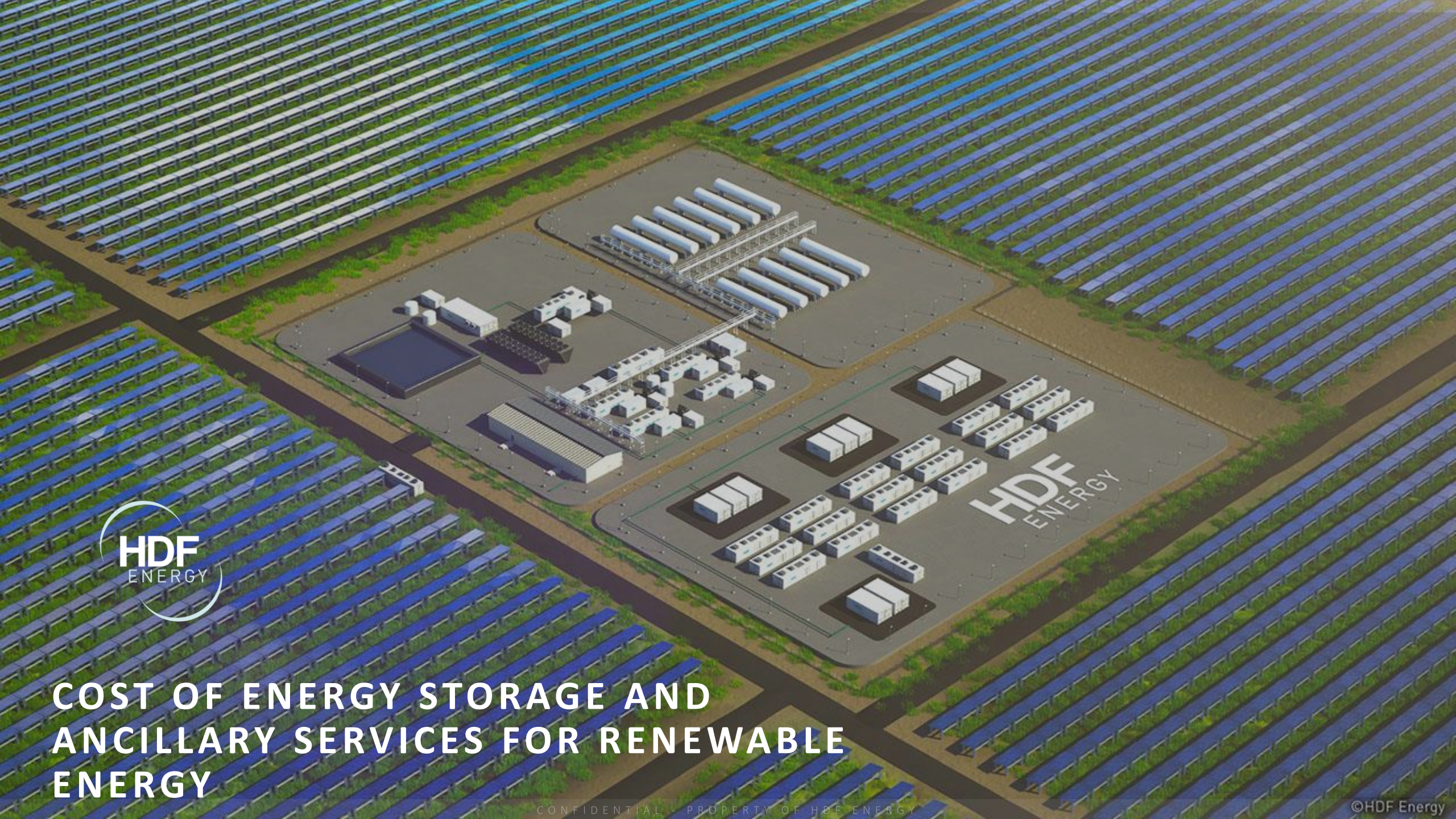
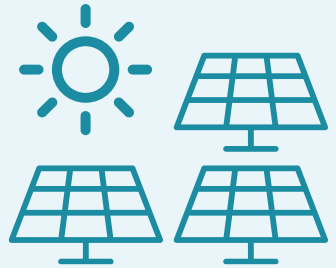


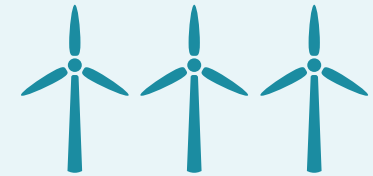
COST OF ENERGY STORAGE AND ANCILLARY SERVICES FOR RENEWABLE ENERGY

THE COST OF TRANSITION TO RENEWABLE

IS IT POSSIBLE?

?





WE ARE NOT FAR AWAY!

South Australia runs on more than 100 pct net renewables in last week of winter

Even without hydro or geothermal!

But with gas and electricity import / export…

DEFINING COST

Generation Costs

- Development Costs
- Capital Costs
- Financing Costs
- O&M costs

System Costs

- Grid Costs
- Balancing Costs
- Profile Costs

External Costs

- GHG emissions
- non-GHG pollution
- Landscape
- Ecosystem

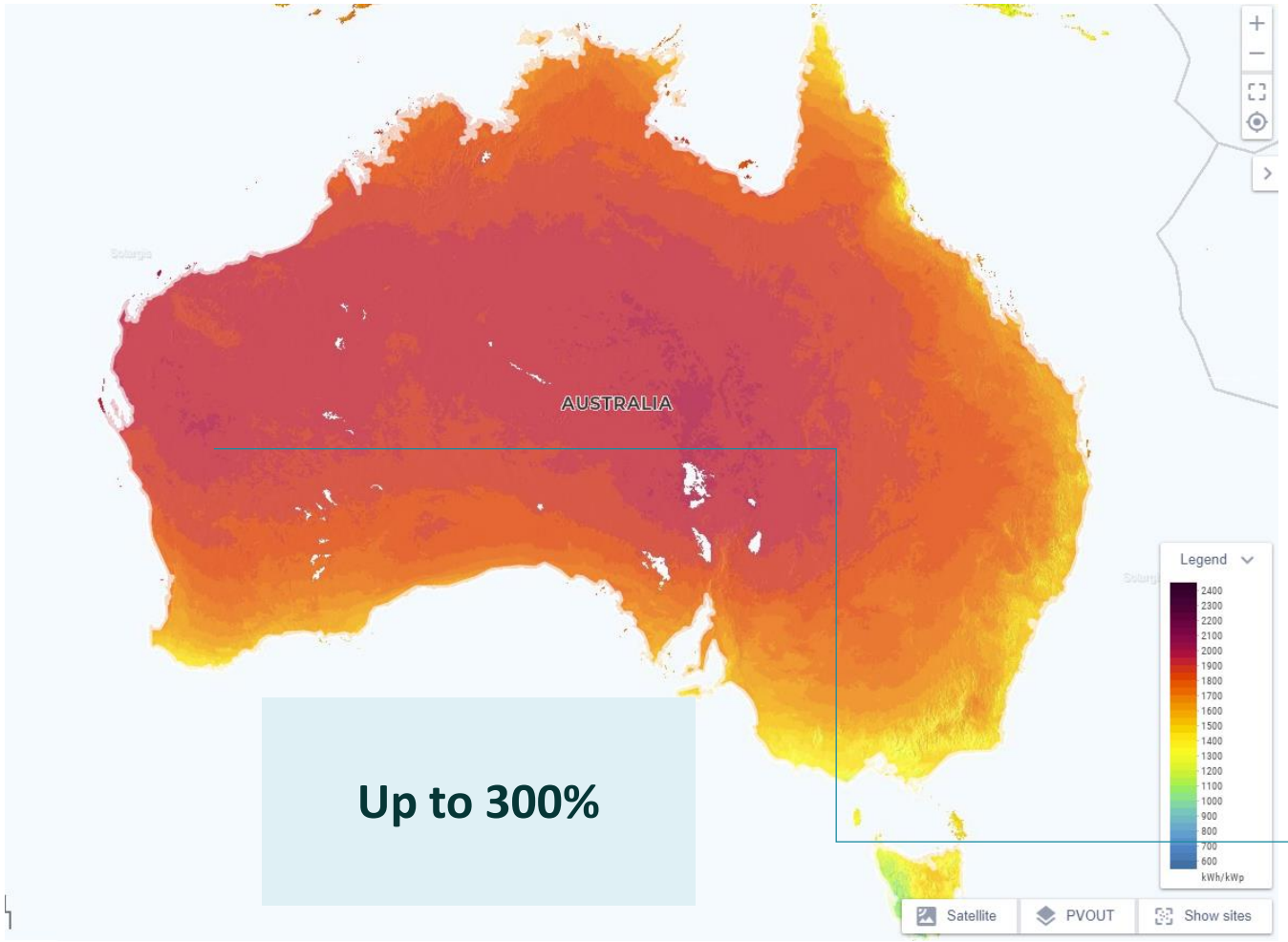
Macroeconomic Costs

- Energy independence
- Trade balance

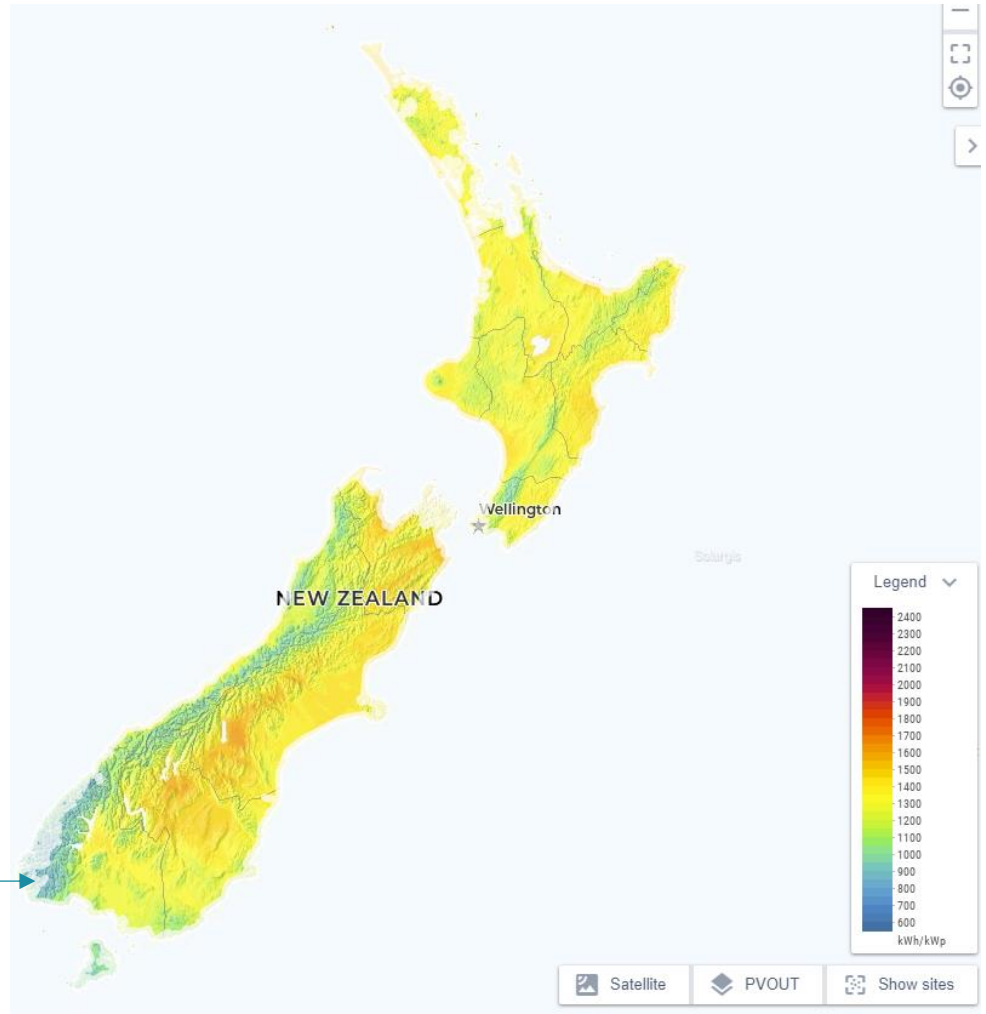
GENERATION

COST OF VARIABLE RENEWABLE ENERGY

KEY DRIVERS – SOLAR RESOURCE

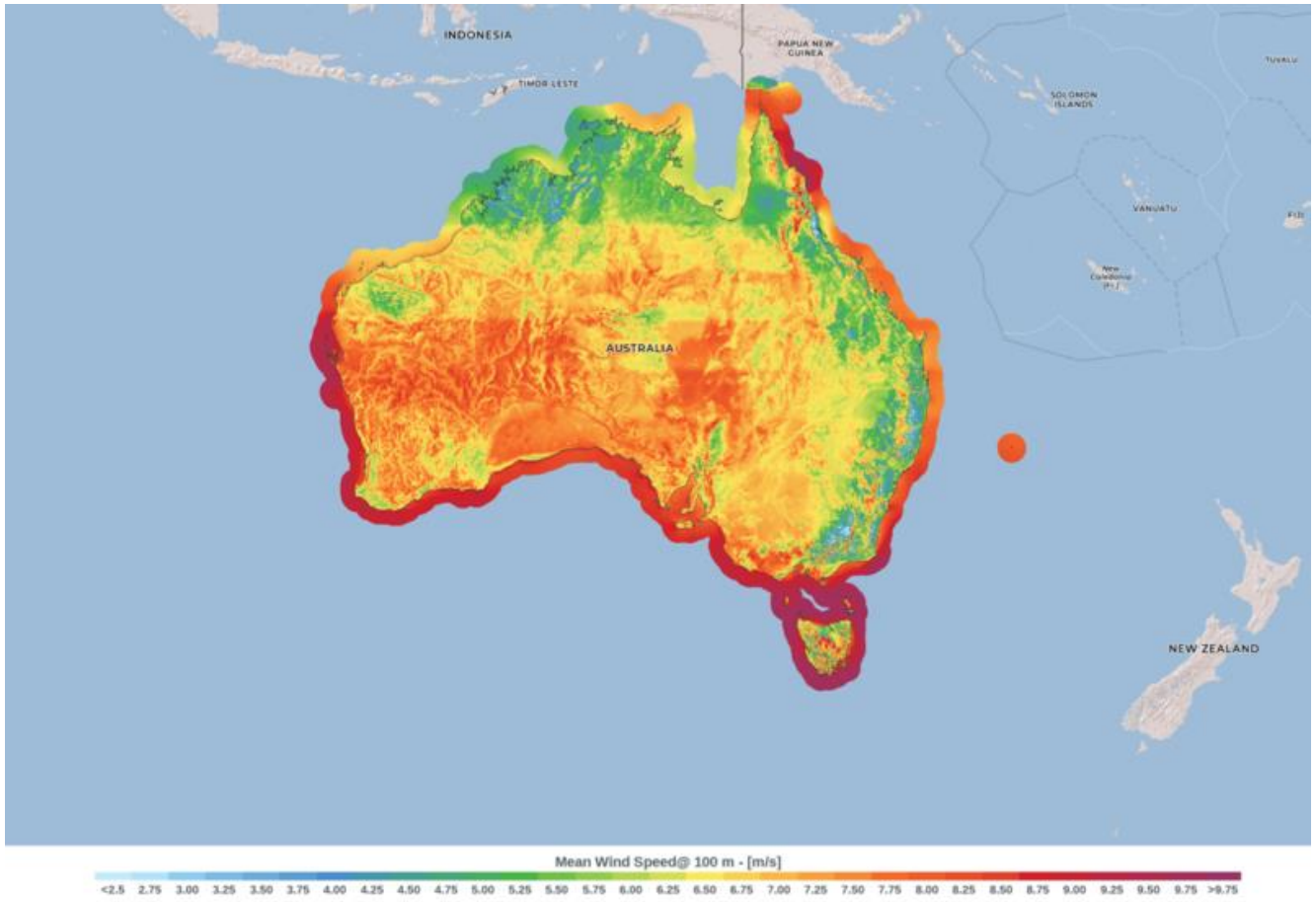


Up to 300%



COST OF VARIABLE RENEWABLE ENERGY

KEY DRIVERS – WIND RESOURCE



- Wind speed ranging from 4 to 8.5 m/s at 100m height.
- Production is proportionate to the cube of the wind speed.
- **Ratio of 10** depending on the location!

COST OF VARIABLE RENEWABLE ENERGY

KEY DRIVERS – COST OF FINANCING

- Renewable energy projects are **capital intensive**.
- Financing conditions can be very different from one country to the other.
- 1 point on the interest rate can increase the electricity tariff by 10%.

Cash Rate

Country

Technology

Agreement

COST OF VARIABLE RENEWABLE ENERGY

KEY DRIVERS –LOCATION

- Most pacific islands are subject to harsh environment (cyclones, corrosion, earthquakes, etc.).
- Cost and availability of the manpower impacts significantly construction and capital cost.
- The power plant must be designed to cope with such conditions.
- These factors can significantly impact the capital cost of the project (PV plant: up to 20%).

COST OF VARIABLE RENEWABLE ENERGY

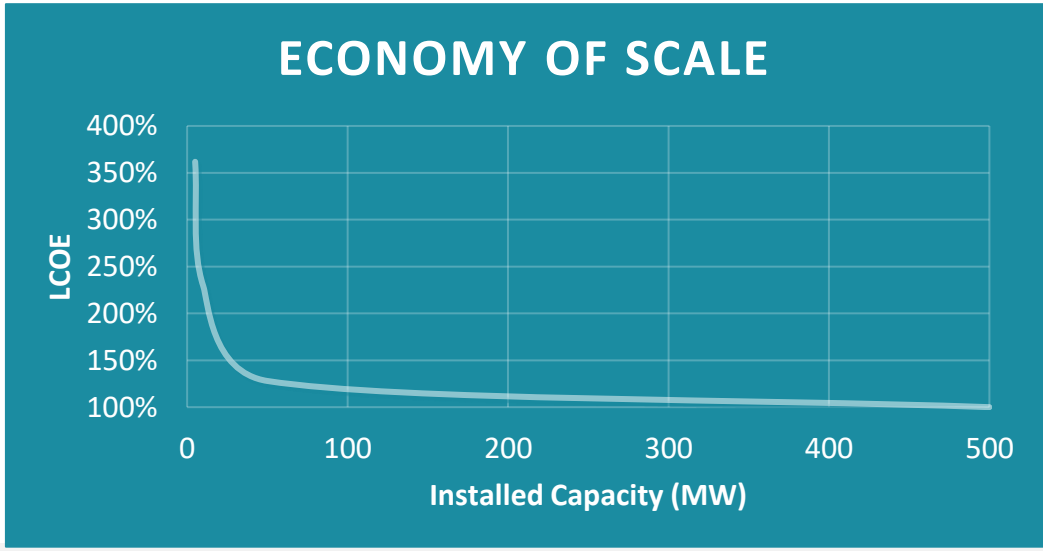
KEY DRIVERS –ECONOMY OF SCALE

The bigger, the better!

5MWe

50MWe

500MWe



IRENA
International Renewable Energy Agency

RENEWABLE POWER GENERATION COSTS IN 2023

COST OF VARIABLE RENEWABLE ENERGY

SOLAR AND WIND - LCOE

Figure 3.10 Global utility-scale solar PV project LCOE and range, 2010-2023

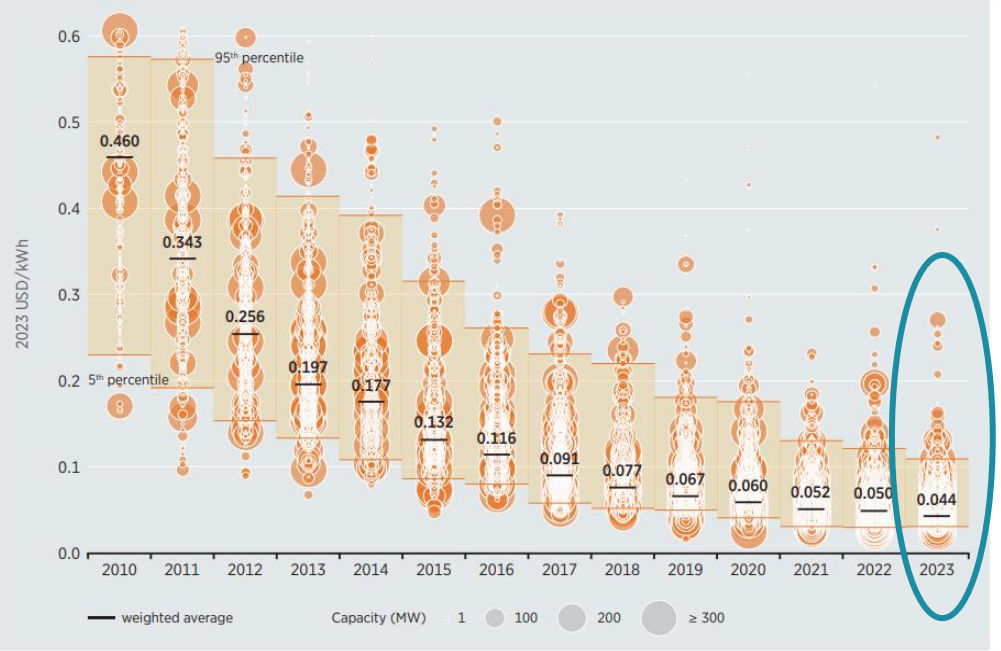
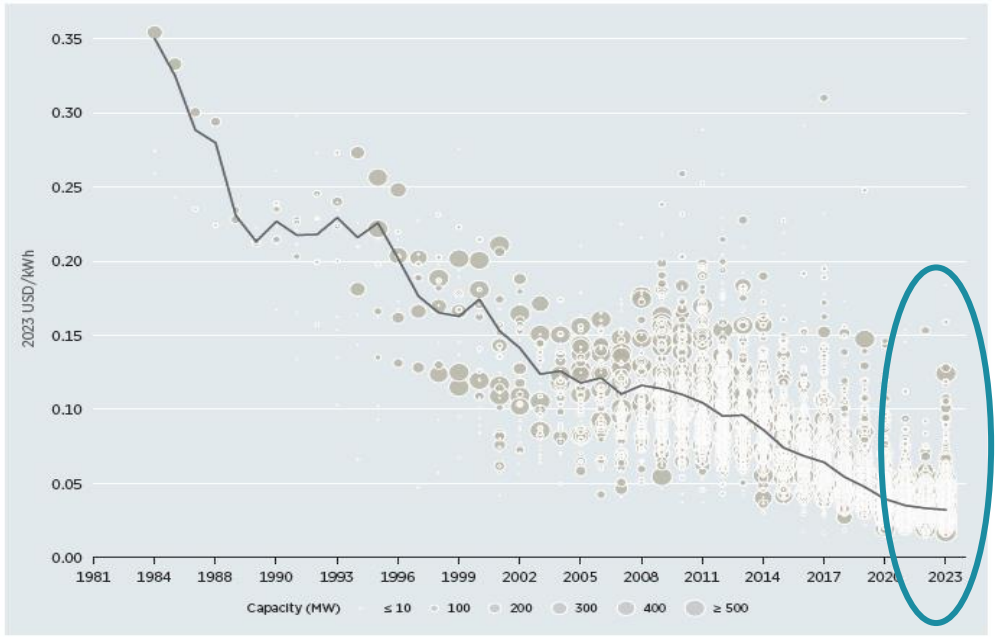


Figure 2.11 LCOE of onshore wind projects and global weighted average, 1984-2023



- The cost of variable renewable energy is country specific, especially in the pacific islands that are characterized by relatively small power systems and a unique environments.

02

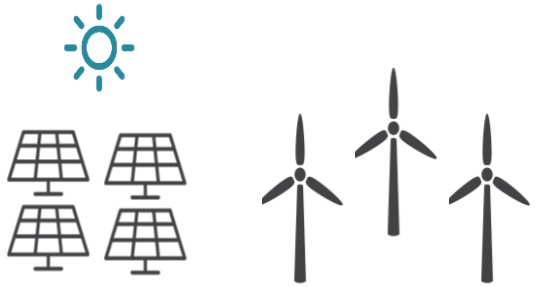
POWER SYSTEM

CHALLENGE ASSOCIATED WITH VRE

The biggest challenge associated with VRE

1

Variable renewable sources…

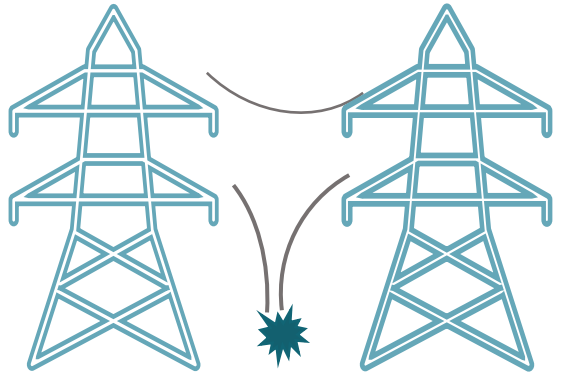


2

…cause mismatches between supply and demand…

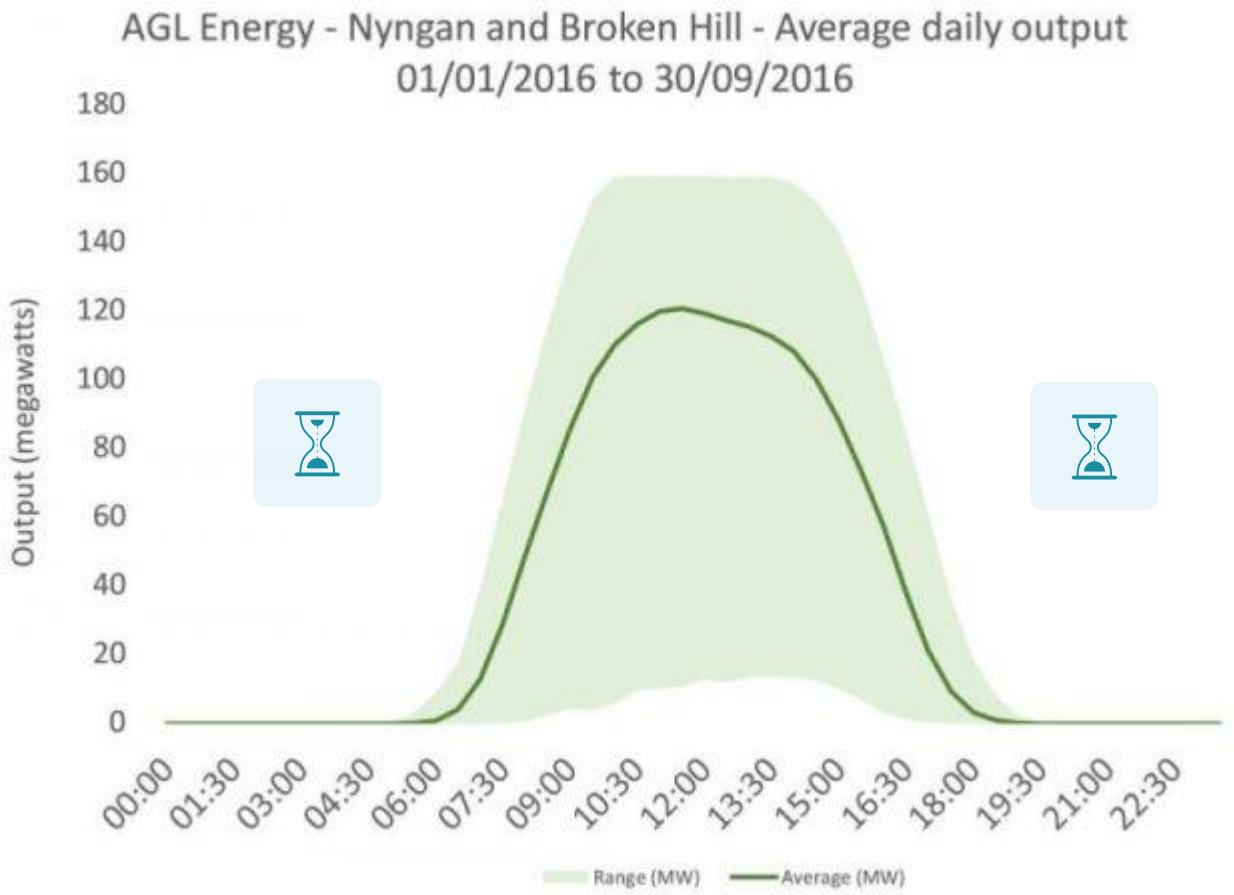
3

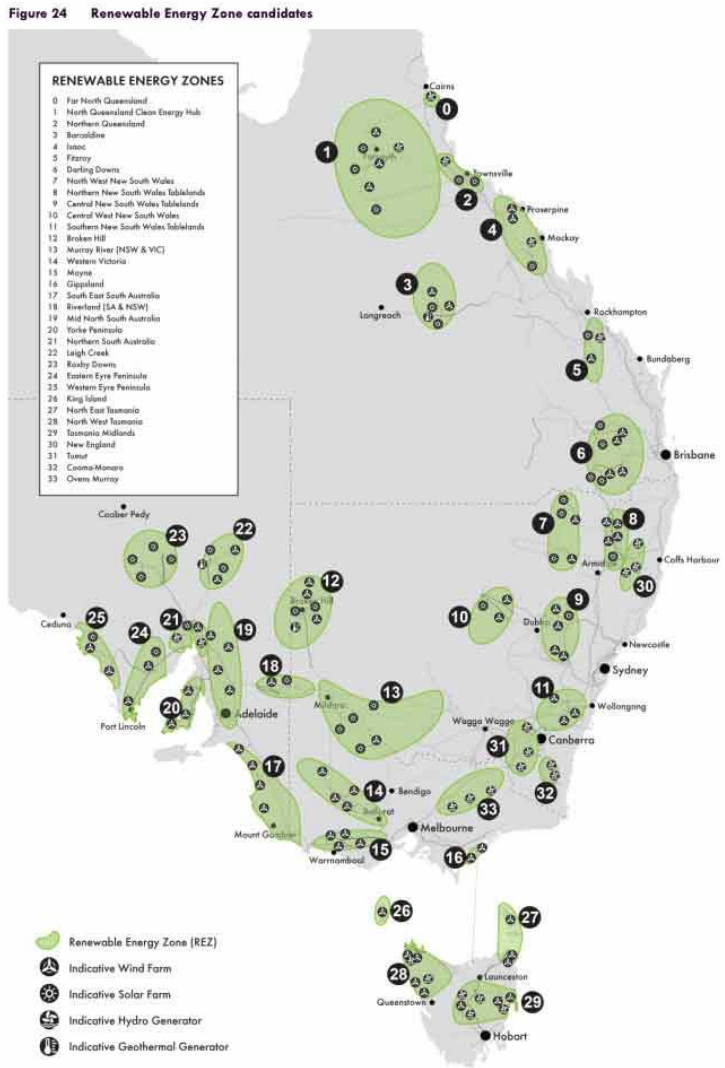
…which results in a lot of pressure being put on the power system



The power system must be adapted to cope with Variable Renewable Energy.

THE NEED FOR GRID AUGMENTATION

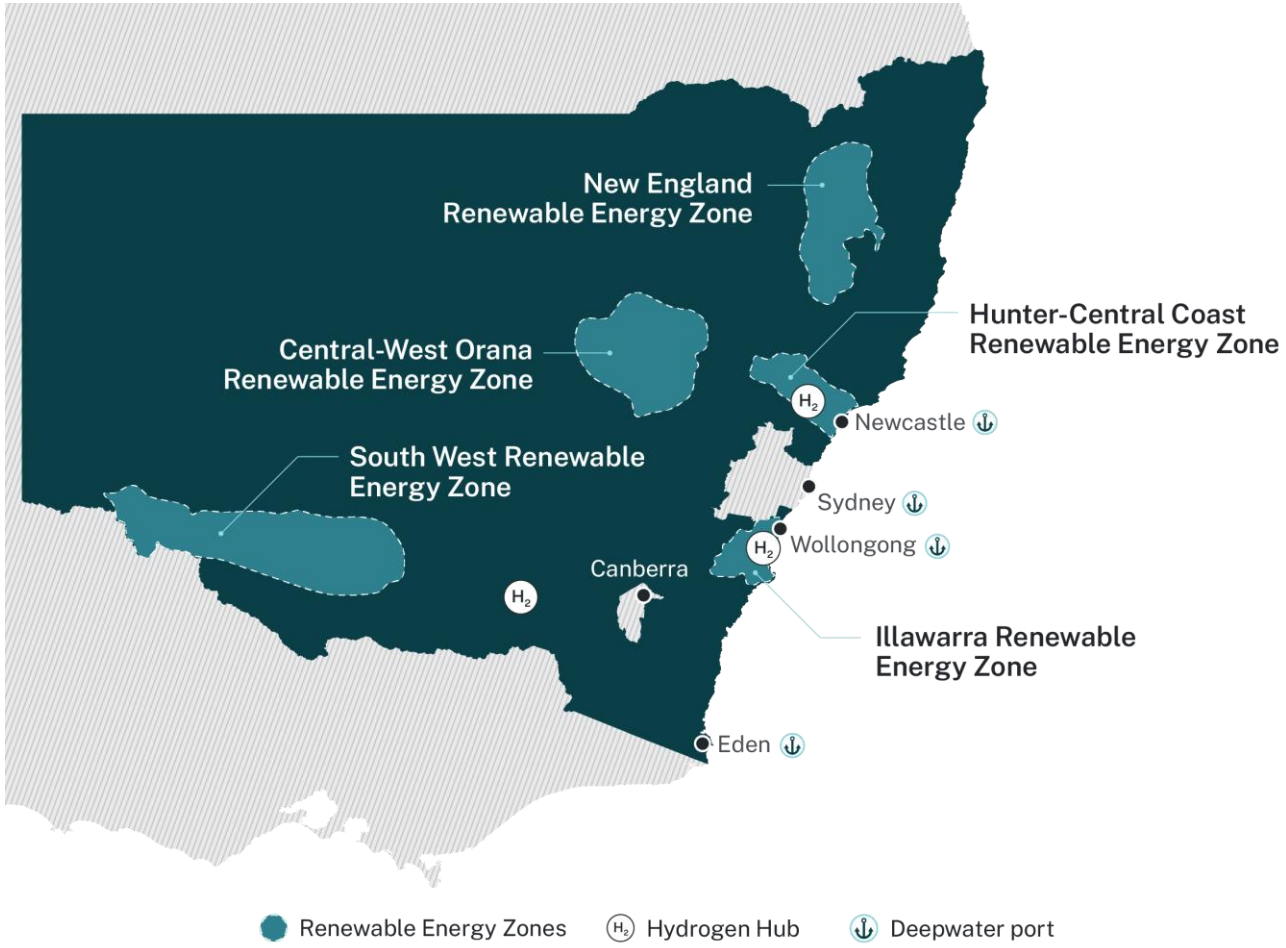




ARENA
Australian Government
Australian Renewable Energy Agency

- VRE can create congestion to the grid. To provide the same amount of energy, there is a need for grid augmentation.

COST OF GRID AUGMENTATION



AU$9.3 Billions

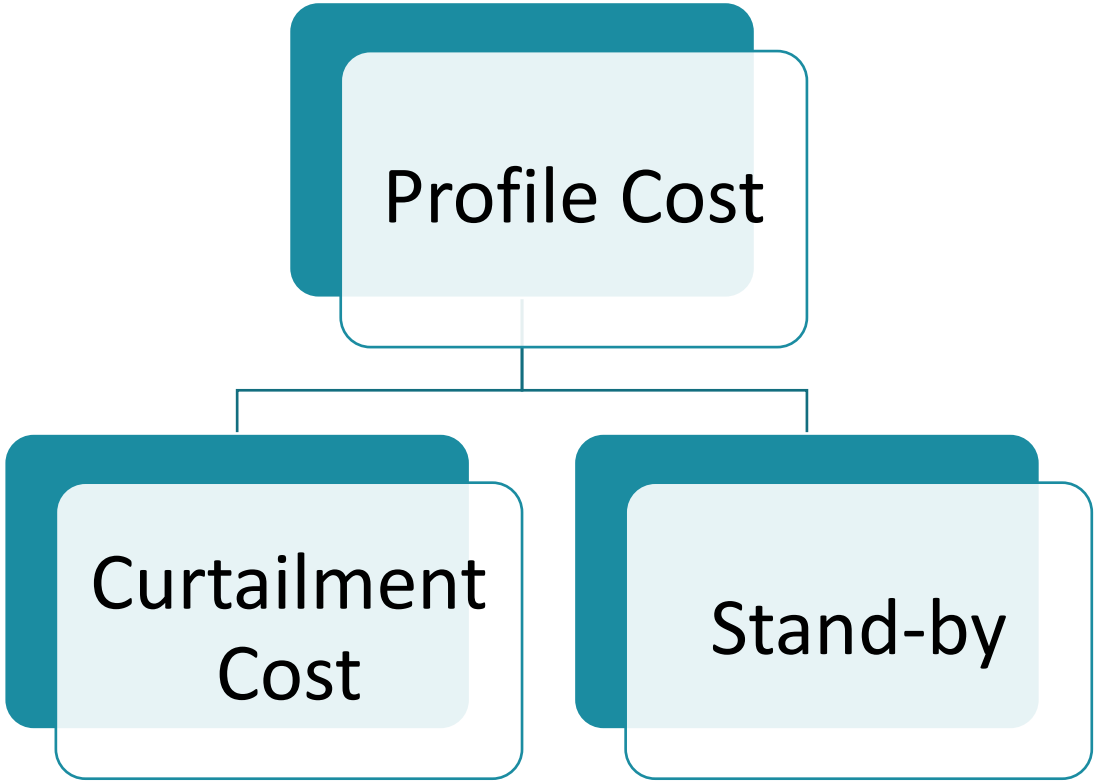
- **The cost of grid augmentation is often underestimated.**
- **The higher the penetration share, the higher the grid augmentation costs.**

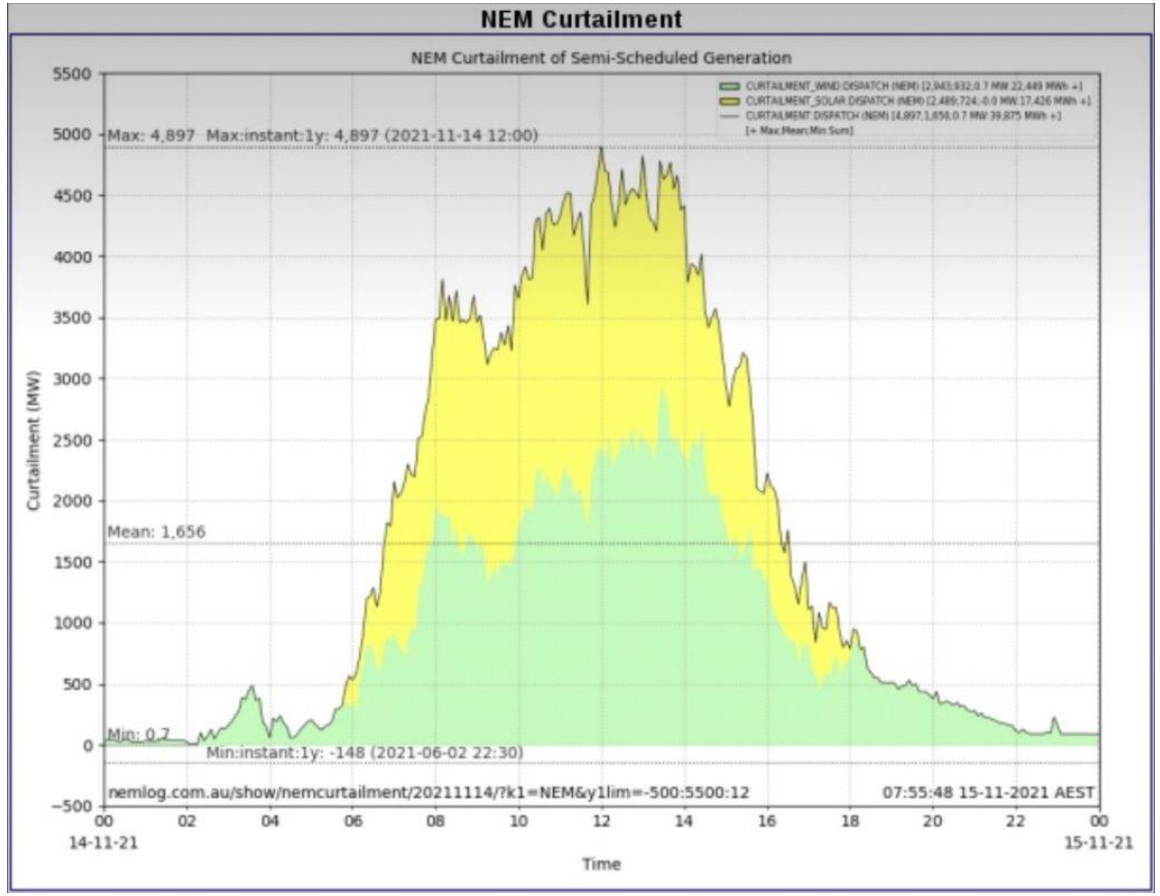
COST OF GRID BALANCING

BASE LOAD POWER GRID-FOLLOWING GRID FORMING BLACK START SHORT CIRCUIT

COST OF GENERATION PROFILE

South Australia curtailed nearly as much wind and solar on Sunday as it used





COST OF POWER SYSTEM

Type of Cost	Renewables		
	Onshore Wind	Offshore Wind	Solar PV (Utility-Scale)
Sum of plant-level costs (w/o CO_2 costs) (central values; ranges in parenthesis)	5.5 (2.3–8.3)	7.6 (4.7–11.1)	4.6 (3.0–6.2)
Grid costs	1.0	1.0	1.0
Balancing costs	0.3	0.3	0.2
Profile costs (additional costs for VRE plants for shares of around 35% for wind and 15% for solar PV)	2.5	2.5	2.5
Sum of system costs	3.8	3.8	3.7

- **System Costs can be as high as variable renewable energy costs.**
- **The higher the penetration of VRE, the higher the system costs.**

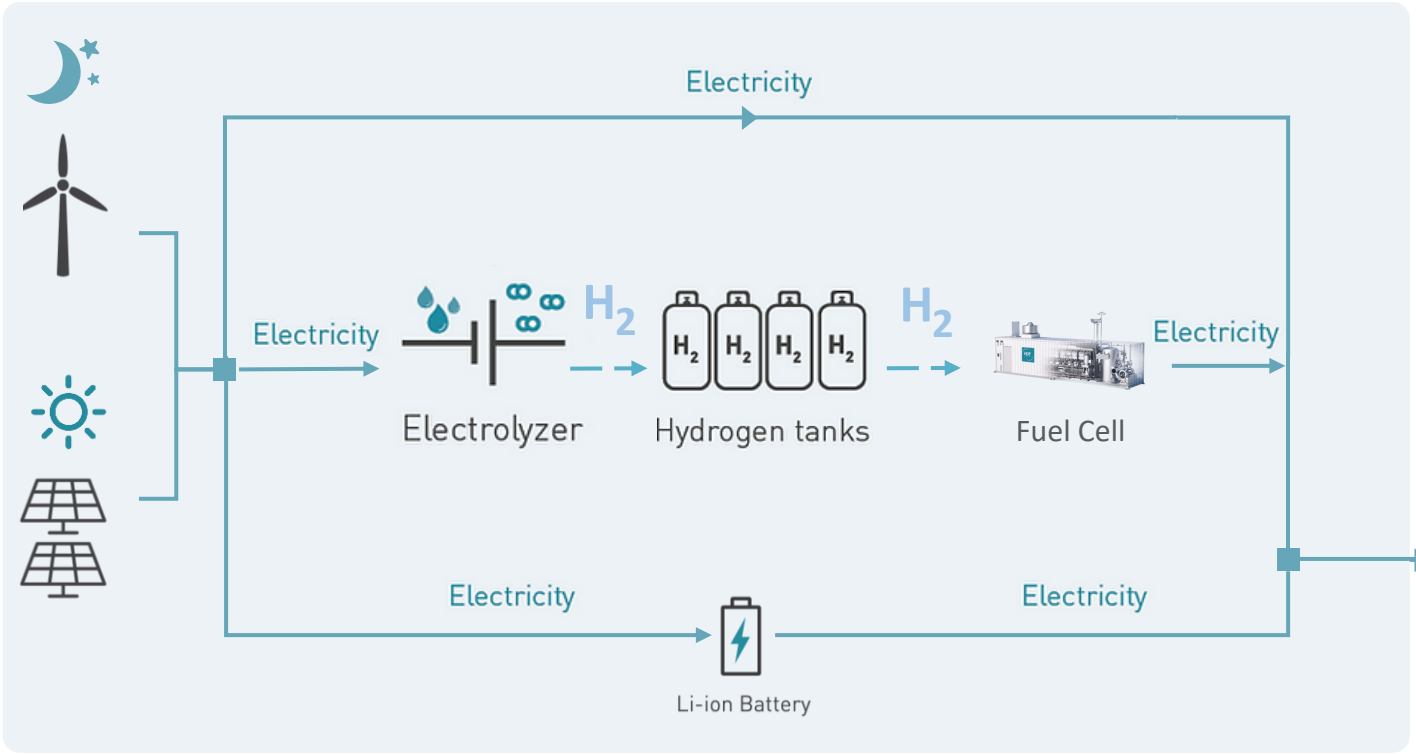
03

RENEWSTABLE®

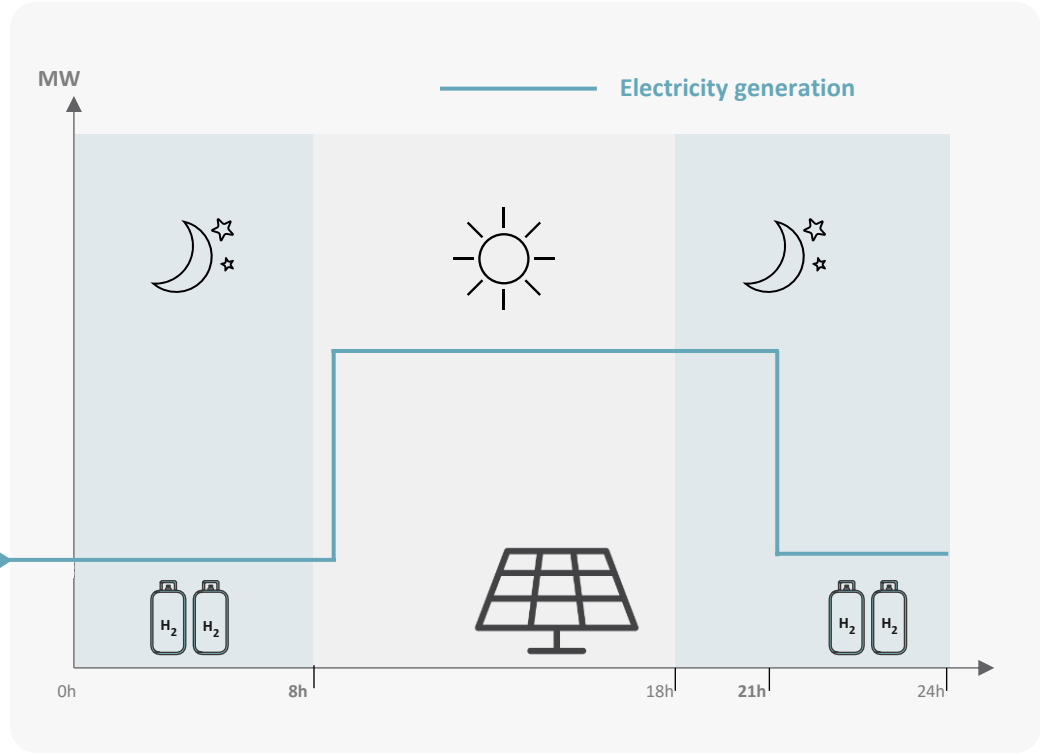
HYDROGEN POWER COMPANY

RENEWSTABLE®

Power-to-Power
Long term hydrogen storage



Fully dispatchable
green electrons



RENEWSTABLE®

Renewstable® provides the following services (adaptable to multiple use-cases):

Power flexibility

- ✓ **On demand** energy
- ✓ Load following
- ✓ Morning and evening **peak response**
- ✓ Load management control

System restoration

- ✓ Black start
- ✓ Island mode
- ✓ Operating reserves

Ancillary services

- ✓ **Frequency** control
- ✓ **Voltage** control
- ✓ **Network** support control

Long term storage and Back-up capability

- ✓ **Capacity contract**
- ✓ Green **hydrogen** availability

FLAGSHIP PROJECT: CEOG

PROJECT CHALLENGES

- Aging diesel generators
- Unstable power grid
- CO_2 High carbon emissions
- $$$ High electricity costs

OUR SOLUTION

CAPACITY
10 MW/ 3 MW
8am – 9pm / 9pm – 8am

GENERATION
54,000
people

COST REDUCTION
LOWER
per year

CO2 REDUCTION
39,000 tons
per year

Status : Under Construction

OFFTAKER
25 year PPA with EDF

EPC
SIEMENS energy

EQUITY PARTNERS
meridiam
SARA

WHY A RENEWSTABLE FOR THE PACIFIC ISLANDS?

Easy

Bankable

Clean

GREEN CLIMATE FUND

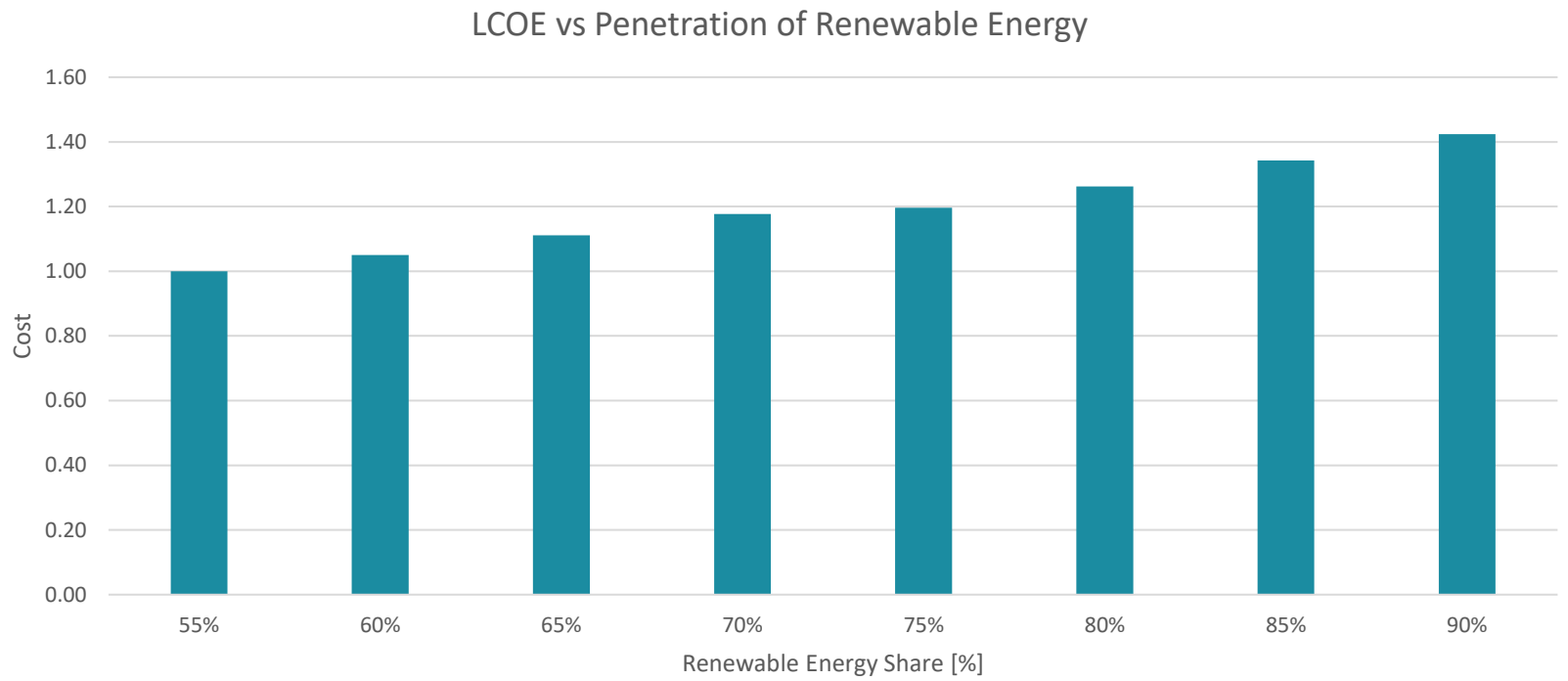
IFC International Finance Corporation WORLD BANK GROUP

Creating Markets, Creating Opportunities

European Investment Bank

COST OF GENERATION VS RENEWABLE ENERGY SHARE

The cost of generation increases with the penetration of renewable energy as there is a need to integrate more and more storage.



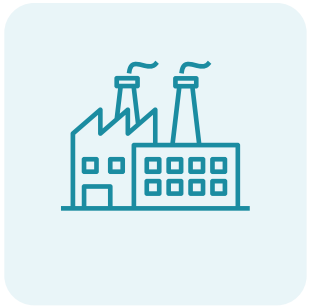
Moving from 60% to 90% RES might increase the cost of electricity by around 40%.

EXTERNAL COSTS

Climate Change

Landscape

Environment



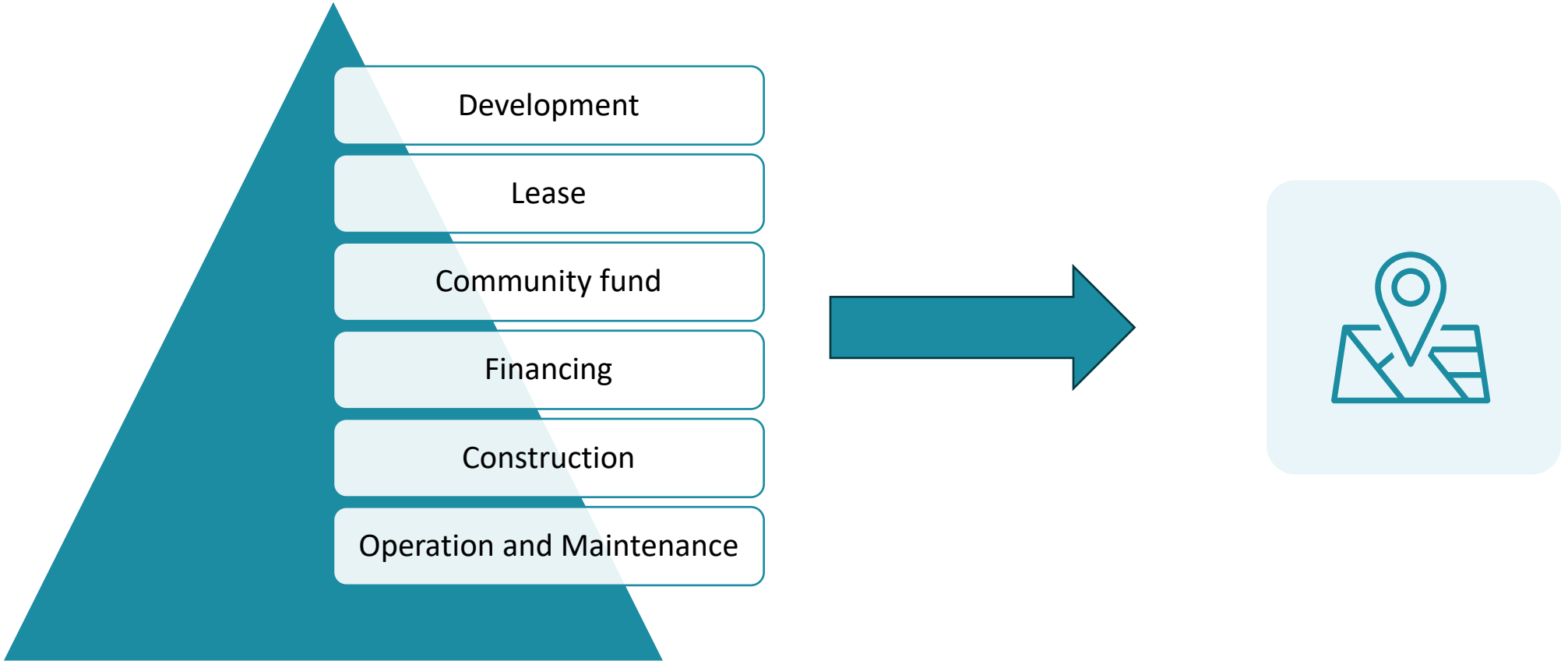
Health

When comparing power generation technology, decision makers should also consider the impact of the solution on climate change, health pollution and the local environment.

MACROECONOMY

Many pacific islands are relying on the import of fossil fuels for power generation. In most cases, fossil fuels is the biggest import which adversely impacts the commercial balance of these countries.

Conversely, renewable energy projects can boost the local economy significantly. Up to 45% of the cost of a renewable energy project in the pacific islands might be channelled directly to the local economy.



TAKEAWAY

- The cost of Variable Renewable Energy is **country specific** and depends on several factors such as the **solar / wind resource**, **size** of the project and the **bankability** of the project / off-taker.
- Power Utilities shall take into consideration the **impact on VRE on its power system** and **reward integrated solutions.**
- The Renewstable® is a **fully-integrated solution which** provides **stable** and **dispatchable** renewable energy.
- Decision makers shall take into consideration **external costs** and the **macroeconomic costs** when setting renewable energy goals.

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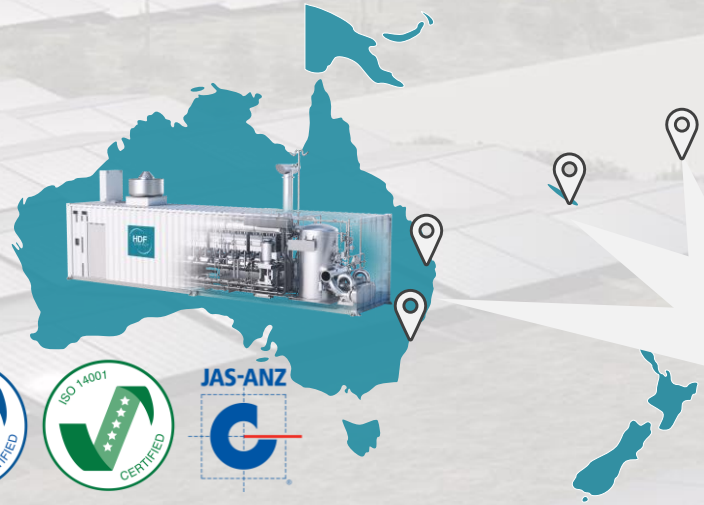

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