The logo is a right-angled triangle with a purple border. Inside the triangle, the text "SET PLAN" is in bold black, "Conference" is in regular black, and "2015" is in regular black.

**SET
PLAN**
Conference
2015

Research, innovation
and competitiveness
for the Energy Union

THE ROLE OF FLEXIBILITY FOR THE FUTURE SYSTEM

Anna Carolina Tortora,
Terna

SESSION 6

Being the world leader in developing the next generation
of renewable energy technologies

Tuesday 22 September 2015

SOMMAIRE

- 1 TERNA
- 2 THE SYNCHRONOUS AREA
- 3 OUR ENERGY POLICY
- 4 SUSTAINABILITY
- 5 COMPETITION
- 6 SECURITY OF SUPPLY
- 7 THE DEFENSE OF THE GRID
- 8 TECHNICAL CHALLENGES
- 9 WHY WE NEED MORE FLEXIBILITY ON THE GRID AND HOW TO OBTAIN IT
- 10 FLEXIBILITY: WHAT ARE WE DOING ABOUT IT

Research, innovation and competitiveness
for the Energy Union

- ...the **largest independent transmission system operator (TSO)** in Europe and the sixth in the world
- ...the **owner** of the Italian High Voltage National Transmission Grid
- ...**responsible for the transmission and dispatching of electricity** throughout the Country
- ...in charge of the development and maintenance of the Grid, employing a workforce of ~3,500
- ...listed on the Italian Stock Exchange since 2004, with a market cap of about € 8.5 Billion.

Numbers ...

Grid

~ **63,900 Km** of three-phase
conductors in Italy

21 Interconnections lines with foreign
countries

491 Substations

Assets

8 Transmission Operating Areas

8 Distribution Centers

3 Remote-Control Centers

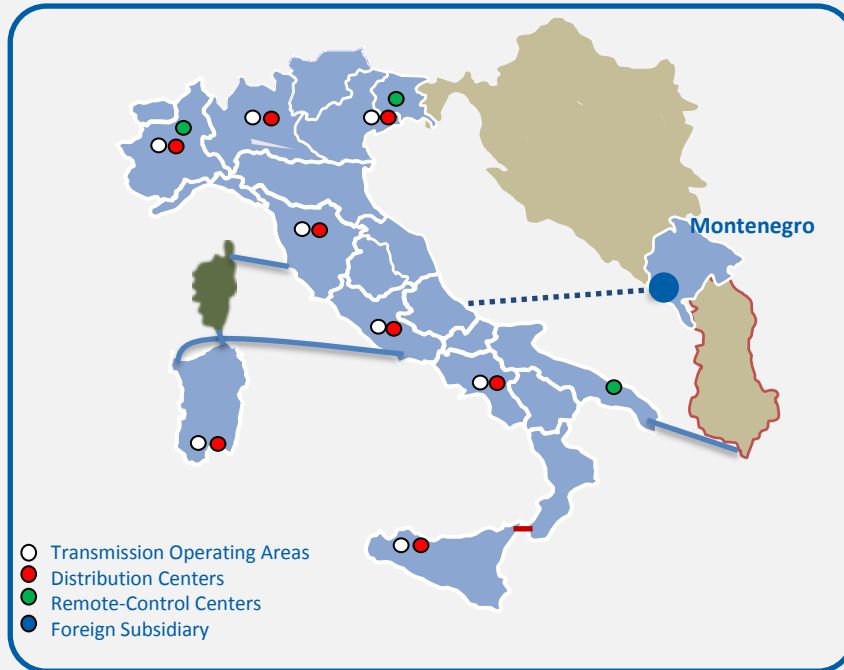
1 Foreign Subsidiary

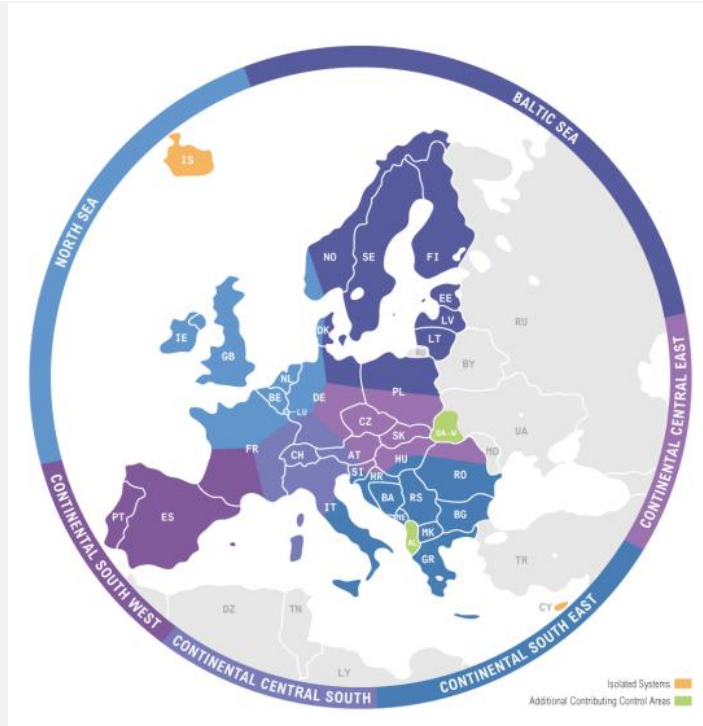
Electricity Market (2014)

309 TWh of energy demand

59.35 GW 21th July 2015

... and Premises





Europe in numbers *

- 34 Countries
- 41 TSO
- 307.503 km of lines
- 3.307,9 TWh electricity consumption
- 1.004.062 MW net generation capacity

09.22.2015

(*) Data from Entso-e (2013)

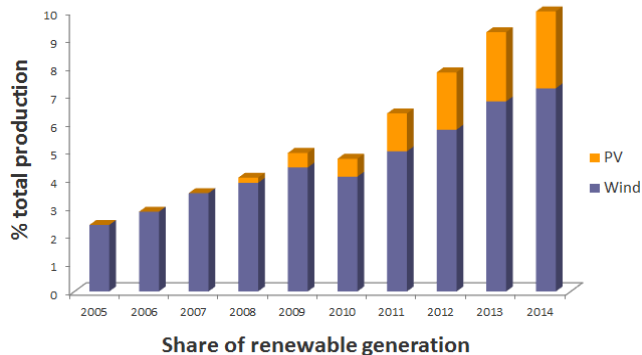
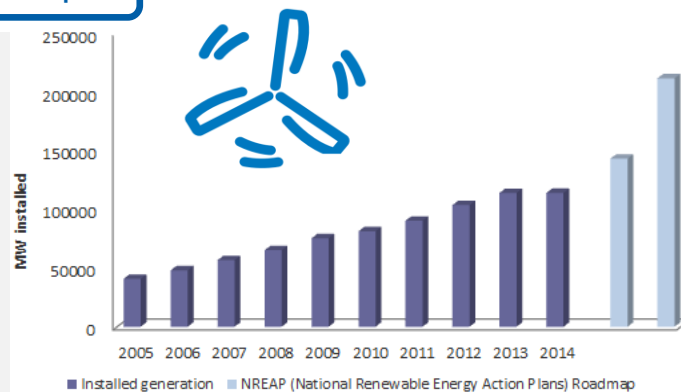
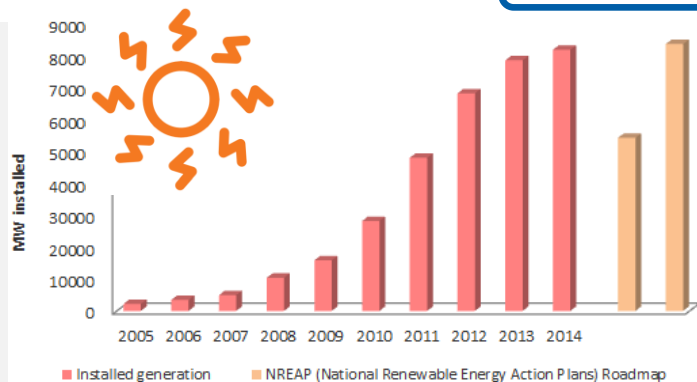


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Sustainability – The Situation so Far

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RES Generation in Europe



Following the NREAP, each European country has done its best to successfully achieve the targets set by European Directive 2009/28/EC.

PV generation in 2014 has already exceeded the forecasted value for 2020

Electric Market

Energy Market

Day-ahead market

- **Scope:** Energy Trade
- **Product:** MWh
- **Participants:** All producers and consumers can participate

Infra-day Market

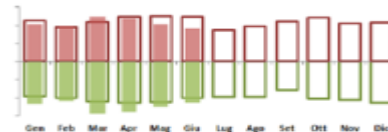


Ancillary Services Market

Day-ahead

- **Scope:** Ancillary Services
- **Product:** MWh and MW;
- **Participation:** mandatory for all qualified producers

Real-time



Clear Regulatory Context



The European legislation addressing the issue of the creation and development of the electricity market is grouped into three different Packages:

- Directive 96/92/EC;
- Directive 2003/54/EC;
- Directive 2009/72/EC.

Fair Market Access



The market must be completely open for both non-household and household customers. For the purpose of allowing access to the network, procedures must be objective, transparent and non-discriminatory

**Towards a
unified
European
energy market**

Reliable energy supplies at reasonable prices for businesses and consumers and with the minimum environmental impact are crucial to the European economy

1

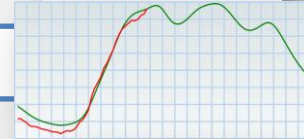
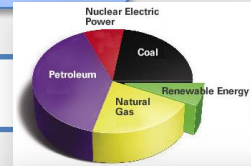
Energy Supply must be guaranteed

2

Demand must be met

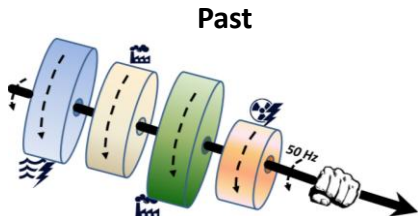
3

System must be secure



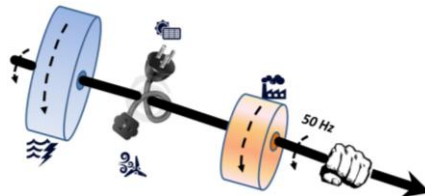
Time

Instantaneous/
Spinning
Reserve



The physical resistance (**inertia**) of the system against frequency change due to an imbalance.

Future



Primary
Regulation

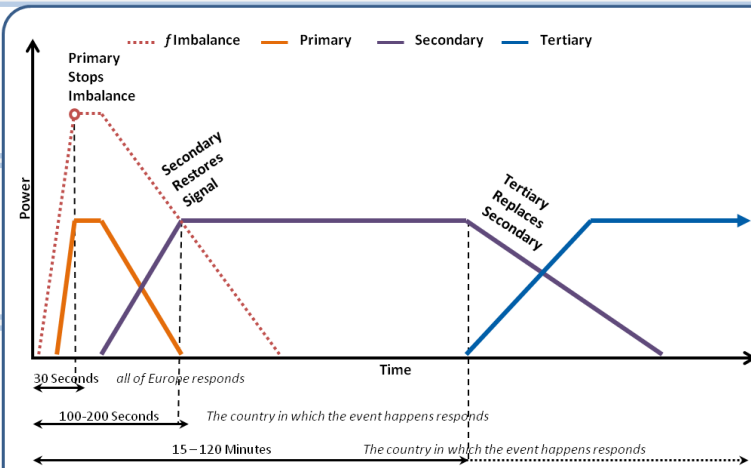
Ensures that power frequency (in Europe) is *always kept* at 50 Hz

Secondary
Regulation

Ensures that power frequency (in Europe) is *brought back* to 50 Hz

Tertiary
Regulation

Partially complements and finally replaces Secondary Reserve by re-scheduling generation.

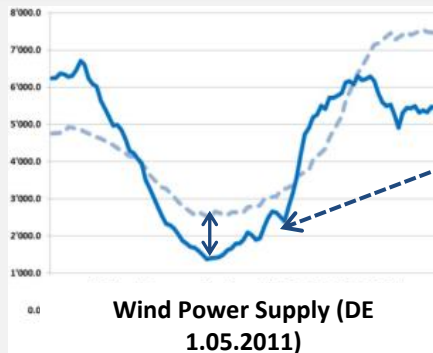
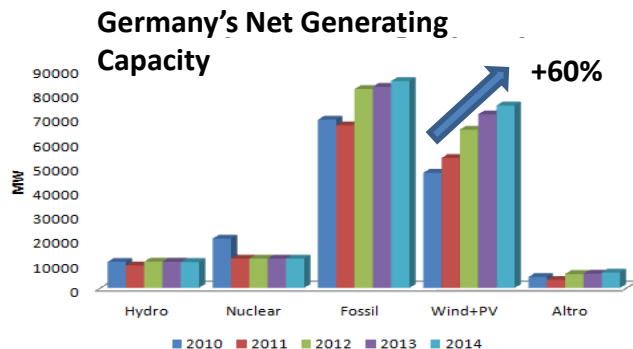


The huge increase in RES generation has brought new challenges to the system

Challenges

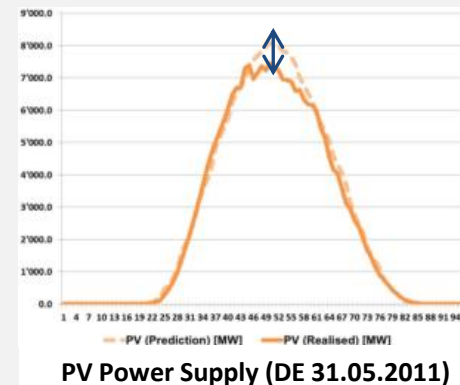
- Still mostly uncontrolled and non-programmable power supply
- Difficult estimation of grid availability
- Challenges in dealing with congestions on critical lines
- Very fast fluctuation in power supply
- Reduction of the market share for traditional generation = reduction in regulating reserves

Case Study- Germany



Error ~1000
MW!

Sources: <https://www.entsoe.eu>
<http://www.esc.ethz.ch>



The solution is **Operational Flexibility in Power Systems!**

Definition

Flexibility is Defined as the
Capacity of an Asset to
react to Different
Scenarios

Example 2011 Event in Sicily
Loss of a Group coupled with the system's very low Inertia and the high amount of Distributed Generation caused a very fast Frequency drop and the activation of Emergency Load Shedding

The Changing Energy Mix

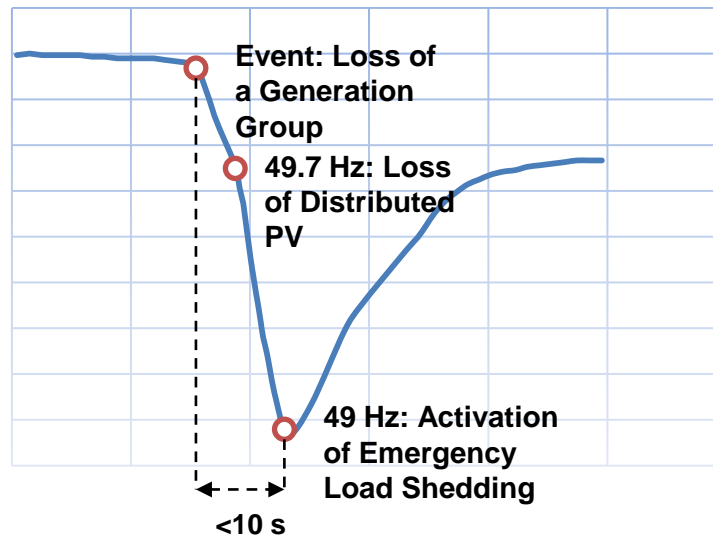
Means that all planned assets must be
adequate to today's as well as tomorrow's
Grid

The adequacy of the Grid

Has been traditionally evaluated by assessing
the point of highest demand

Distributed Generation

The net increase in **DG** makes this approach
alone ineffective so new methods are
necessary



Be faster, have more resources and better control over network elements

Demand Side Response



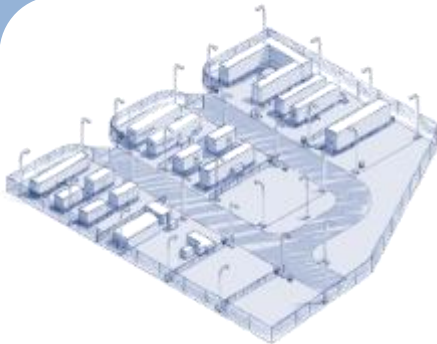
Opportunities for controlling demand exist in many **energy intensive industrial processes**: irrigation and municipal **water pumping, wastewater treatment**, air and water heating and cooling (**HVAC**) systems, as well as **electric vehicle charging**.

Smart Grid



Smart Grids will allow **rapid system-wide response to changing conditions** of both supply and demand.

Energy Storage



Energy storage, both long-term and short-term, becomes a **vitaly important source of flexibility** when **variable resources reach the highest penetration levels**.

RES Control



Variable resources are often treated as uncontrollable, **but sophisticated controls can reduce the need for flexibility from other Sources**.

Be Faster



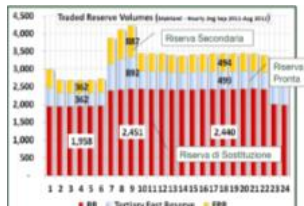
Fast reacting and flexible assets on the grid could act as a substitute for the constantly decreasing inertia of Continental Europe. This will slower the change in frequency allowing the System Operators to access other resources in time to avoid Shedding of loads and dangerous escalations of events.

Have Better Control



Given that much of the issues that we are facing today are a result of the increase in RES, European consumers will find great benefit in an increased ability to predict Renewable Power on the system. .

Have More Resources



Allowing Demand to participate in the market for ancillary services, as well as introducing RES in the Ancillary Market will increase the number of resources on the system. Thus impacting prices as well as security.





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