



*I contributi tecnologici per la trasmissione  
delle energie rinnovabili*

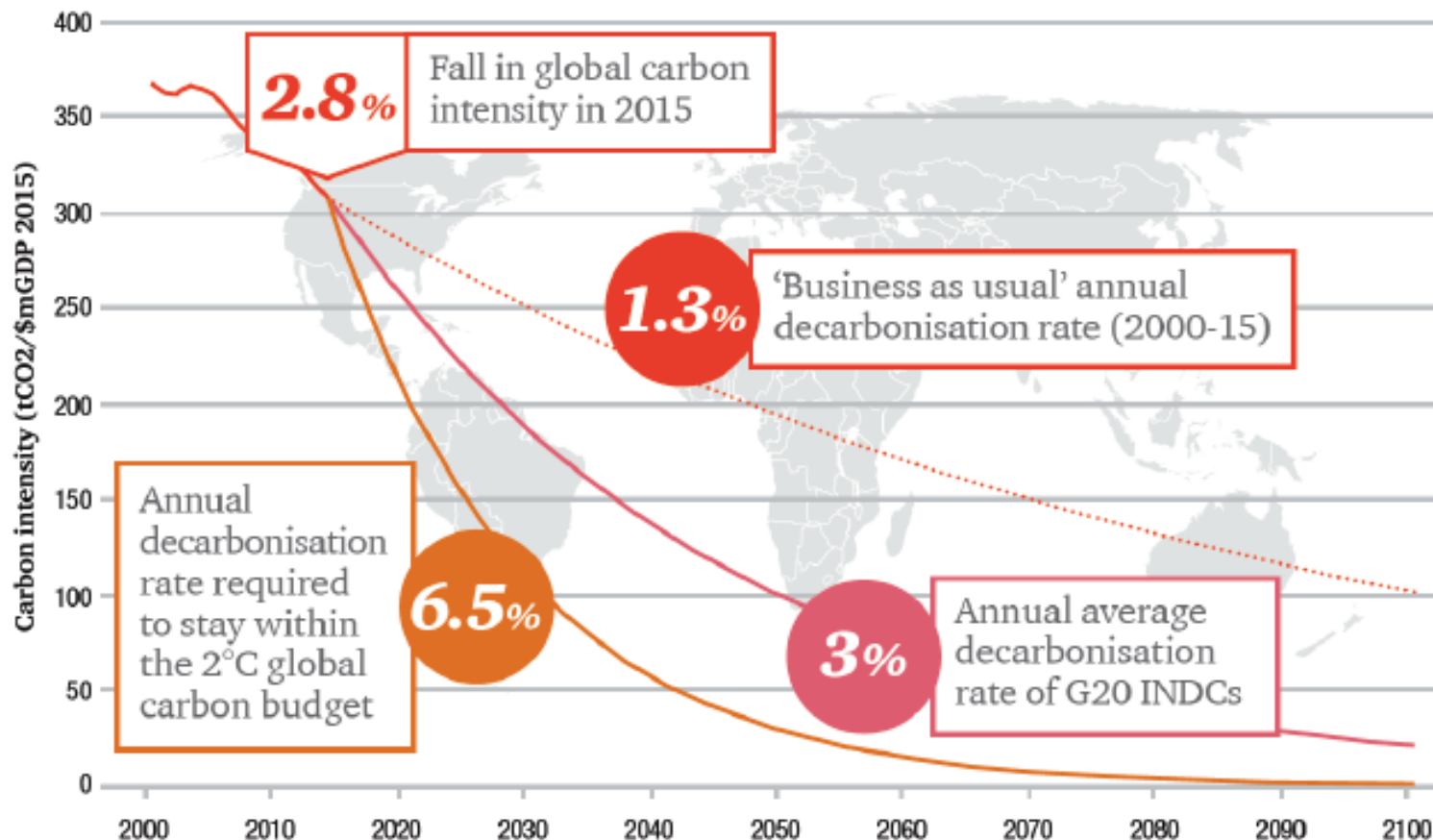
Luigi Ferraris  
CEO

October 27<sup>th</sup>, 2017

# The Overall Scenario (1/4)

Evolution of global economy carbon intensity

## PATHWAY TO 2° C - From “Low Carbon Economy Index 2016”, PWC



# The Overall Scenario (2/4)



**COP22**  
*Marrakech  
Climate Change  
Conference -  
November 2016*

- › Implementation of **Paris Agreement** underway
- › Multilateral cooperation on climate change continues



**United Nations**  
*17 Goals to  
Transform Our  
World*

Mobilize efforts to achieve **Sustainable Development Agenda** by 2030



**Closing the loop**  
*EU action plan  
for Circular  
Economy*

“Closing the loop” of product lifecycles through greater **recycling** and **re-use**. Bring benefits for both **environment** and **economy**

# The Overall Scenario (3/4)

The Energy Transition






European  
Guidelines

Decarbonisation  
Market Efficiency  
Security of Supply



...to ensure that Europe has *secure, affordable and climate-friendly energy*

## TARGETS

	2020 <i>EU 20-20-20</i>		2030 <i>The energy bridge</i>
			
<i>Reduction of GHGs emissions</i>	- 20%	- 13% <sup>1</sup> 	- 40%
<i>Consumption covered by RES<sup>2</sup></i>	≥20%	≥17% 	27%
<i>Energy Efficiency (vs BAU scenario)</i>	+ 20%	+ 20%	+30% <sup>3</sup>
<i>Interconnection vs. installed capacity</i>	≥ 10% <sup>4</sup>	≥ 10% <sup>4</sup>	≥ 15% <sup>5</sup>

# The Overall Scenario (4/4)

World global power capacity additions and energy production by source 2004-2014

Source	Installed Capacity 2004 [GW] and (%) share		Installed Capacity 2014 [GW] and (%) share		Average Annual Growth Rate (%)	2014 Production [TWh] and (%) share		Average Equivalent Operating Hours [h]
Hydro	715GW	18.8%	1,055 GW	17.1%	4%	3,898TWh	16.6%	3,694
Wind	48GW	1.3%	370GW	6.0%	23%	728TWh	3.1%	1,967
Biomass	39GW	1.0%	93GW	1.5%	9%	423TWh	1.8%	4,545
Solar	3GW	0.1%	181GW	2.9%	51%	211TWh	0.9%	1,168
Geothermal	9GW	0.2%	13GW	0.2%	4%	94TWh	0.4%	7,225
Total Renewables	814GW	21.4%	1,712GW	27.7%	8%	5,353TWh	22.8%	3,127
Total Conventional (Oil, Gas, Coal) and Nuclear	2,986GW	78.6%	4,468GW	72.3%	4%	18,127TWh	77.2%	4,057
<b>TOTAL</b>	<b>3,800GW</b>	<b>100%</b>	<b>6,180GW</b>	<b>100%</b>	<b>5%</b>	<b>23,480TWh</b>	<b>100%</b>	<b>3,799</b>

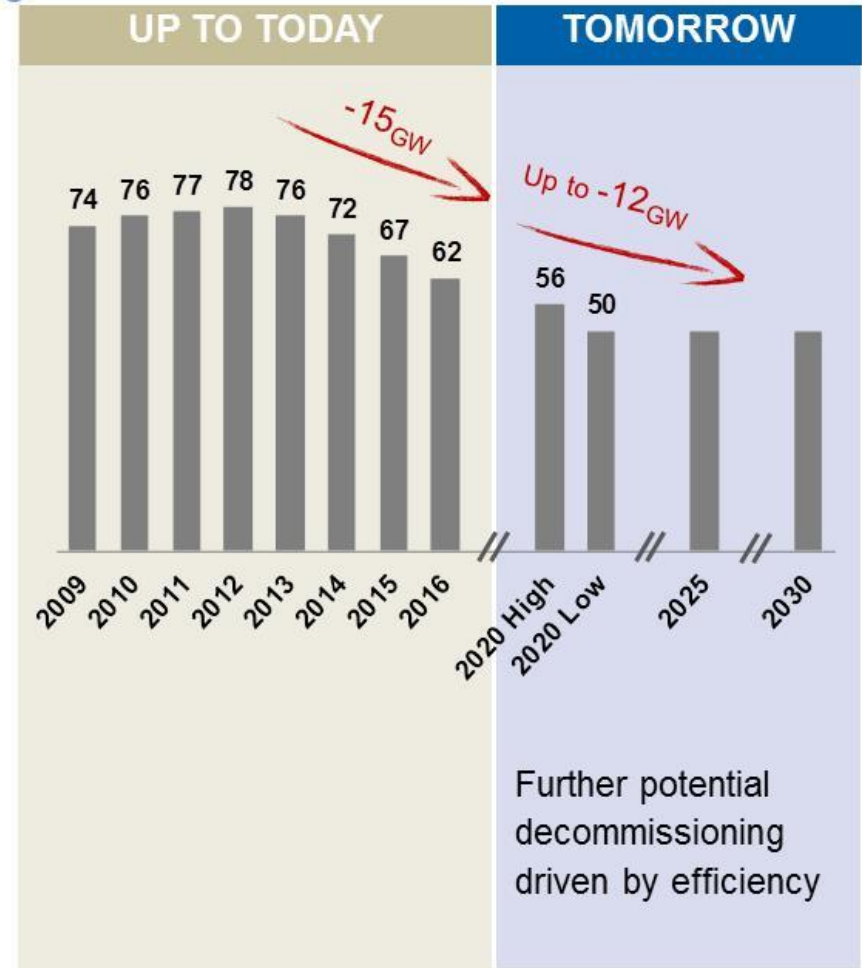
# The Italian Case (1/4)

## RES Growth & Thermal Drop

### RES GROWTH (GW)



### THERMAL DECOMMISSIONING (GW)

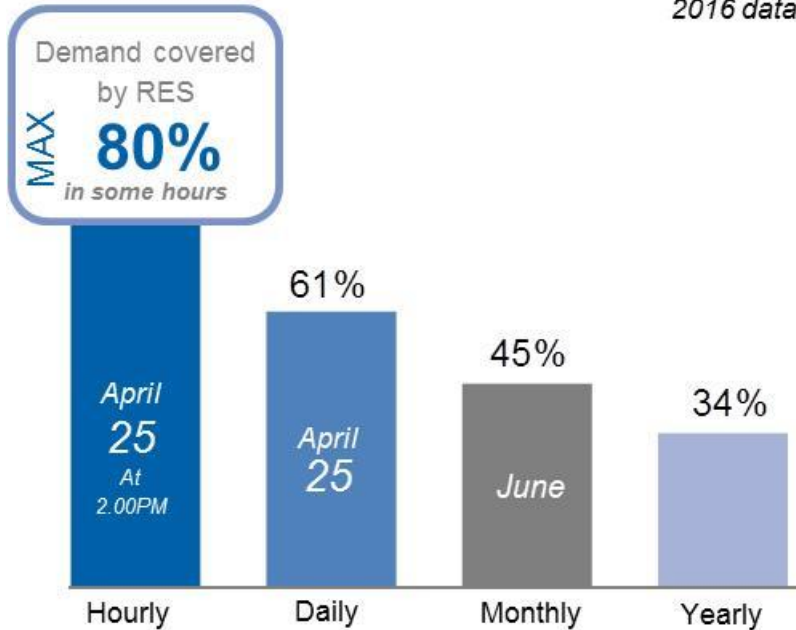


# The Italian Case (2/4)

## Understanding RES Integration

### DEMAND COVERED BY RENEWABLES<sup>1</sup>

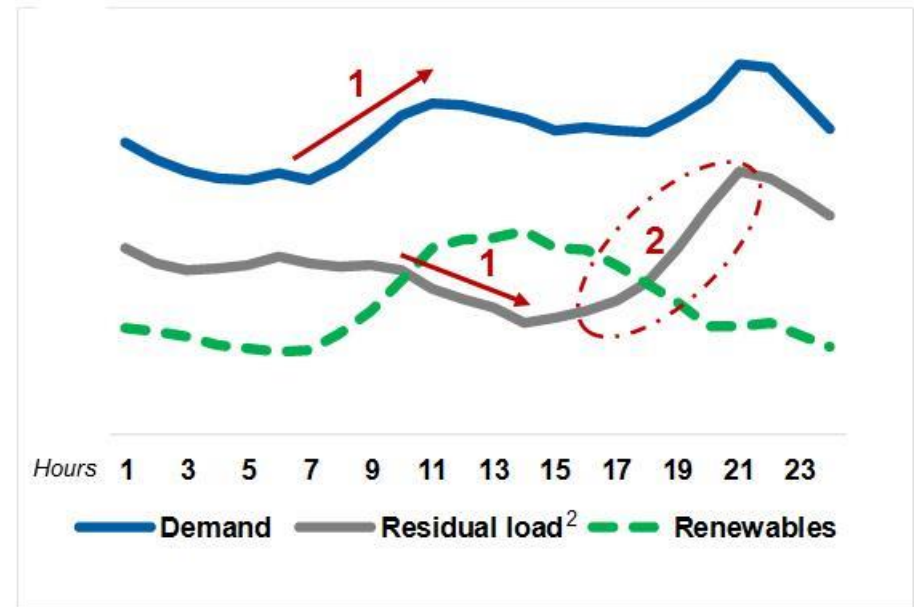
2016 data



### SYSTEM BALANCING NEEDS

GW

2016



- > **1** Peak inversion management
- > **2** Increased complexity of ramp up management

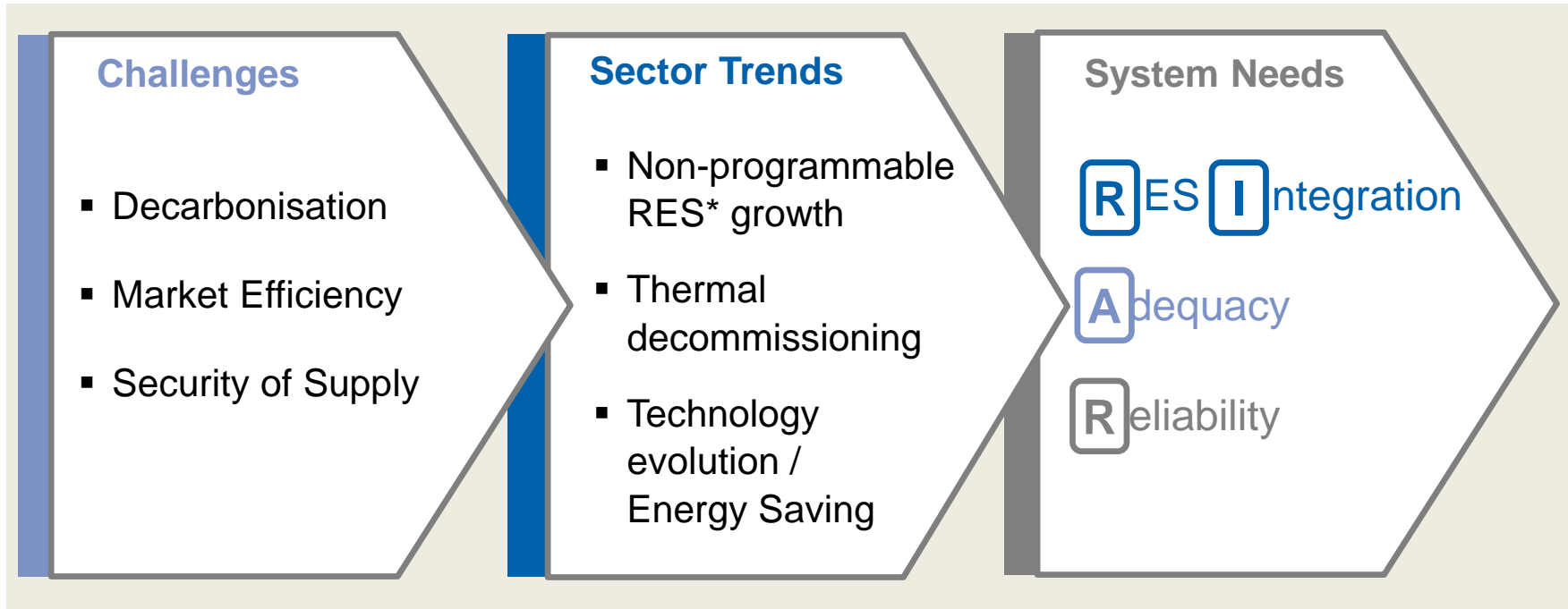
Need to integrate RES production



# The Italian Case (3/4)

The Energy Transition is Accelerating

## NEW TRENDS TO INCREASE CAPEX REQUIREMENTS



At the **lowest cost** for the System with **high quality** standards



# The Italian Case (4/4)

## Key enablers of the energy transition

### Capacity Market

Fundamental to deliver long term price signals in an energy only market; **fully integrated in the energy market structure**

### Network Development

**Transmission capacity increase** on a zonal and local basis; **interconnections** with other countries

### Storage

Both **large scale storage** solutions (5 GW additional PHES might be necessary by 2030) and **distributed small-medium scale** solutions (typically electrochemical storage)

### Demand Response

Enabling demand to provide ancillary services based on **explicit and/or implicit price signals**

### Smart Grids

Investing in **FACTS** (Flexible AC Transmission systems), **voltage compensators** and **real time digital management** systems

### Market Evolution

Driving the evolution of Ancillary Services Market **to foster the participation of new resources** (demand, distributed generation, storage)

### Data Management

**Full availability of metering data** is a fundamental enabler to allow for the participation of new resources to ASM

# The Role of Terna in Energy Transition (1/4)

## Company Overview

### Terna is

- the largest independent Transmission System Operator (TSO) in Europe
- the owner of the National High Voltage Transmission Grid
- responsible for the transmission and dispatching of the electricity all over the Country
- listed on the Italian Stock Exchange since 2004
- 4.6€bn cumulated dividends since IPO<sup>1</sup> and TSR ~500%

### Our Grid<sup>2</sup>

{ ~ 72,800 Km of three-phase conductors  
25 interconnections  
861 substations

### Electricity Market

{ 314 TWh energy demand<sup>3</sup>  
54.5 GW highest peak of demand (July 2017)

# The Role of Terna in Energy Transition (2/4)

Our contribution to the Energy Transition through Innovation

## CLUSTERS



Transmission Technologies  
Electric Power System Operation  
Grid & Markets Development  
Smart Grids (*i.e. Smart Islands*)  
Business Improvement

## PARTNERSHIPS



Start Up & SMEs  
Academy & research centers  
Energy sector & Infrastructures  
Supply chain

demonstration cases – interconnection - interdisciplinarity

### Open Innovation

Tools to turn ideas into new strategic initiatives

### Environment

A more sustainable approach to environmental themes adopting stringent standards

### Human capital

Attract, develop and retain talents

# The Role of Terna in Energy Transition (3/4)

## Storage – an Example of Innovation

### Power Intensive (Storage Lab)

- **Objective:** increasing the grid safety
- **Power in operation:**  $\approx 13.5$  MW
- **Solutions:** Li-Ion, Zebra, Flow, others (Supercap)
- **Number of sites:** 2

### Energy Intensive (Large scale)

- **Objective:** reduction of local congestions
- **Power in operation:**  $\approx 35$  MW
- **Solutions:** NaS (Sodium Sulfur)
- **Number of sites:** 3

#### PHASE I: 16 MW - Storage Lab

##### Site 1) Sardinia - Codrongianos

- Power planned:  $\approx 8.65$  MW
- Power in operation:  $\approx 7.9$  MW

##### Site 2) Sicilia - Ciminna

- Power planned:  $\approx 7.3$  MW
- Power in operation:  $\approx 5.55$  MW



##### Site 1) Ginestra

- Size:  $\approx 12$  MW
- In operation since 31/12/2015

##### Site 2) Flumeri

- Size:  $\approx 12$  MW
- In operation since 31/12/2015

##### Sito 3) Scampitella

- Size:  $\approx 10.8$  MW
- In operation since 31/12/2015

# The Role of Terna in Energy Transition (4/4)

## Smart Islands Projects

### Geographic islands are normally not connected to the main electricity grid

There are also “electric islands” that are portion of territory electrically independent and unconnected

### Power supply provided by diesel generators

- Low efficiency
- High generation costs
- Uncertainty on oil prices
- Unreliable fuel supply (political vulnerability)



### Impact of fossil fuel fired generators

- Local pollution (NO<sub>x</sub>, SO<sub>x</sub>, PM10)
- CO<sub>2</sub> emission
- Noise impact



### Small grid with very variable load

- Extreme seasonal variations in electric demand
- Very low minimum load
- Normally managed without redundancy

