India: Perspectives on the Draft National Wind-Solar Hybrid Policy

June 8, 2018 Asia Clean Energy Forum Panel on Renewable Energy Auctions

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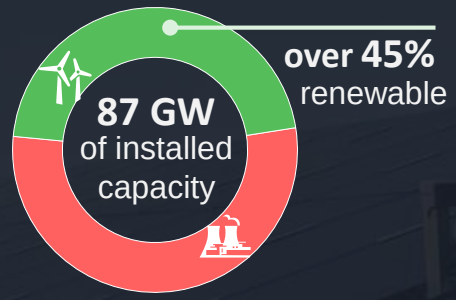
Head of Business Development Asia Pacific
Enel Green Power

Enel Group Introduction

- **Leadership in all segments of the value chain**
- **Diversified by technology & geographically**
- **Focused on sustainability & growth**

2017 Key Figures



over 45% renewable

Over 43 % Emission free

1.9 Million km distribution networks

44 Million smart meters

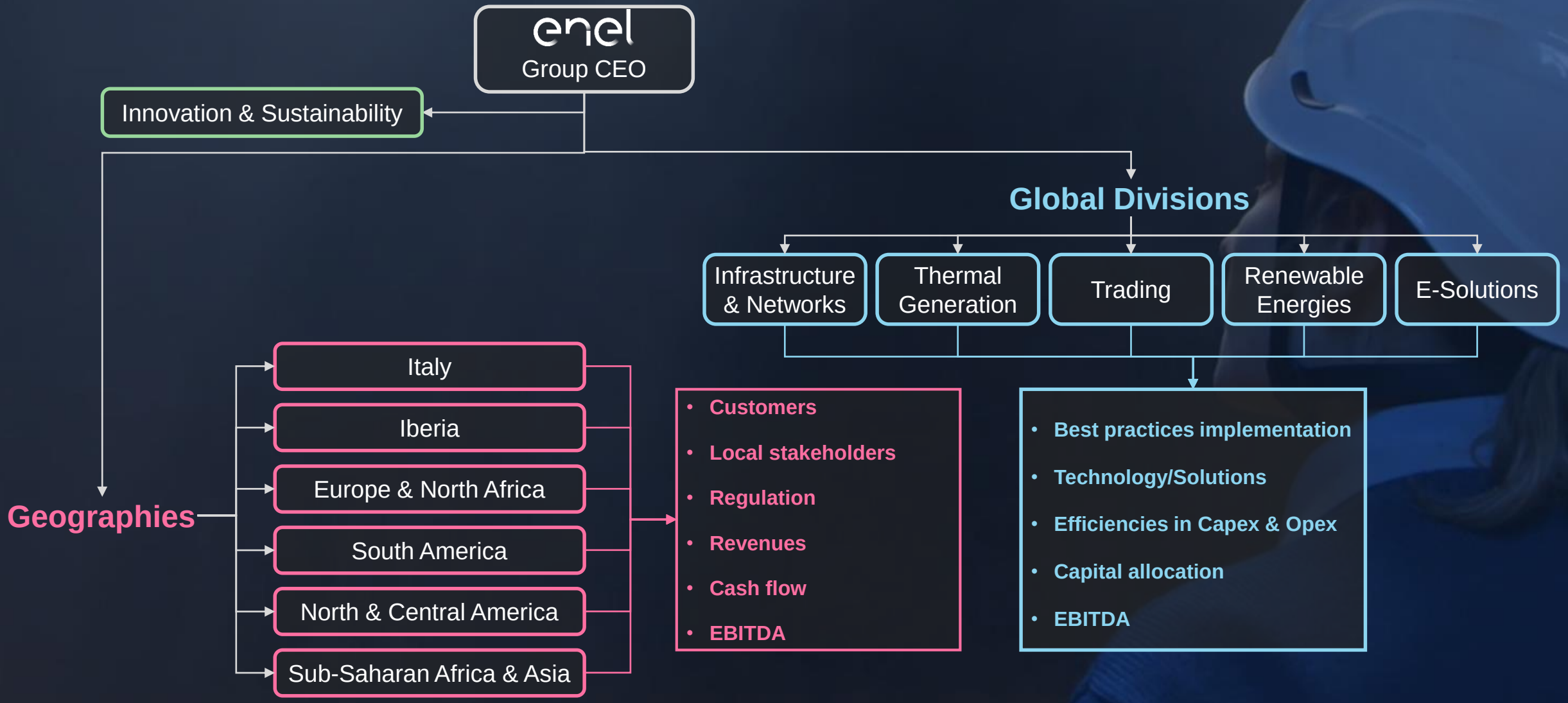
63,500 EMPLOYEES

915,000 SHAREHOLDERS

REVENUES(2016)	EBITDA(2016)	MARKET CAP.(Dec 2017)
70.6 BN EUROS	**15.3 BN EUROS**	**54.0 BN EUROS**

World's largest global utility with the resources and products that are changing the way the world uses energy.

A simple and effective organization

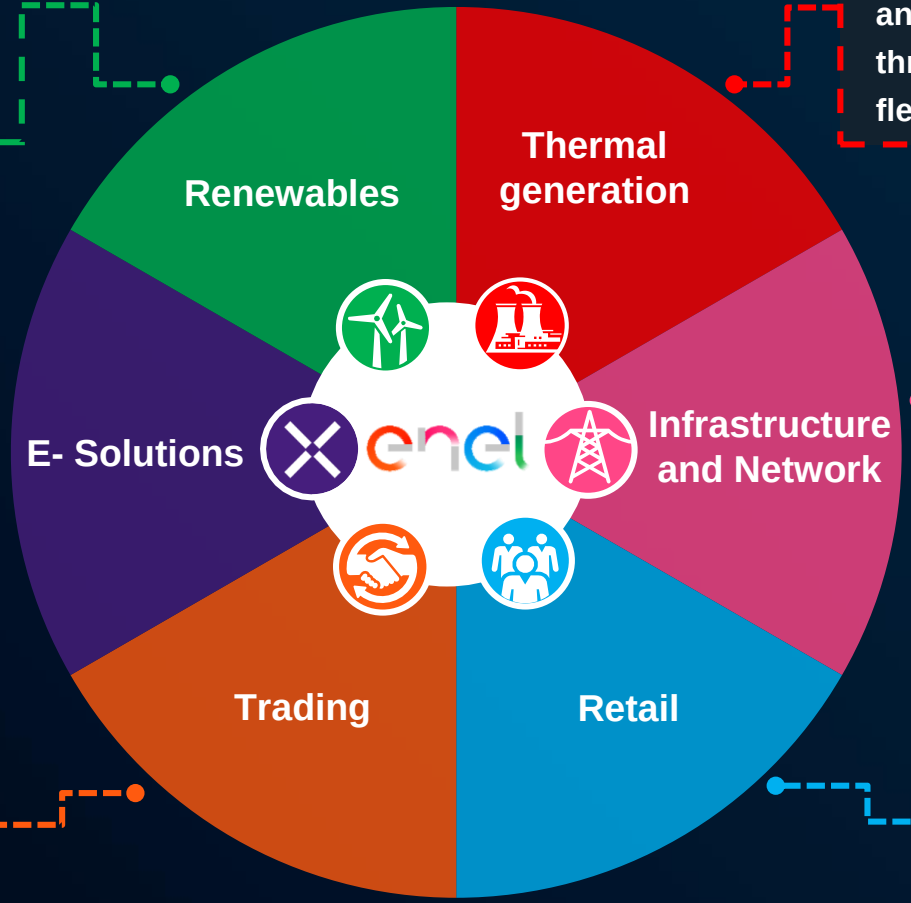


A simple and effective organization

Manage renewable generation fleet, maximizing global footprint of the Group in the renewable space

Manage the conventional generation, reduce emissions and improve performances through digitization and flexible assets

Downstream positioning of the Group as leader in the energy transition; customer side innovation and digital proposition



Manage the Group energy distribution assets, improving customers' reach also enhanced by digital platform infrastructures

Overall Group portfolio optimization, integrated margin management, capacity strategy supervision

Energy commodities sales to end-user, maximize customer reach and improve customer journey

Enel Green Power

Enel Green Power
A recognized World leader in renewables

All of our projects and goals are based on **sustainability, innovation and a proactive mindset** to create **shared value for ourselves and the communities in which we operate**

Enel Green Power is committed to delivering **tailor-made 100% sustainable energy solutions** worldwide

When business meets sustainability,
Enel Green Power is the **best partner at your side.**

Enel Green Power in the World

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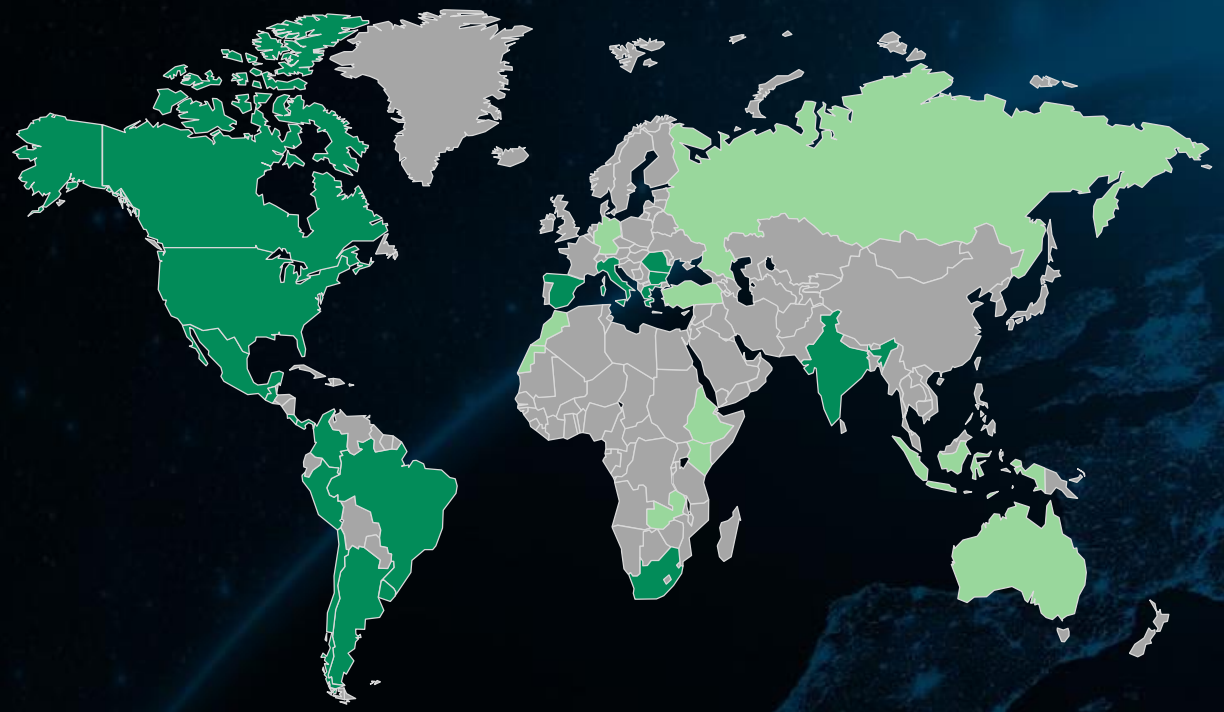


29 countries

1200 plants

more than **7,600** employees

2017 Key Figures

40.5 GW managed

37.1 GW consolidated

9.2 GW WIND

27.8 GW HYDRO

2.6 GW SOLAR

0.9 GW GEO

92 TWh managed

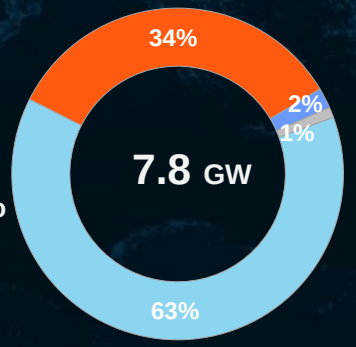
89 TWh consolidated

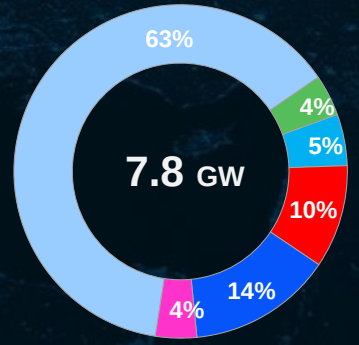
EBITDA
4.1 BILLION EUROS

GROWTH CAPEX
3.4 BILLION EUROS

2018-2020 Industrial Growth Plan

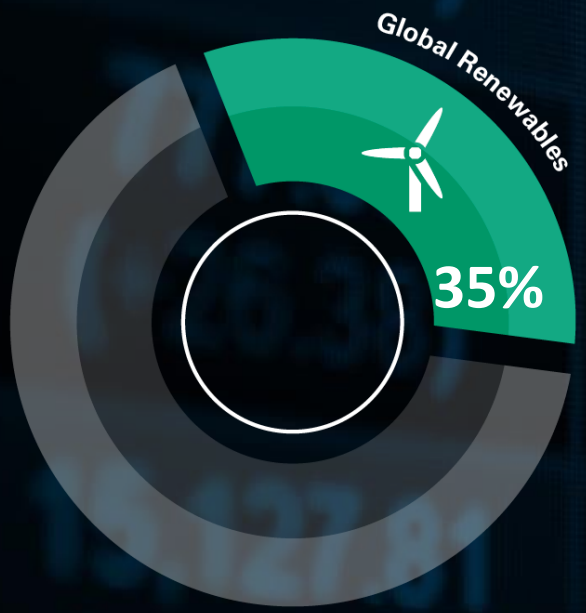
Wind
Solar
Hydro
Geo



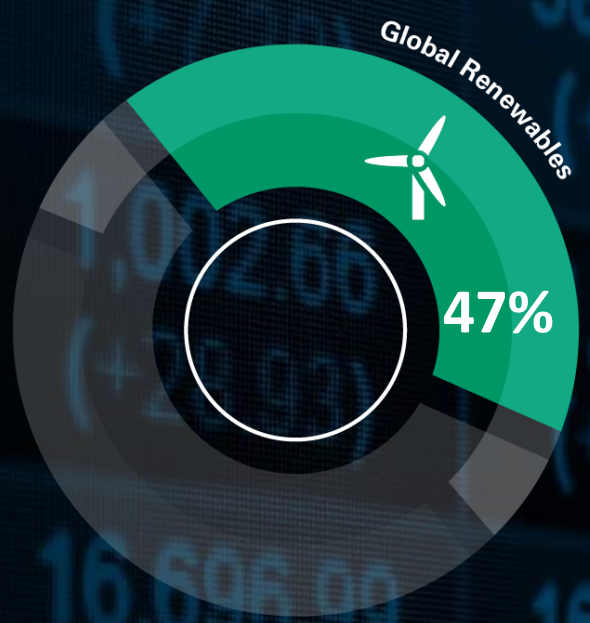


Italy
Iberia
South America
Europe & North Africa
North & Central America
Subsaharian Africa & Asia

EGP contribution to Enel Group



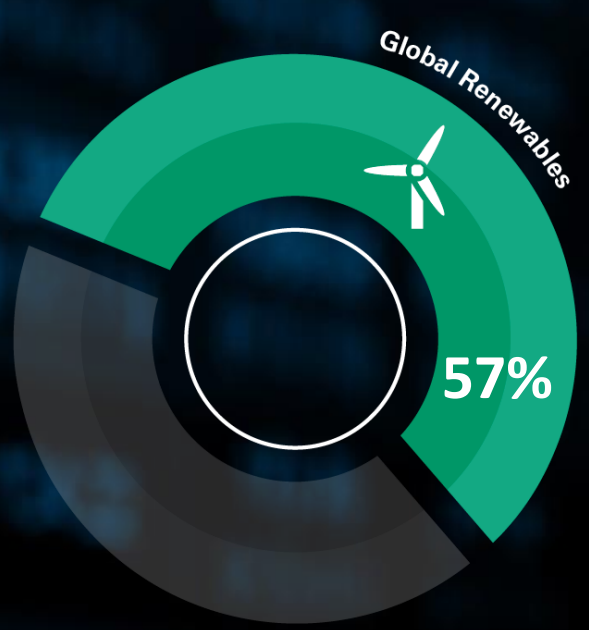
Energy Production



Managed Installed Capacity

EBITDA

2017



2018 – 2020 Growth Capex

Competitors' Benchmarking

2017 Footprint

Notes: Installed capacity figures excl. Pumped Storage and refer to gross/managed capacity.

Sources: Annual Reports 2017

1)10,4 GW including "Pre-Construction & Ready to HO" Capacity ; 2) Generation includes Pumped Storage; Under Construction figure reaches 5,6 GW including Tamega Pumped Storage (880 MW)

Generation growth engine
Leading geographic expansion

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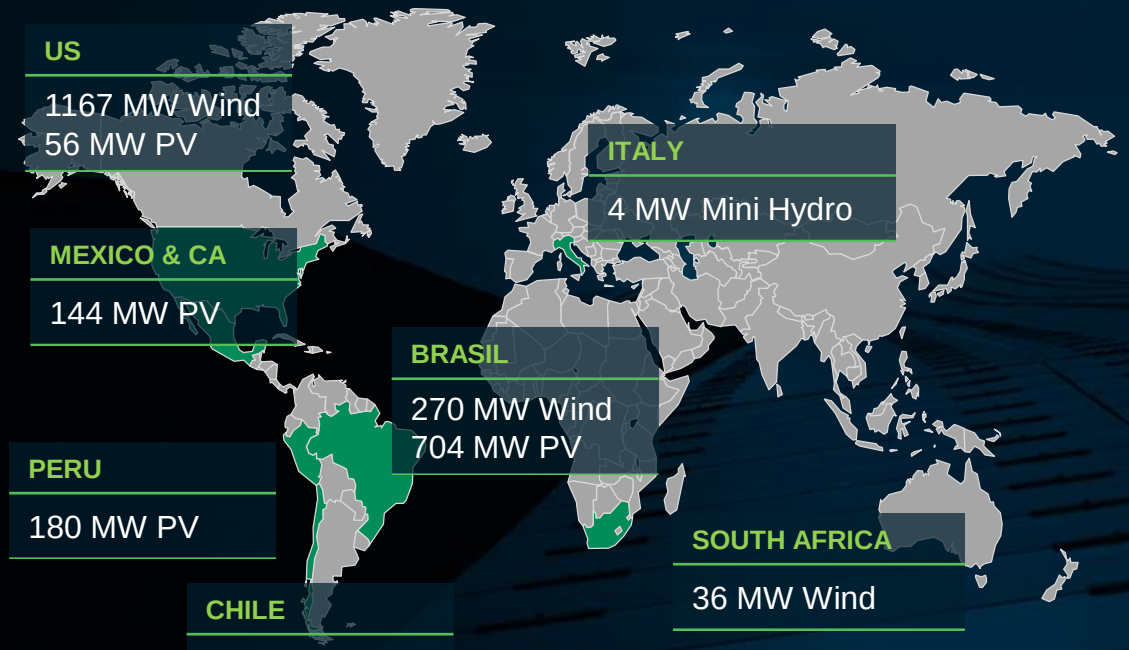
Record 2.6 GW built in 2017



US
1167 MW Wind
56 MW PV

MEXICO & CA
144 MW PV

PERU
180 MW PV

CHILE
41 MW Geo

BRASIL
270 MW Wind
704 MW PV

ITALY
4 MW Mini Hydro

SOUTH AFRICA
36 MW Wind

5 GW new projects awarded/contracted in 2017

CANADA
Tender: 147 MW Wind

US
PPA C&I/Utility: 998 MW Wind
+ 27 MW PV

MEXICO
Tender: 597 MW Wind
PPA C&I/Utility: 112 MW PV

PANAMA
PPA C&I/Utility: 8 MW PV

COLOMBIA
PPA C&I/Utility: 84 MW PV

CHILE
Tender: 93 MW Wind
+ 116 MW PV
+ 33 MW Geo

SPAIN
Tender: 540 MW Wind
+ 339 MW PV

RUSSIA
Tender: 290 MW Wind

ETHIOPIA
Tender: 100 MW PV

BRASIL
Tender: 380 MW Hydro
+ 618 MW Wind
+ 388 MW PV

ARGENTINA
Tender: 100 MW Wind

AUSTRALIA
PPA C&I/Utility: 190 MW PV

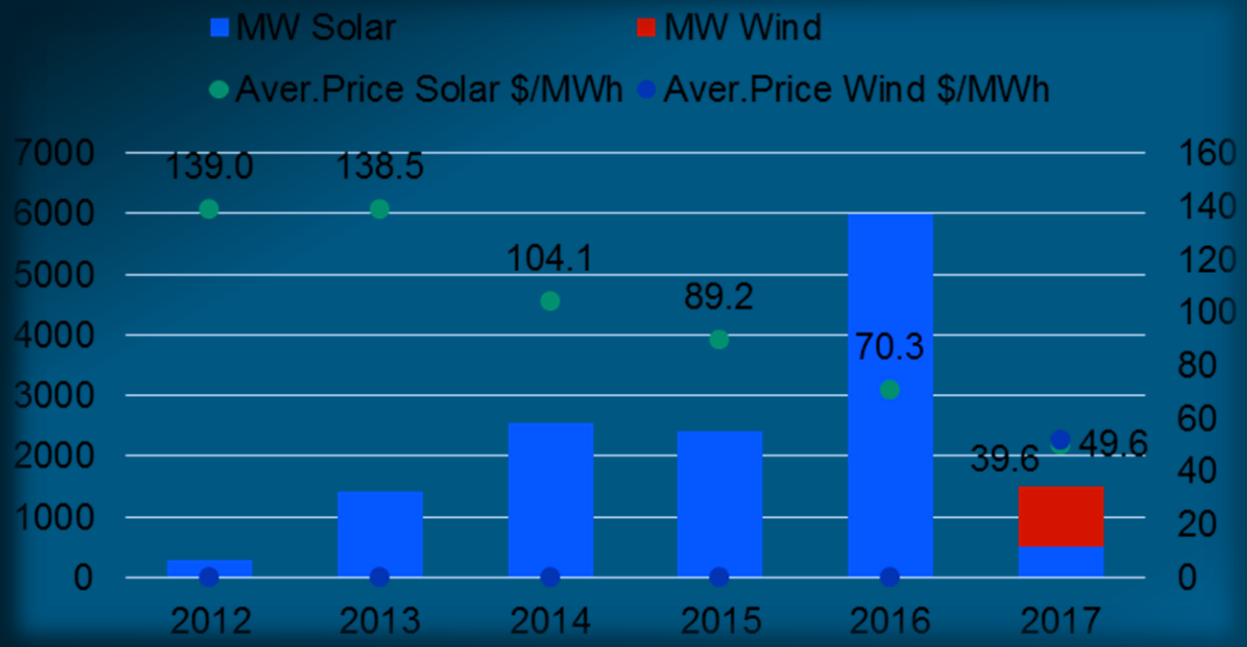
Renewable Energy Tenders in India

India RES targets and outlook

Sizeable RES targets purely based on tenders for wind and solar

Competitive tariff environment

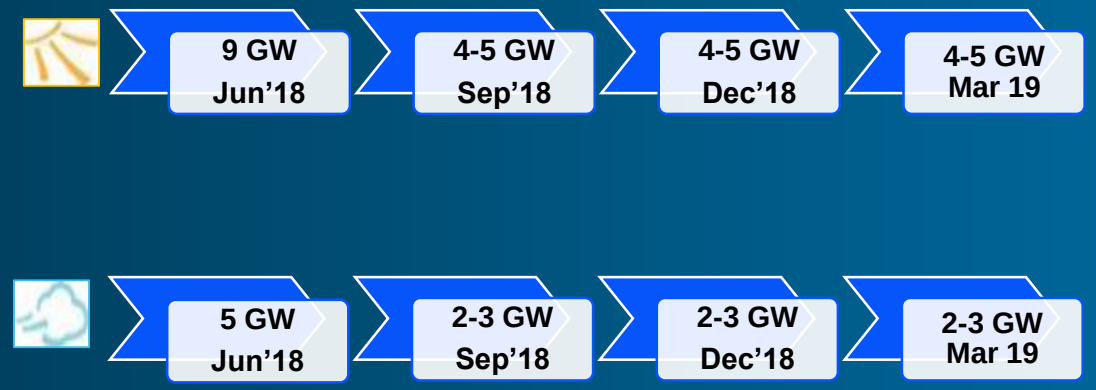
Auction clearing prices 2012 – 2017 (USD)



Total MW	280	1.410	2.556	2.410	6.003	1.500	$/MWh

Stable and consistent tender schedule

Broad View of Upcoming Capacities by March 2019

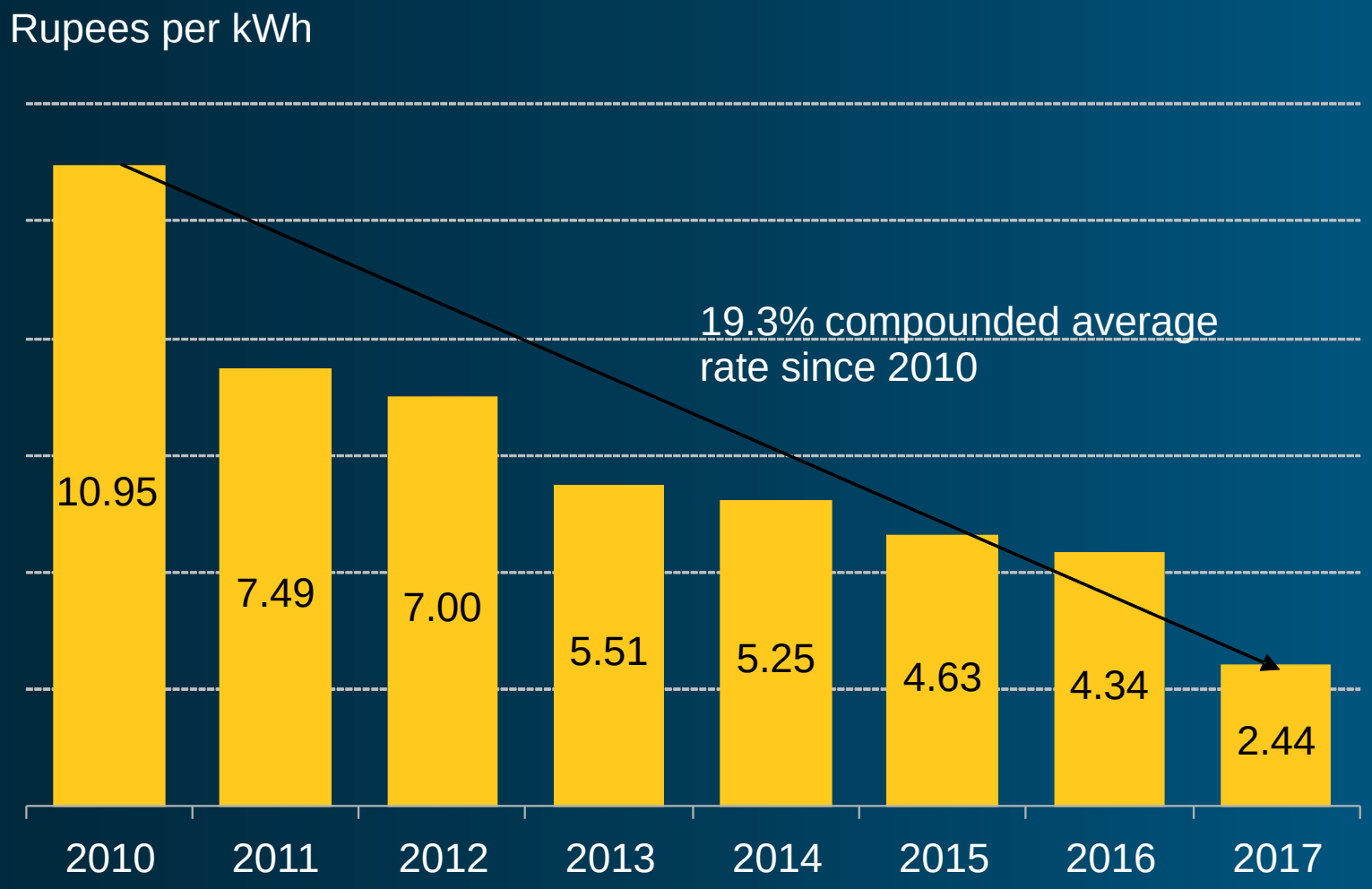


175GW renewable target by 2022, of which 129GW remains to be awarded

Source: BNEF 1Q 2017 Global Auction and Tender Results_2017-04-07

Auctions driving down prices

Winning solar tariffs in Indian national solar tenders

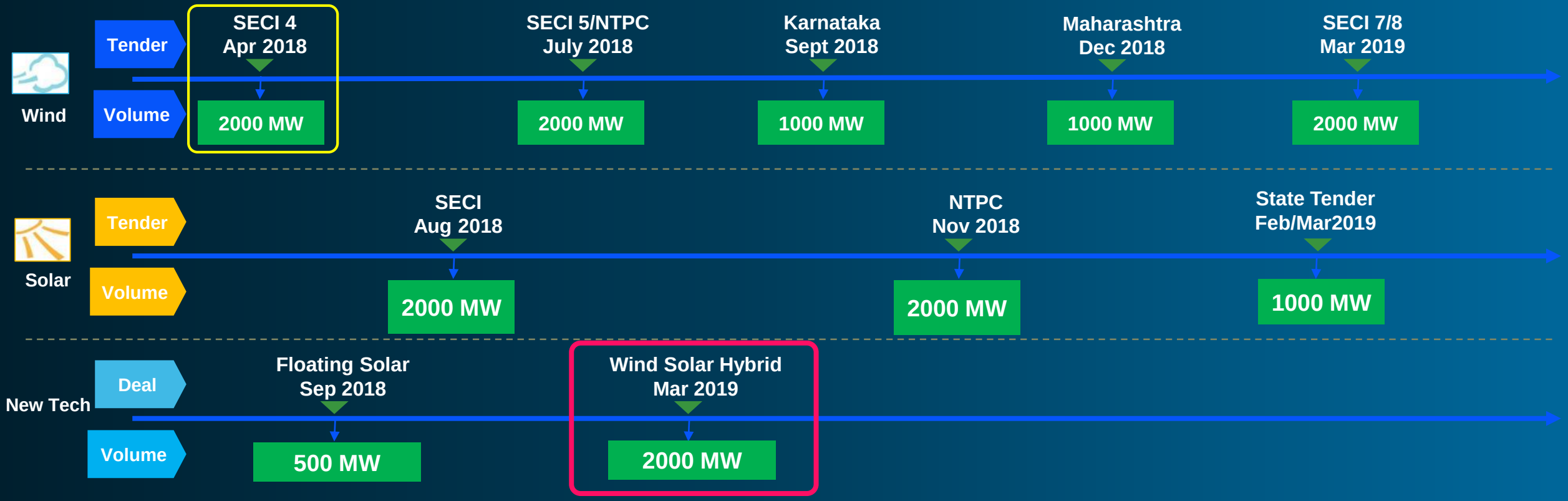


Source: BNEF

Projected renewable tenders in India

Steady pace of strong volumes, and introduction of new technologies

Enel Green Power awarded



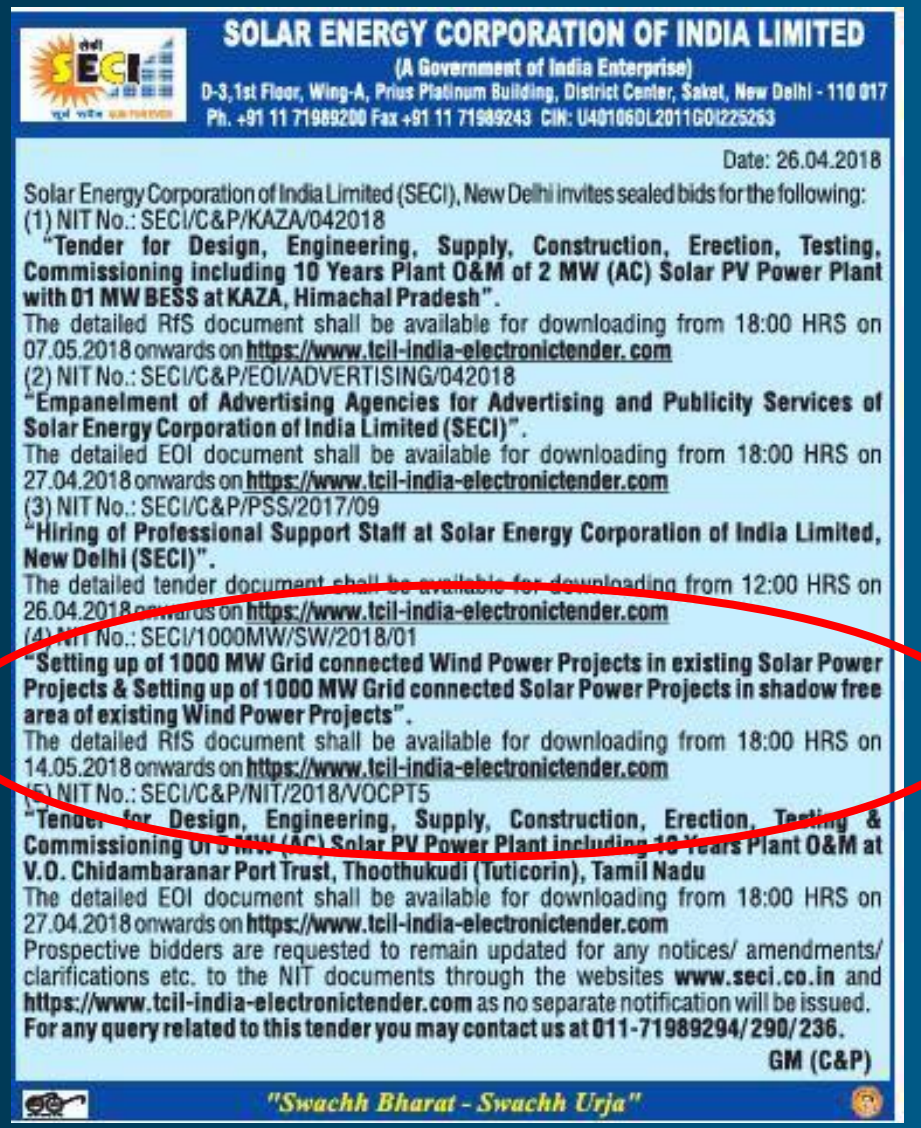
(*) Timelines based on market intel and subject to government announcement

Renewable Hybrid Tender in India

First Notice for Hybrid Tender

NiT (April 26, 2018)

1000 MW of wind in existing solar projects or 1000 MW of solar in existing wind projects



SOLAR ENERGY CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)
D-3,1st Floor, Wing-A, Prius Platinum Building, District Center, Saket, New Delhi - 110 017
Ph. +91 11 71989200 Fax +91 11 71989243 CIN: U40106DL2011GOI225263

Date: 26.04.2018

Solar Energy Corporation of India Limited (SECI), New Delhi invites sealed bids for the following:

(1) NIT No.: SECI/C&P/KAZA/042018
"Tender for Design, Engineering, Supply, Construction, Erection, Testing, Commissioning including 10 Years Plant O&M of 2 MW (AC) Solar PV Power Plant with 01 MW BESS at KAZA, Himachal Pradesh".
The detailed RfS document shall be available for downloading from 18:00 HRS on 07.05.2018 onwards on **https://www.tcil-india-electronictender.com**

(2) NIT No.: SECI/C&P/EOI/ADVERTISING/042018
"Empanelment of Advertising Agencies for Advertising and Publicity Services of Solar Energy Corporation of India Limited (SECI)".
The detailed EOI document shall be available for downloading from 18:00 HRS on 27.04.2018 onwards on **https://www.tcil-india-electronictender.com**

(3) NIT No.: SECI/C&P/PSS/2017/09
"Hiring of Professional Support Staff at Solar Energy Corporation of India Limited, New Delhi (SECI)".
The detailed tender document shall be available for downloading from 12:00 HRS on 26.04.2018 onwards on **https://www.tcil-india-electronictender.com**

(4) NIT No.: SECI/1000MW/SW/2018/01
"Setting up of 1000 MW Grid connected Wind Power Projects in existing Solar Power Projects & Setting up of 1000 MW Grid connected Solar Power Projects in shadow free area of existing Wind Power Projects".
The detailed RfS document shall be available for downloading from 18:00 HRS on 14.05.2018 onwards on **https://www.tcil-india-electronictender.com**

(5) NIT No.: SECI/C&P/NIT/2018/VOCPT5
"Tender for Design, Engineering, Supply, Construction, Erection, Testing & Commissioning of 5 MW (AC) Solar PV Power Plant including 10 Years Plant O&M at V.O. Chidambaranar Port Trust, Thoothukudi (Tuticorin), Tamil Nadu
The detailed EOI document shall be available for downloading from 18:00 HRS on 27.04.2018 onwards on **https://www.tcil-india-electronictender.com**

Prospective bidders are requested to remain updated for any notices/ amendments/ clarifications etc. to the NIT documents through the websites **www.seci.co.in** and **https://www.tcil-india-electronictender.com** as no separate notification will be issued.
For any query related to this tender you may contact us at 011-71989294/290/236.

GM (C&P)

"Swachh Bharat - Swachh Urja"

Policy from Central Government

Approved May 25, 2018

Format and bidding rules borrow from existing SECI solar & wind tenders

Set minimum ratio (4:1) for hybridization

Allow only AC-level combination (“co-located”)

Opened possibility to also incorporate storage

But still lacking in details!

25th May, 2018 *(Approved by Ministry with directive to SECI to roll out tenders)*

RfS: Expected Mid July

Implementation Agency: SECI

Selection: e Bidding followed by e Reverse Auction

Eligible Bid Capacity: Minimum 200 MW; Maximum 500 MW per Bidder

Projects: Any rated capacity of wind and solar projects along with any energy storage facility

Criterion for Hybrid: Rated Power Capacity of one resource (SOLAR/WIND) should be 25% of the Rated Power Capacity of the other resource

Location: To be identified by bidders

Connectivity: CTU @220 kV and above at bidder's cost and responsibility

PPA: 25 Years with SECI (Within 2 Months of LoA)

PSA: Back to back with DISCOMs/Bulk Consumers. Solar/Non-solar RPOs can be fulfilled through purchase of hybrid power.

Technical Eligibility: Developer/Owner/EPC of Wind/Solar projects of at least 25 MW capacity at one location

Financial Eligibility: 1.5 Cr/MW

Bid Processing Fee: 3 lakhs + GST

EMD: 10 Lakh/MW

PBG: 20 Lakh/MW

Commissioning – 18 Months from LoA

Part Commissioning - The minimum capacity for acceptance of first part commissioning shall be 50 MW or 50% of the allocated project capacity, whichever is lower.

CUF - Has to be at least 40% or more. To be declared at PPA signing, allowed to be revised once with 1st year of CoD and cannot fall below 90% of the declared CUF value

Hybrid Renewable Projects

Why Hybrid Renewable Projects?

Taking the cue from last year's discussion..

Closing Remarks

- Competitive auction is an effective and efficient mechanism to attract private investment in **large-scale renewable generation** (However, auctions cannot start from scratch..)
- Long-term planning as well as a **consistent long-term signals** is important from the government
- Competitive pricing depends not only on the level of competition but also on the **terms of the PPA** and other contractural terms
- Alignment with **grid infrastructure buildout** is a key factor

ACEF Presentation
(June 2017)

Why Hybrid Renewable Projects

Challenges Facing Renewables

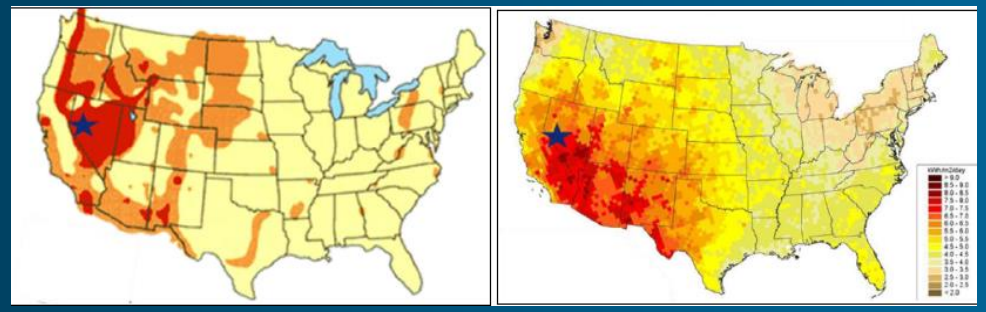
- **Siting Constraints**
  - *Siting depends on resource availability*
  - *Environmental challenges (e.g. land use, wild-life), local opposition*
  - *Transmission challenges*
- **High Upfront Capital Costs**
- **Resource Intermittency**
  - *Higher challenge for solar and wind projects*
  - *Reliability challenges*

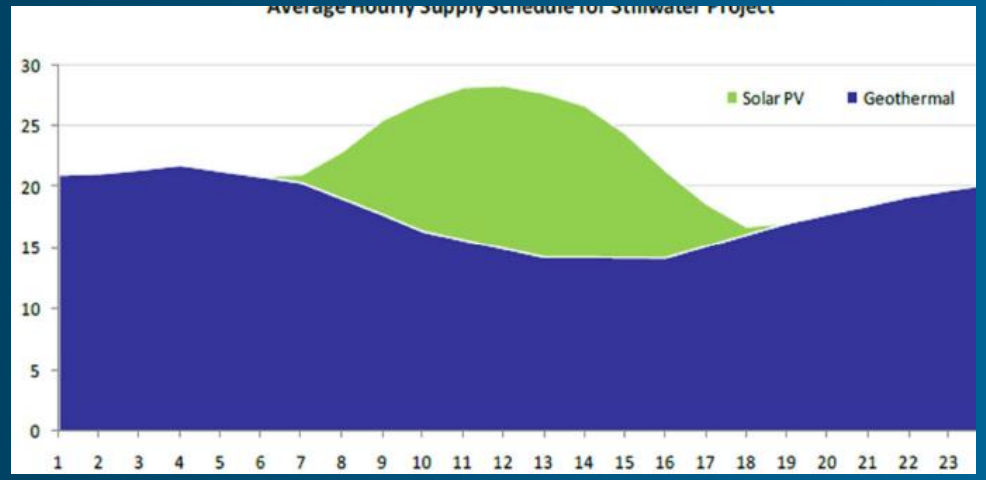
Need to find smarter and more efficient ways to **maximize renewable electricity production** and **minimize environmental footprint**

One solution is to combine (“hybridize”) renewable technologies on a single site.

Benefits of Hybrid Renewable Projects

Stillwater Geothermal-Solar PV-CSP Hybrid Project (Nevada, USA)

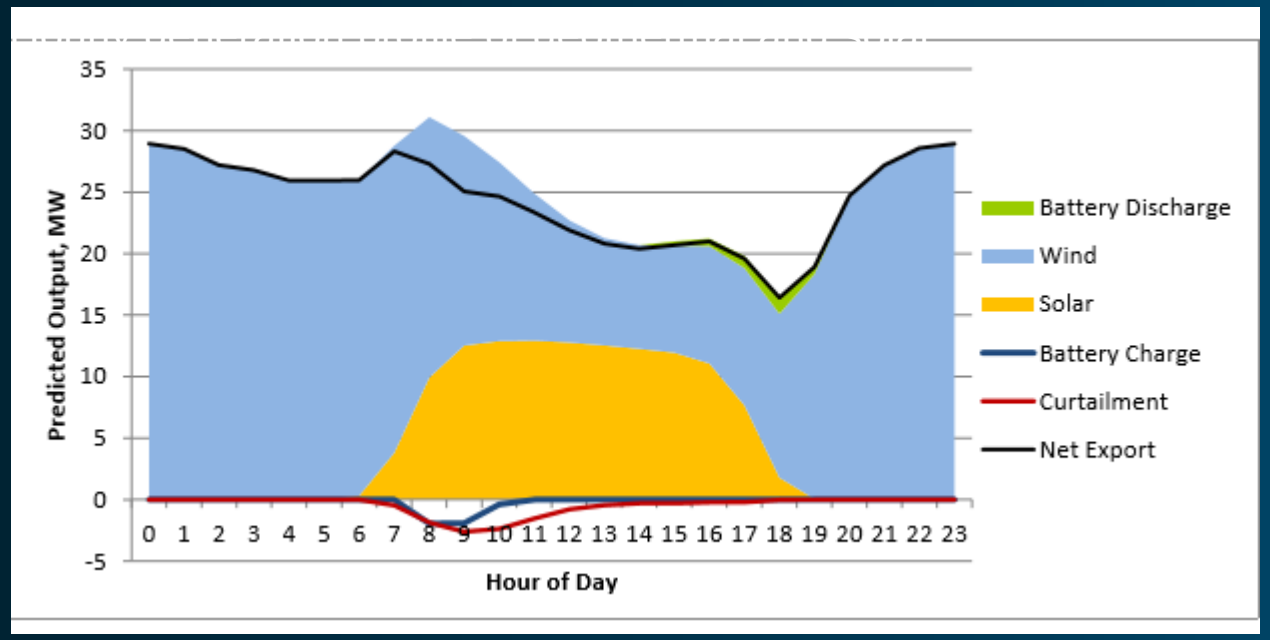




Hourly generation profile of geothermal and solar

- ✓ Generation that closely follows the daily load
- ✓ Cost-saving on shared infrastructure and maintenance
- ✓ Minimize environmental footprint

Potential Benefits for Wind/Solar/ESS Hybrid



Source: DNV-GL presentation

- Wind and Solar also (often) yield complementary generation profiles
- Addition of batteries could further minimize curtailment/congestion losses and optimize the serve of peak load
- Problems are site specific and cost!

Fontes Hybrid Plant

Tacaratu (PE) - Brazil

Fontes dos Ventos (wind) – 80 MW of installed capacity

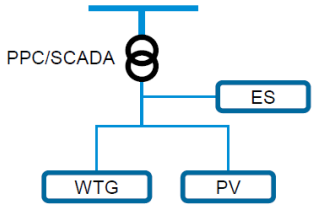
Fontes solar – *11 MW of* installed capacity

Generating more than 340 GWh per year.

Wind/solar hybrid configuration

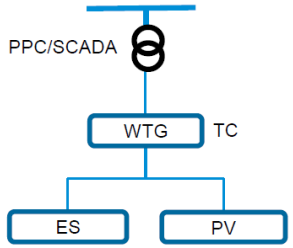
AC or DC combination?

Co-located
Integration of assets at substation level



- Combines the wind and solar output in AC (using separate inverters)
- Achieves savings through the common use of the sub-station (utilizing the spare capacity)
- Recently launched Indian tender allows only this configuration

DC-coupled
Integration through the WTG converter



- Solar (and battery) output is integrated with the wind output in DC and converted together to AC
- Potentially lower losses, higher efficiency, and higher degree of integration (sharing of components)
- Purpose-specific WTG is needed (and being developed)

Final Thoughts

- Hybridizing renewables can bring value in terms of generation profile, environmental profile and cost
- Certain combination (e.g. storage) may not be cost-competitive with stand-alone renewables (yet)
- Integrating different technologies using a shared infrastructure (especially if different project sponsors) may require clear rules on metering and cost-sharing

Key levers for a winning Business Model

Technological and Geographical diversification with an optimized Value Chain

enel Green Power

4 technologies across the Globe

Wind Onshore
our main portfolio driver

Solar Photovoltaic
increasing key role in solar market

Geothermal Energy
leadership in the sector

Hydroelectric
focused on small-medium hydro

How We Originate

PROJECT DEVELOPMENT

- Strategic partnerships and co-development agreements
- High quality pipeline of projects

COMMERCIAL STRUCTURING

- Tailor made solutions to meet a variety of customer needs
- Flexible structures squeezing risk-value trade offs

How We Execute

FINANCE SOURCING

- Access to competitive cost of financing
- Attractive alternatives to industry financial players

ENGINEERING & CONSTRUCTION

- Economies of scale, global procurement
- Design-to-value to increase reliability and minimize costs

How We Deliver

OPERATION & MAINTENANCE

- Big data and predictive maintenance
- Performance excellence at lower costs

ENERGY MANAGEMENT

- Integrated portfolio (generation/retail/trading)
- Risk mitigation synergies at Group level

Thank you

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