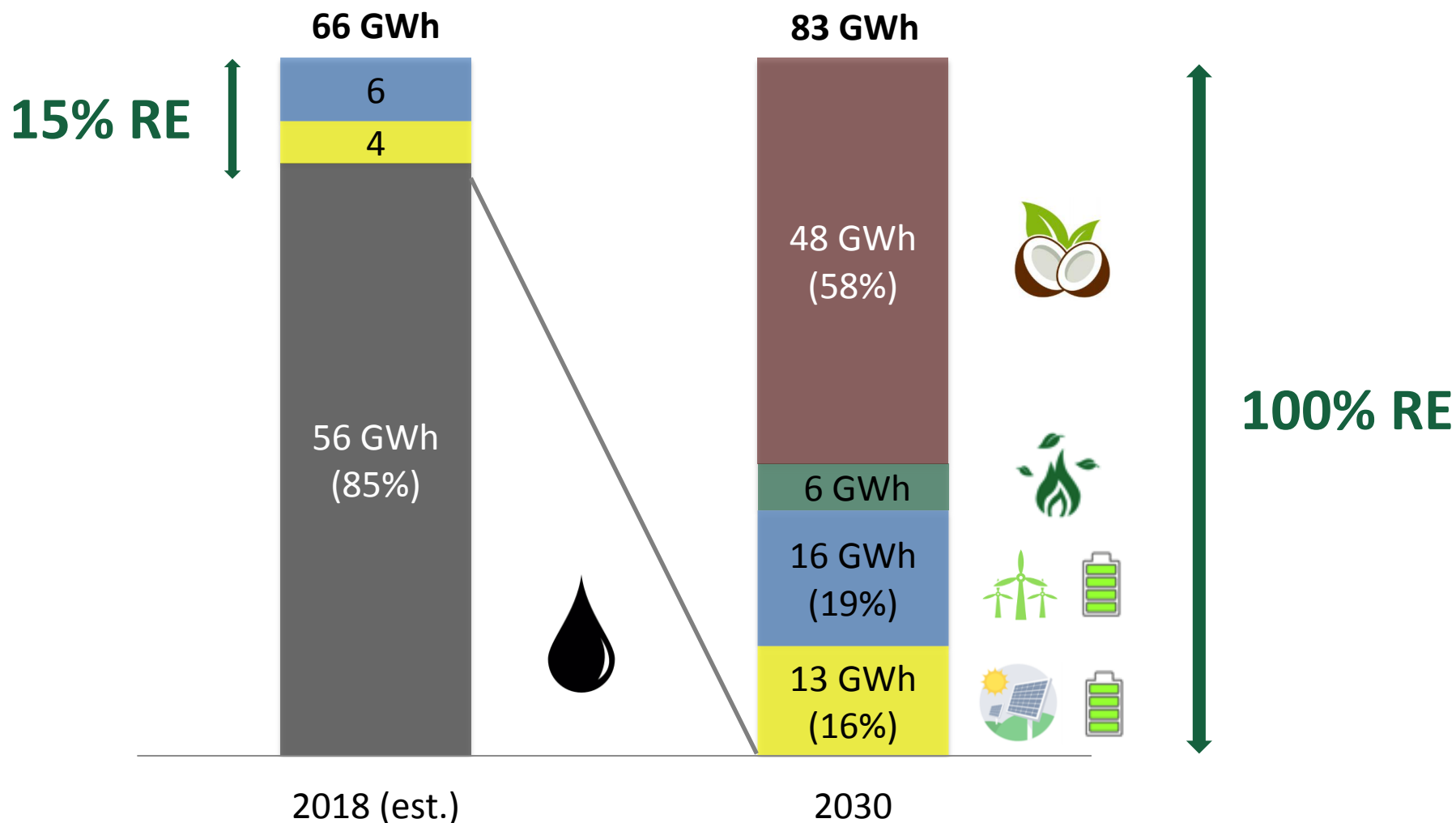
CONCLUSIONS

- ➔ **All incremental intermittent capacity will require associated buffering/storage capacity.**
- ➔ **A mix of both Solar and Wind is important to create a portfolio effect**
- ➔ **A large part of RE investment must be financed by grants**
- ➔ **A part of the energy mix must therefore be allocated to CAPEX intensive RE technologies; not just copra fuel**
- ➔ **Past a certain point, copra must be used because of the “decreasing returns” of battery stabilised intermittent energy**






One technically and financially coherent scenario to reach 100% RE by 2030 would be entail the following additions ...

	CAPACITY		HOURS AT NOMINAL PER YEAR	Power Gen. 2030
	Existing	Additions		
	2.4 MWp	+ 7.4 MWp	x 1 380 h	= 13.5 GWh
	3.5 MW	+ 5.1 MW	x 1 860 h	= 16.0 GWh
	0.0 MW	+ 0.9 MW	x 6 000 h	= 5.5 GWh
	8.0 MW h	+ 0.0 MW	x 6 000	= 48.0 GWh
TOTAL	10.0 GWh	→		83.0 GWh

... the resulting energy mix would be 58% coprah oil, 19% wind, 16% solar and 7% biomass/incineration and would achieve the 100% RE target of 2030 ...



... the investment requirements would be significant – 6.9 Billion Vatus – but the OPEX component would be sensibly similar to the current ones supported by the customer tariffs ...

	Capacity/Power added	“One-time” INVESTMENT	Recurrent FUEL + O&M
	7.4 MWp	1 370 M Vatus	50 M Vatus/year
	5.1 MW	1 480 M Vatus	75 M Vatus/year
	37.5 MWh	3 750 M Vatus	75 M Vatus/year
	0.9 MW	280 M Vatus	90 M Vatus/year
	14 Million litres per year	0	1 385 M Vatus/year
	TOTAL	6 880 M Vatus	1 675 M Vatus/year

... if the 6.9 Billion Vatus (approx. 60 M USD) can be obtained from the significant donations earmarked for Vanuatu; the customer tariff could remain sensibly the same ...

- 18.9 M litres of fossil fuels not burned per year
- 50 670 tons of CO₂ not emitted per year

**- 1850 M Vatus
In foreign fossil fuel
OPEX from the
Customer Tariff**

- 14 M litres of copra oil purchased locally per year
- 290 M Vatus of locally provided O&M

**+ 1675 M Vatus
in local OPEX to the
Customer Tariff**

6.9 Billion
Vatus of
donated
capex



The operational expenses of this 100% RE scenario are roughly the same as currently supported by the tariff meaning the scenario could be achieved without impacting customer affordability

In summary

- Vanuatu would not only **meet its international climate commitment (CoP21/NDC)** but also
 - Ensure **energy independence for the country**; and
 - **Reduce electricity cost volatility**; and
 - **Sustainably re-inject 1.5 Billion Vatus per year into the local economy through local copra and biomass purchases** (with a very high multiplier effect)
- **Development agencies would need to fund approximately 60 M USD in capex** for the PV Solar, Wind and Buffering/Storage
- **UNELCO would ensure the coordination of the implementation, the long-term O&M** of all the assets funded by the development agencies
- **Total copra oil expenses would be sensibly similar to current oil expenditure, keeping the customer tariff similar to the one today.**
- **If development agencies also help fund developments along the copra oil value chain, and if UNELCO can therefore purchase copra oil below the price of fossil fuels from aided copra producers, the customer tariff could even decrease while meeting the social and environmental objectives.**