



Bluerise

harnessing the ocean's power

Tropical Energy – ARUBA

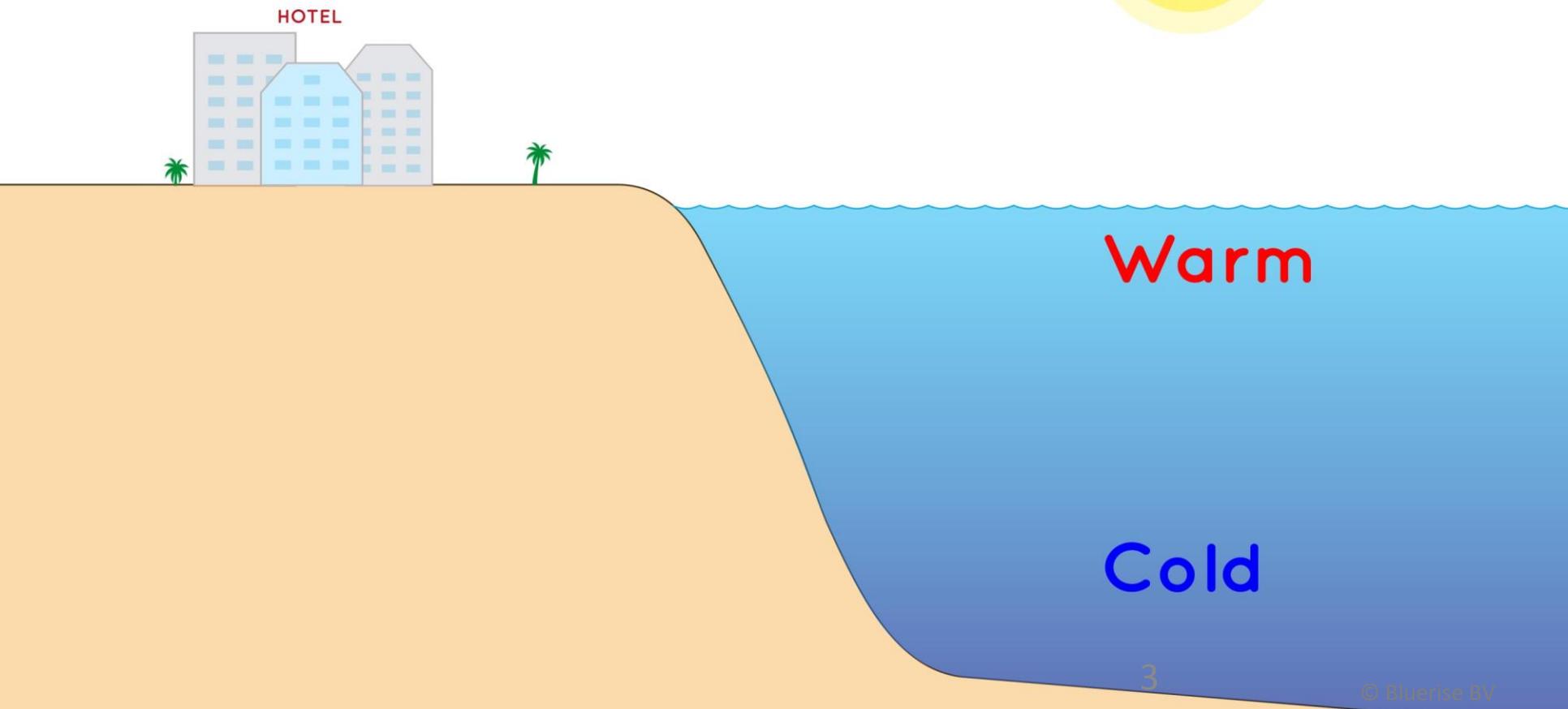
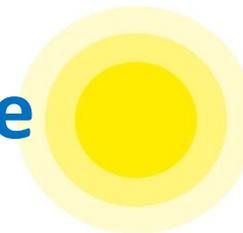
Diego Acevedo – d.acevedo@bluerise.nl

November 2018

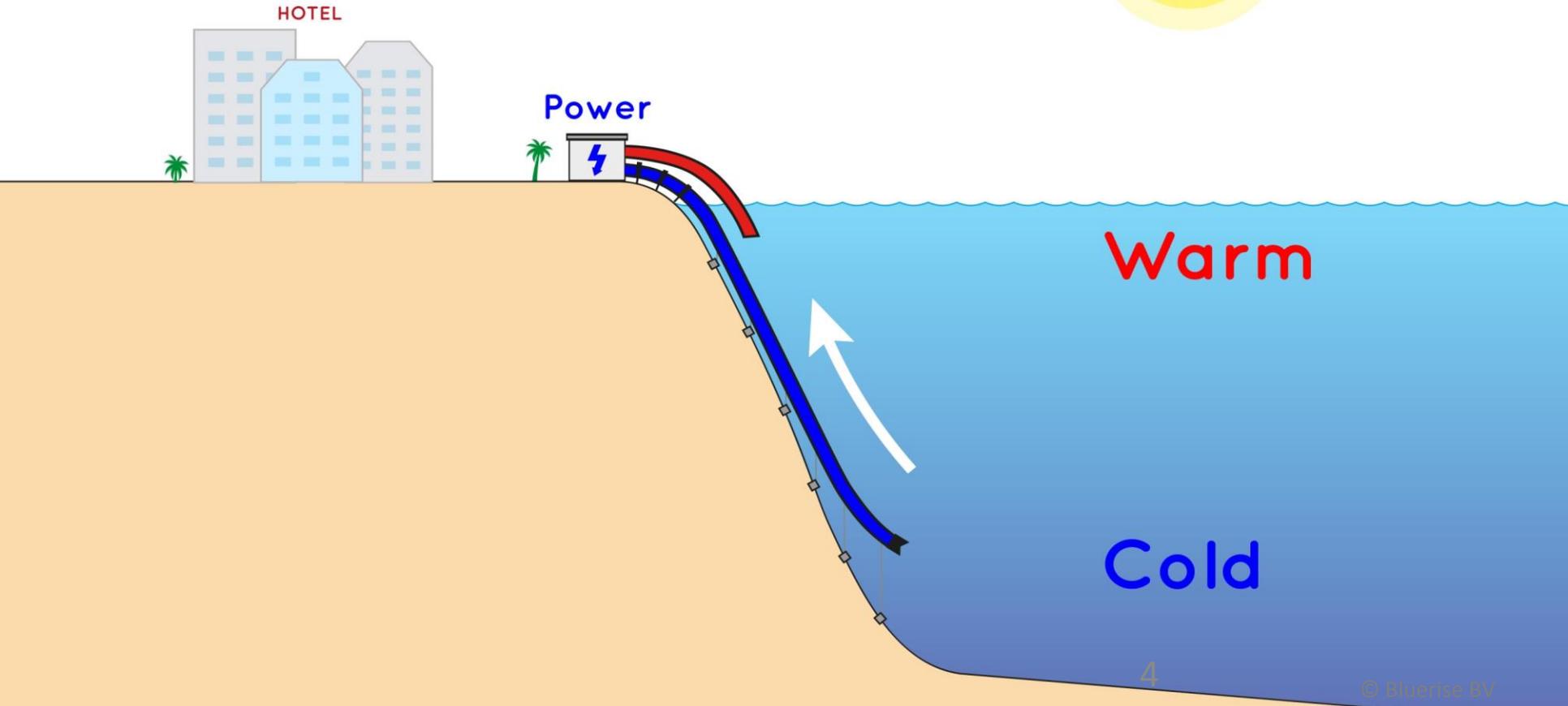
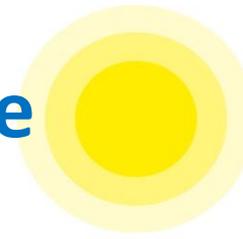


“How inappropriate to call this planet Earth when it is quite clearly Ocean.” Arthur C. Clarke

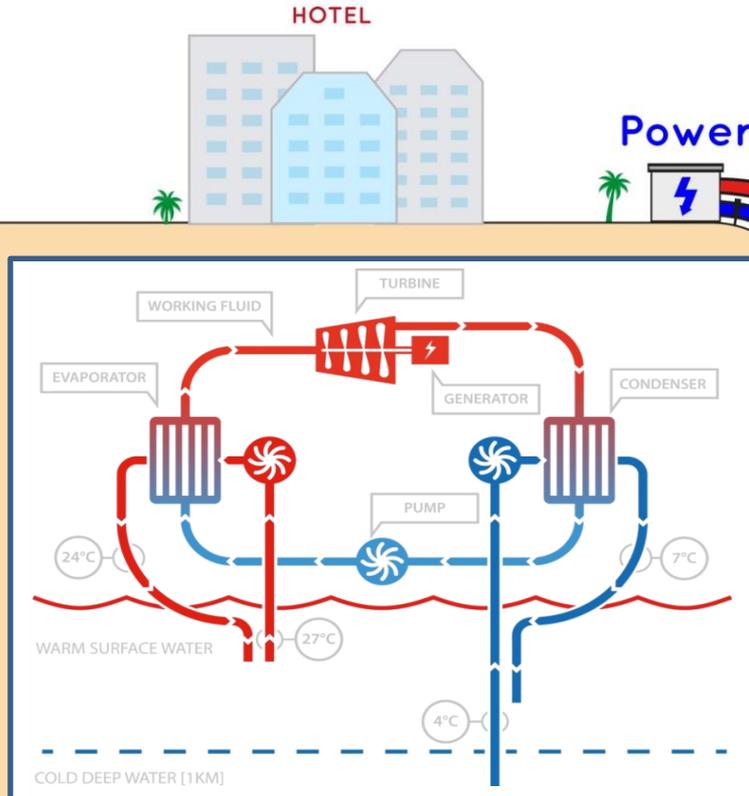
Ocean = solar collector + storage



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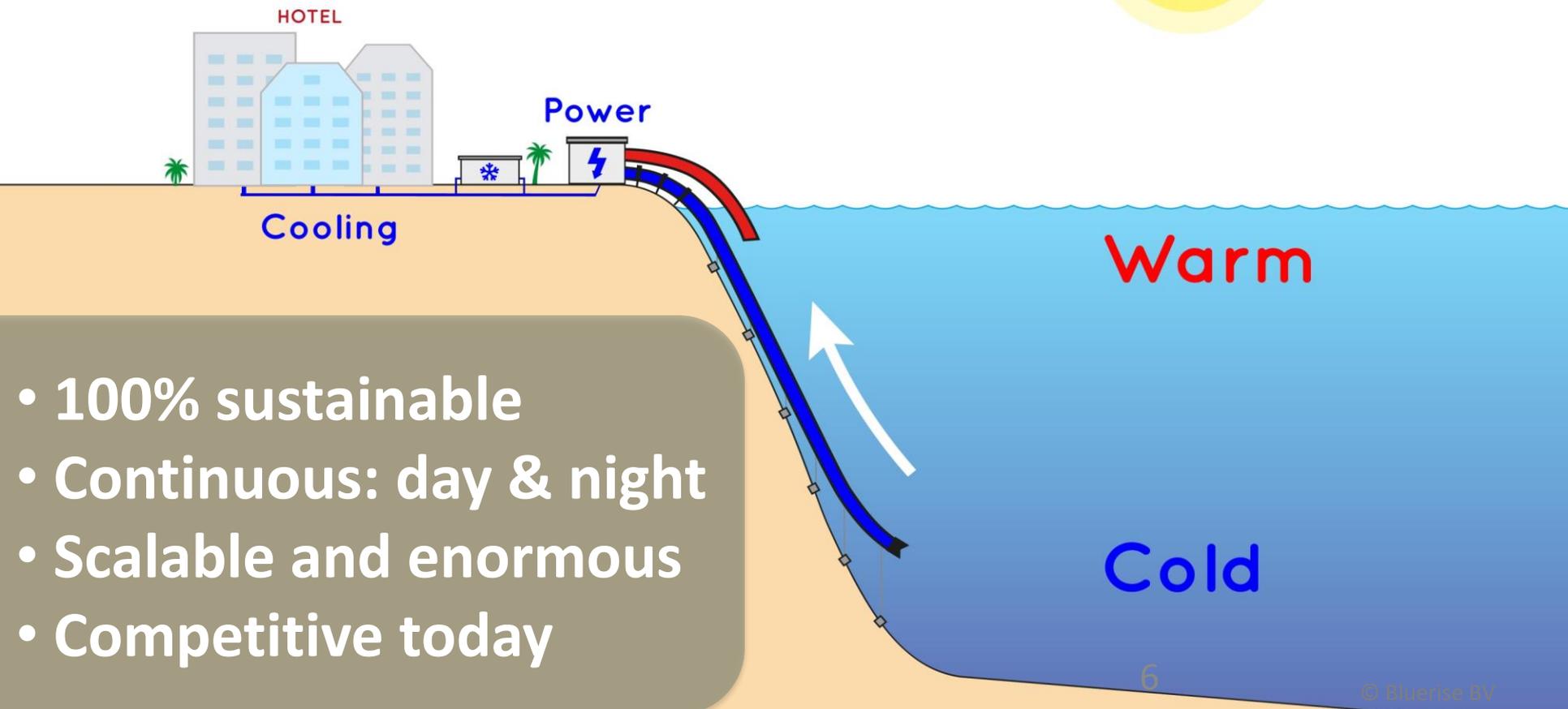
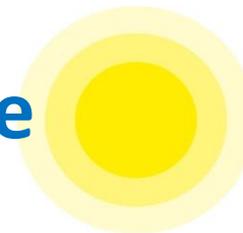
Ocean = solar collector + storage



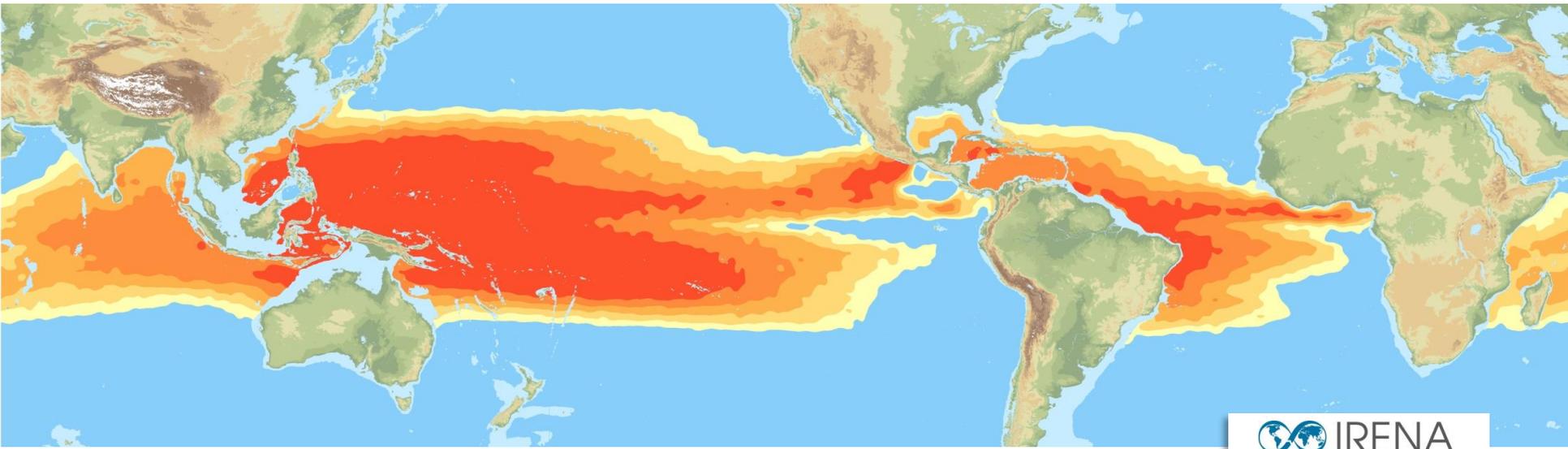
Warm

Cold

Ocean = solar collector + storage



- 100% sustainable
- Continuous: day & night
- Scalable and enormous
- Competitive today



Around **100 countries** have access to Ocean Thermal Energy providing a **billion dollar market opportunity**



Bluerise

Who we are



Company

Founded in 2010,
Offices in Delft (NL) and Aruba



Team

Dedicated team of professionals,
interns and graduates



Partners

Financial, legal, engineering,
EPC construction, universities
and equipment vendors

Bluerise

What we do



Project development

OTEC, SWAC, Ecopark (Curaçao, Colombia, Jamaica, others...)



Technology

More efficient,
lower \$/kWh

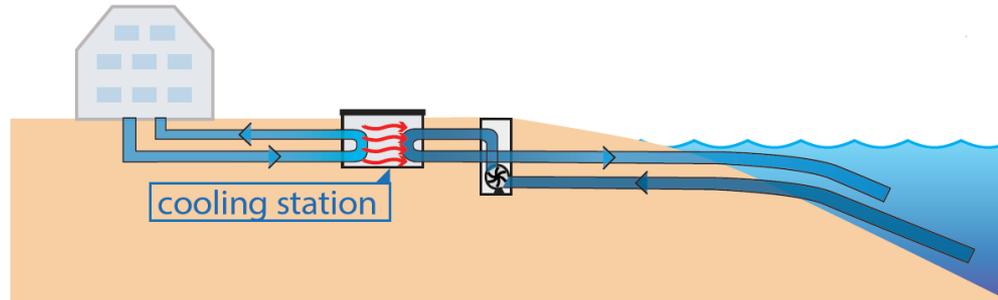
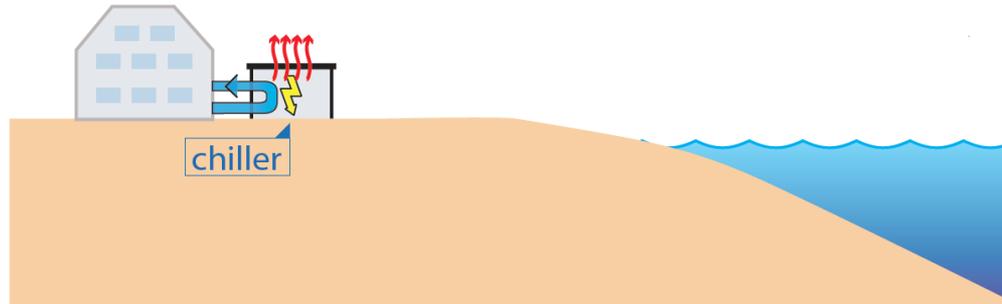


Software

Resource Assessment
my.oceanpotential.com

SDC / SWAC

Seawater District Cooling / Seawater Air Conditioning



SDC / SWAC Benefits

- 💧 Lower energy costs
- 💧 Environmentally benign
- 💧 Less maintenance
- 💧 Plug-and-play
- 💧 Stable price – no volatility



Curaçao Airport Project







Hato Airport, Curaçao





Hato Airport, Curaçao

Exclusive development contract for:



10MWt seawater district cooling



0.5MWe power plant

➔ Seawater district cooling network





Montego Bay, Jamaica



Seawater District Cooling



Montego Bay, Jamaica

- 💧 **21MWt seawater district cooling (\approx 6450 households)**
- 💧 **10x more efficient than regular air conditioning replacing 7 MWe for cooling and reducing 17,000 tons CO2 annually (\approx 3600 cars)**
- 💧 **Costs savings up to 60%**

How do we get to ARUBA +?

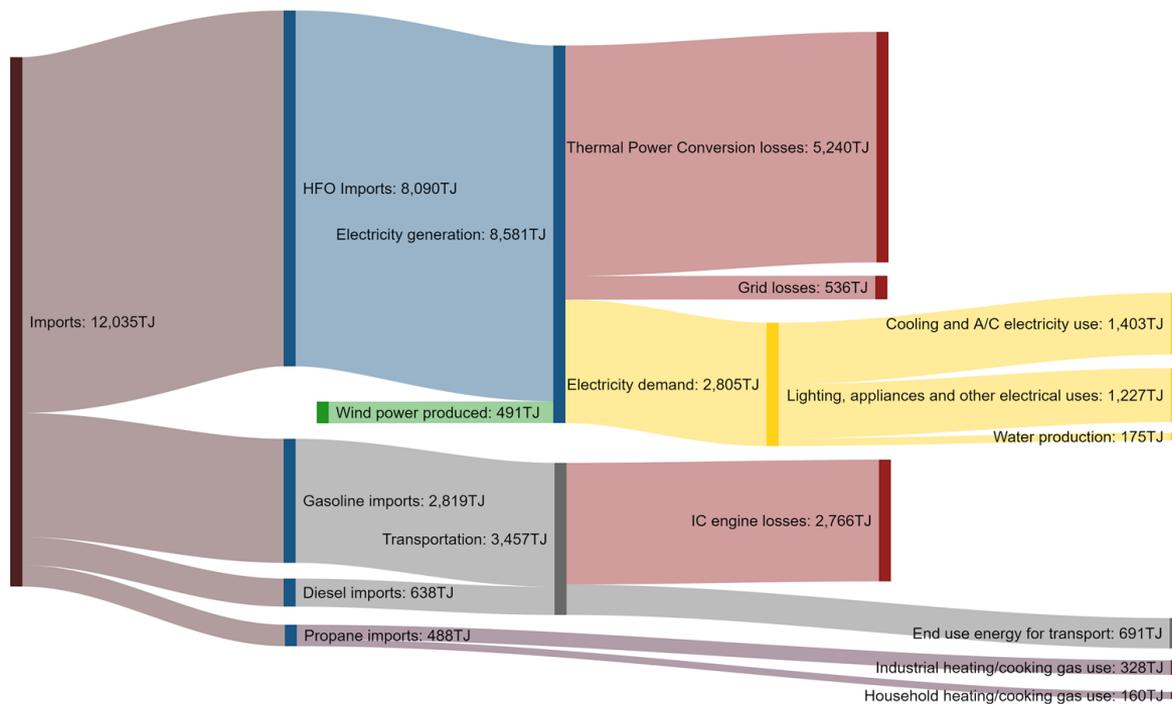
MANEHO DI ENERGIA SOSTENIBEL

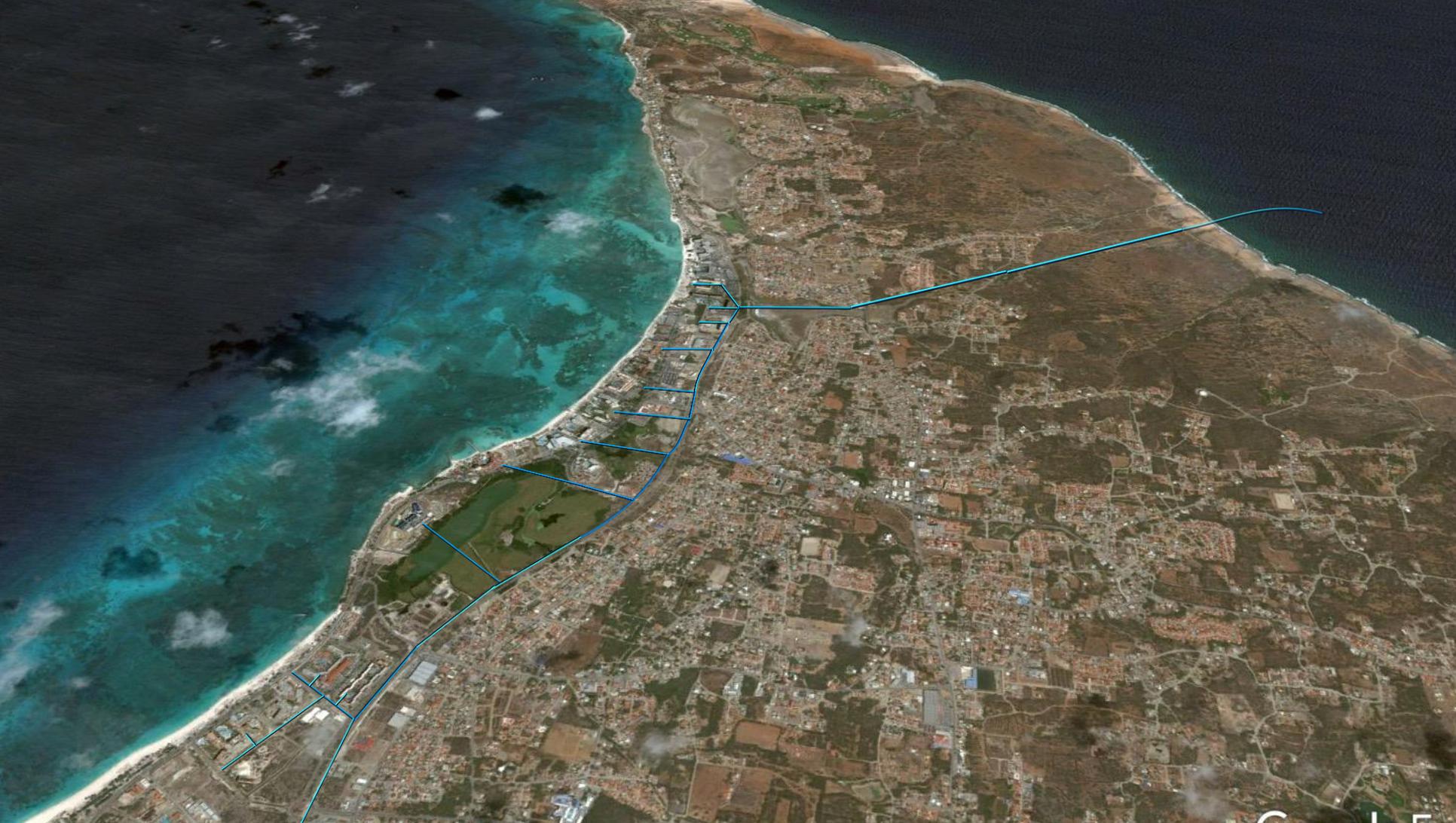
Plan di accion pa resolve problemanan energetico actual:

- Implementa un maneho duradero y sostenibel encunto energia, uso di awa, biento y solo pa bin cu energia alternativo.
- Instala e tecnologia di uso di awa friu (for di lama hundo) pa fria edificionan (“cold water cooling”). Esaki lo nifica menos uso di electricidad pa edificio y a lo largo lo reduci gasto di airco.



Island Energy: Aruba - 2013 energy balance





Current status:

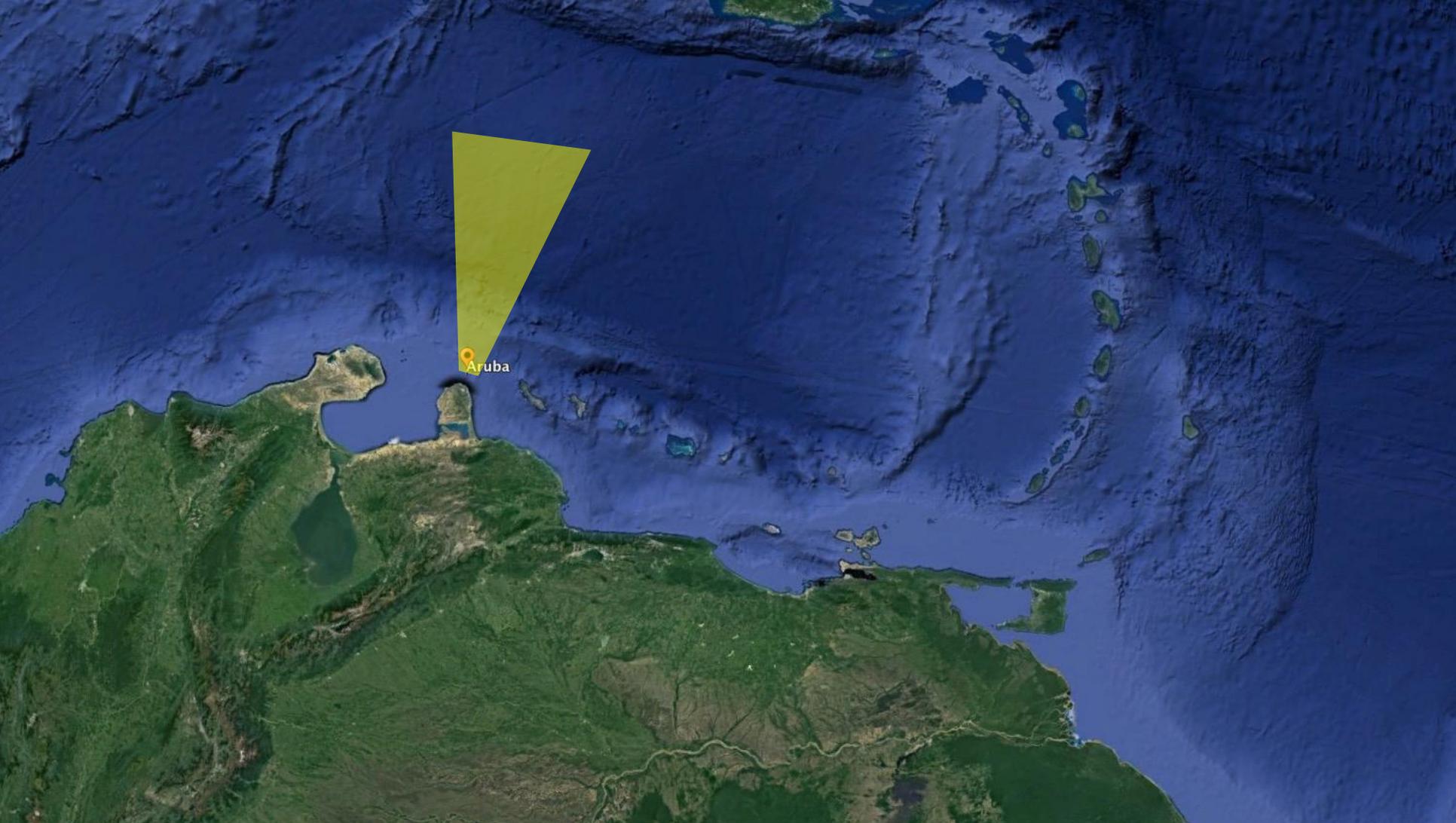
~10% of electricity of Aruba is being used for cooling the hotels

85% depended on heavy fuels despite all efforts

>USD\$20 million used to pay cooling in the hotel area

716.000 tons CO₂ emission for Aruba each year

- 
- + Shift in tourism: guests looking for sustainable and unique experiences
 - + infra advantage: Most hotels clustered on the north side of the island



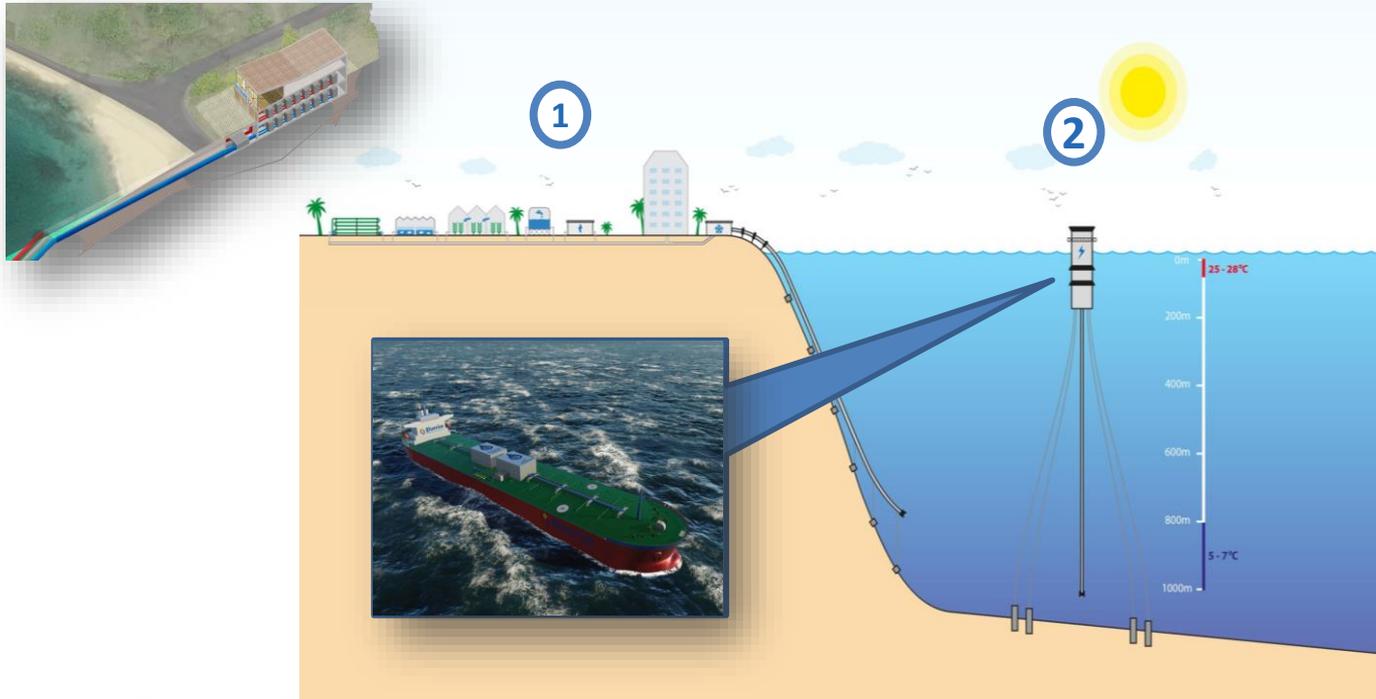
Aruba

Proven Technology

- 💧 District Cooling Systems have matured and are in operation for decades
- 💧 The technology is currently in use in many countries and its implementation expanding
- 💧 Examples can be found in the USA, Canada, Sweden, Denmark, Finland and The Netherlands.
- 💧 District Cooling systems are also operational in relatively harsh and sometimes remote environments like the UAE, French Polynesia or Qatar

OTEC

Ocean Thermal Energy Conversion



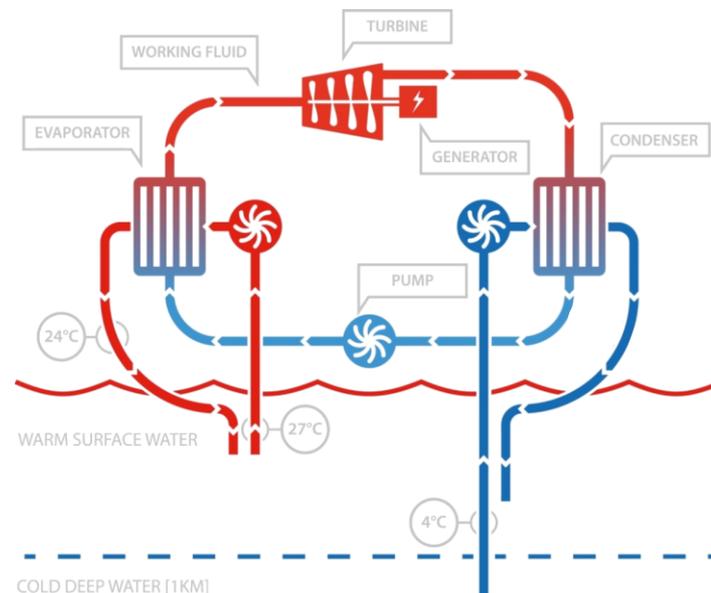
OTEC

Ocean Thermal Energy Conversion



OTEC Benefits – Ocean Thermal Energy Conversion

- 💧 Constant energy source
- 💧 No land requirements
- 💧 No visual impact
- 💧 “By-products”



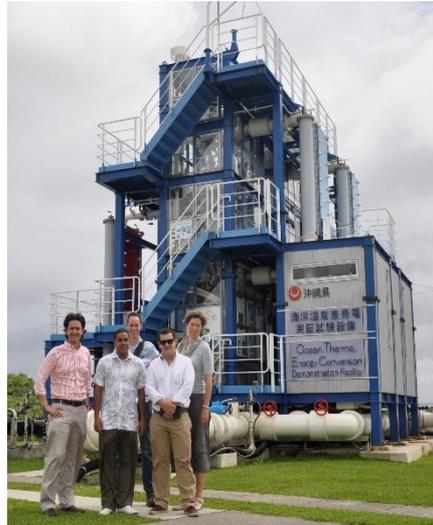
Basic Technical Principle



Technology is ready



OTEC Projects around the world today



➔ Trincomalee, Sri Lanka



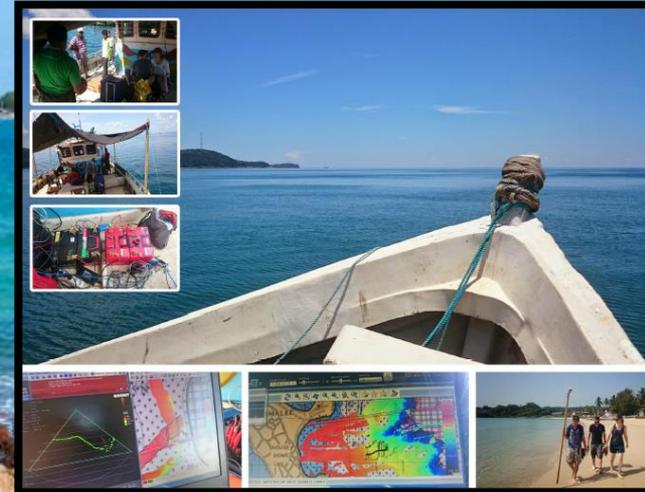
10MW OTEC



Competitive electricity rates

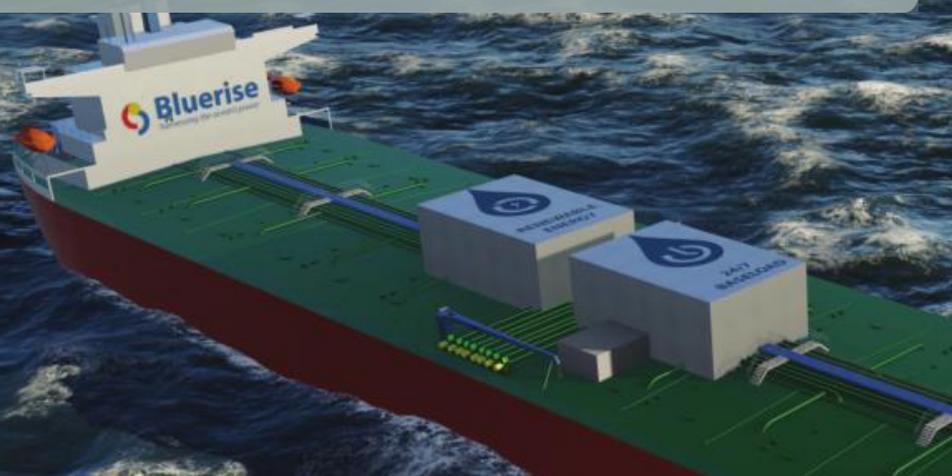


75,000 tons CO₂ savings/yr





Barranquilla, Colombia



- 10 MW OTEC for Barranquilla
- Study supported by the Dutch government (Partners for Water)



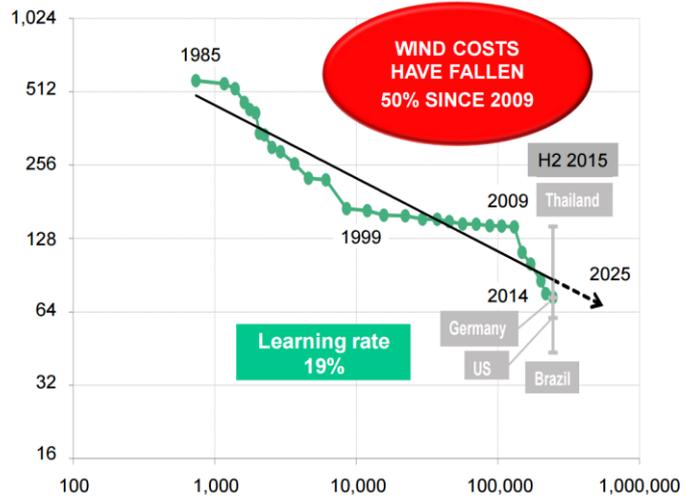
Foreseen Economics

- 💧 LCOE expected to be below USD\$0.05/kwh when mature, unprecedented for baseload renewables.
- 💧 LCOE currently competitive with HFO/Diesel generation in islands
- 💧 Economies of scale apply:
 - 💧 Larger systems → lower LCOE due to lower influence on pipe/platform and other aux costs on overall costs.
 - 💧 Technology maturity

Learning Curve

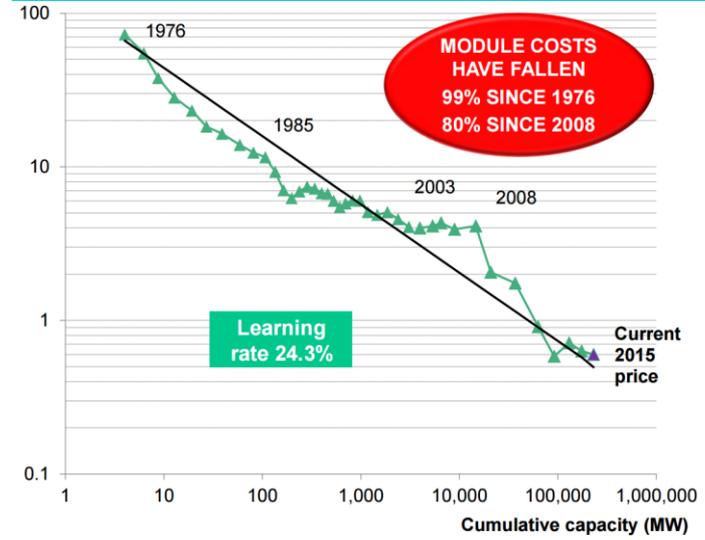
Wind and solar price decrease in time

ONSHORE WIND LEVELISED COST (\$/MWh)



Note: Pricing data has been inflation corrected to 2014. We assume the debt ratio of 70%, cost of debt (bps to LIBOR) of 175, cost of equity of 8% Source: Bloomberg New Energy Finance

SOLAR PV MODULE COST (\$/W)



Note: Prices are in real (2015) USD. 'Current price' is \$0.61/W Source: Bloomberg New Energy Finance, Maycock

Comparing OTEC with solar PV

Main cost driver of OTEC is Heat Exchangers



Solar PV module

- 💧 Complex silicon structure
- 💧 ~35% of installed system cost
- 💧 Annual energy production **440**kWh/m²



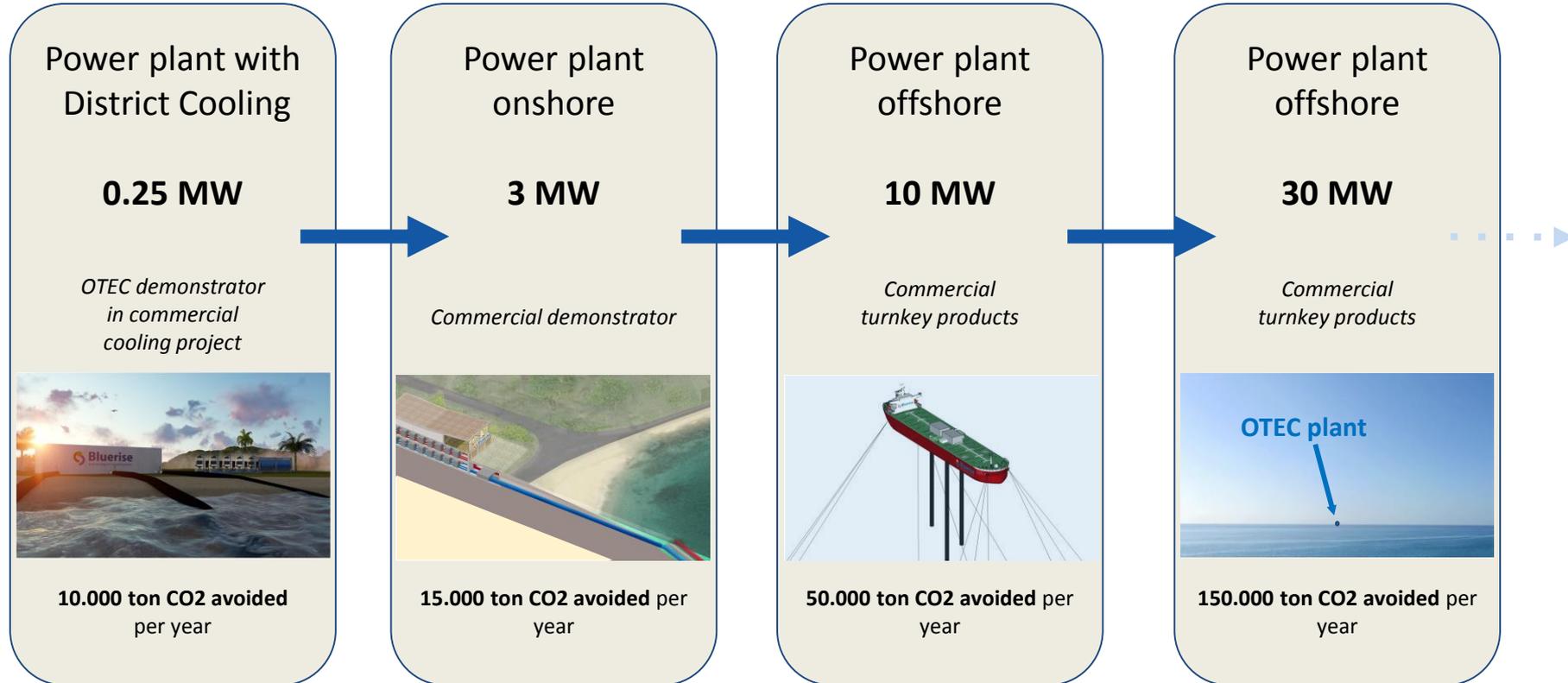
OTEC Heat Exchanger

- 💧 Simple, thin (0.6mm) metal plate
- 💧 ~45% of installed system cost
- 💧 Annual energy production **1,000** kWh/m²

Deployment of the technology

- Implementation of SWAC/SDC projects is essential for tropical coastal cities to meet GHG reduction targets and provide stable prices. Cooling represents over half of current tropical electricity needs.
- OTEC technology can be de-risked by deploying smaller scale OTEC plants that are commercially competitive in combination with SDC
- Standalone 10MW scale OTEC plants can be already be competitive with electricity generation in islands and isolated regions

Roadmap



Important opinions

"OTEC is a clean energy source, a prime example on how to sustainably make use of our oceans without harming the marine environment."



Fabien Cousteau
Bluerise ambassador,
oceanographic explorer
and conservationist

"There is urgent need for our governments to mainstream OTEC within the sustainable development strategies for islands."



Dr. Devon Gardner
Head, Energy Unit
CARICOM Secretariat
'EU of the Caribbean'

Thanks!

www.bluerise.nl



