Key challenges and future role of Distribution Network

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Catania, 23 November 2018

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Key figures - 2017

32 Million
Customers

700.000
Prosumers

440.000
MV/LV Substations

2.100
HV/MV Substation

15.700
People

1.140.000 km
Network

227 TWh energy distributed

85% of Country's distributed energy

10 million of remote operations/year

500 million of automatic readings/year

30.000 CO_2 tons avoided

Scenario

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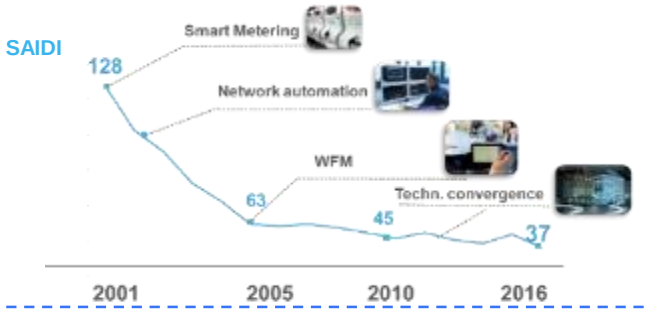
ARERA
Autorità di Regolazione per Energia Reti e Ambiente

Quality of Service

- SAIDI and SAIFI+MAIFI Target 2023

Grid Resilience

- Reduction of risk levels vs. extreme weather events
- 3 years Resilience Plan issued



SEN 2017

RES and energy efficiency

- 55% electricity from RES

Investments on network flexibility

- **Open meter**
- **Network digitalization**
- **Demand Side Management**

Quality of service **Digitalization** **Reliability**

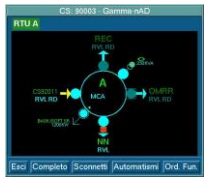
Resilience **Smart Grids** **Innovation**

Quality of Service and Resilience

Route to quality excellence

System Average Interruption Duration Index (min/year per LV Customer)

Smart meter

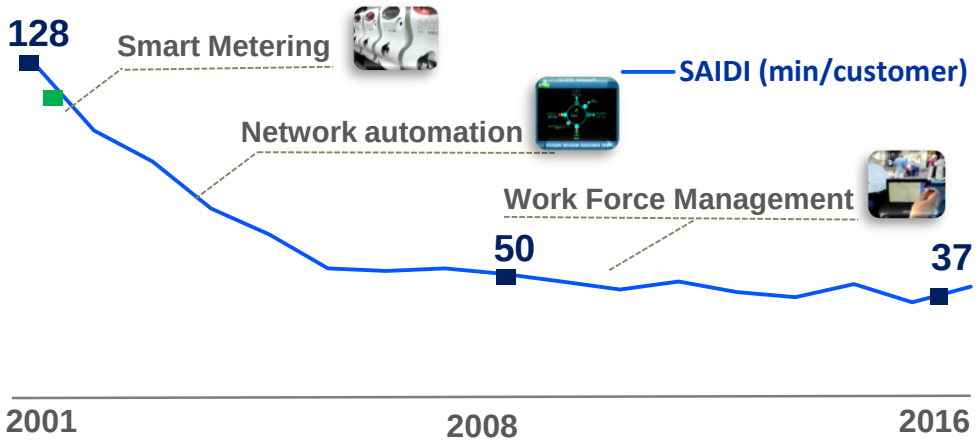


Network automation

Work force management

IT integration

Quality of Service



+ 70% Quality of Service
- 35% Opex

A global benchmark

A new operating context

Climate change impact on network infrastructures

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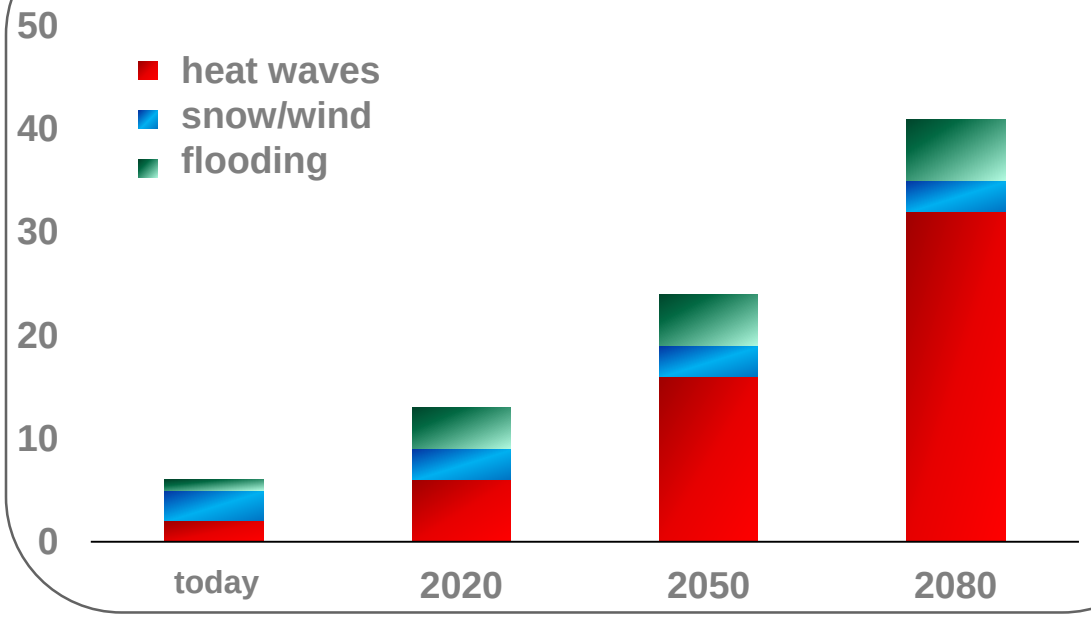
Impact of weather events (Bln€/year)



Evolution of climate hazard damages to critical infrastructures in the EU, JRC

Impact on power networks

Increasing influence of extreme weather events on network infrastructures

Network resilience

Risk evaluation methodology

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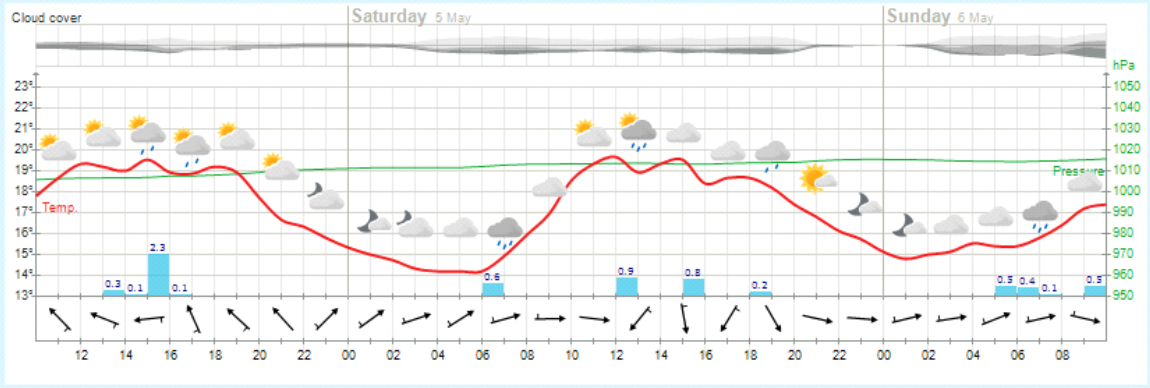
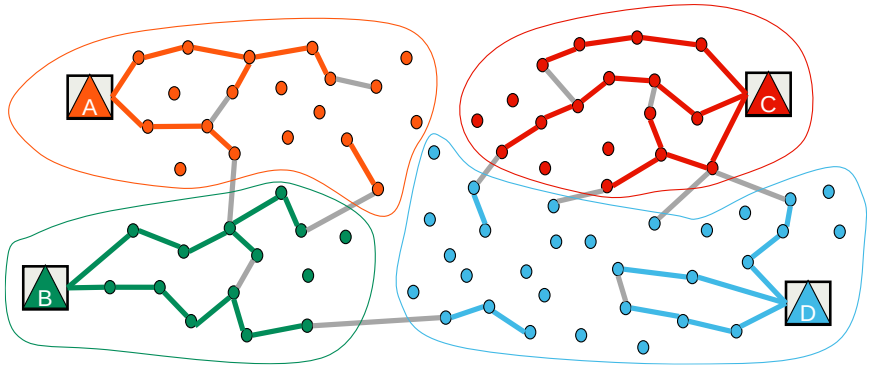
Weather Database

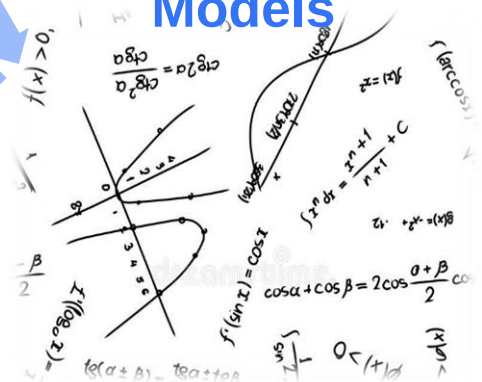


Impact on the service



Extreme weather events

Mathematical Models



Outage Risk Index

$I_{OR} = P \times D$

Risk based investment allocation in Resilience Plan

Network resilience

Technical solutions

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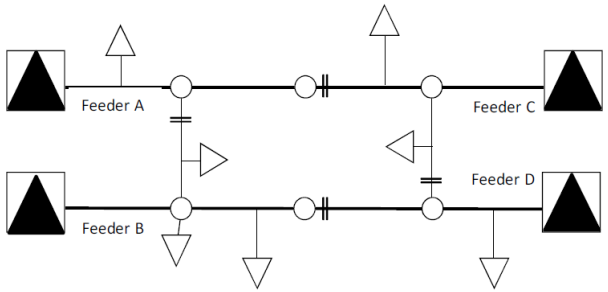
Network reinforcement

Overhead cables
Structural level

Network structure



Meshed structure
Backup lines

Remote control

Fast fault selection
Faster logistics

«P»
Reduction

«D»
Reduction

Outage Risk Index

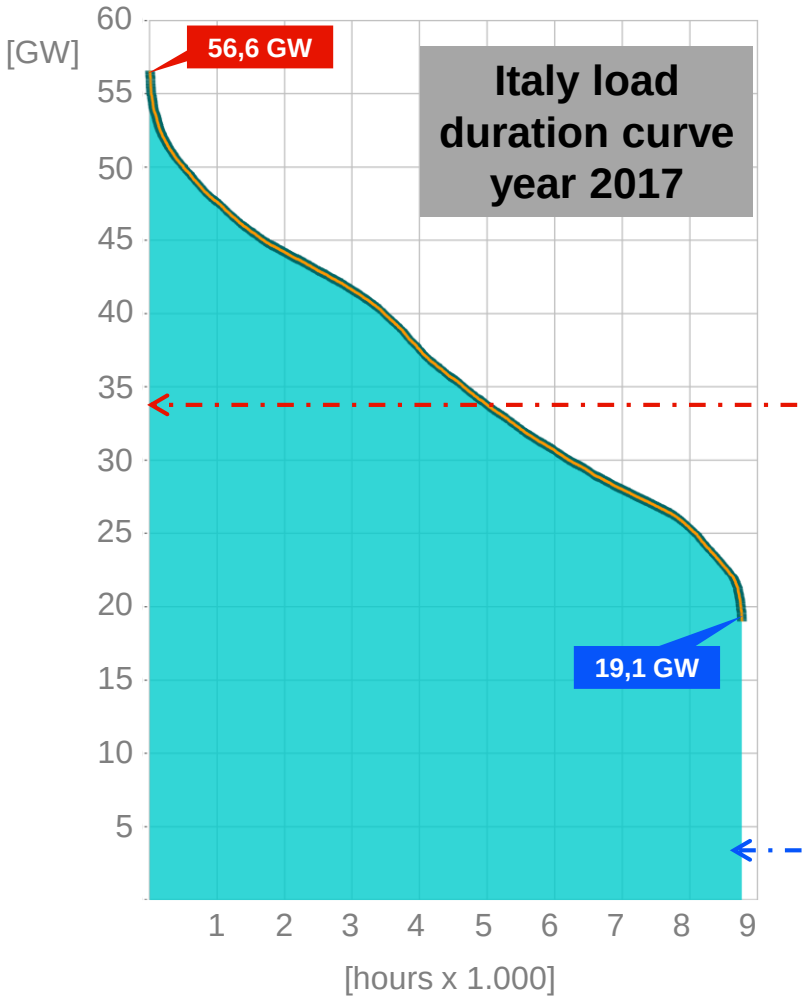
$$I_{OR} = P \times D$$

P = probability of outage at substation($1/T_R$)
D= damage (number of affected customers= N_{AC})

RES Integration

RES Integration

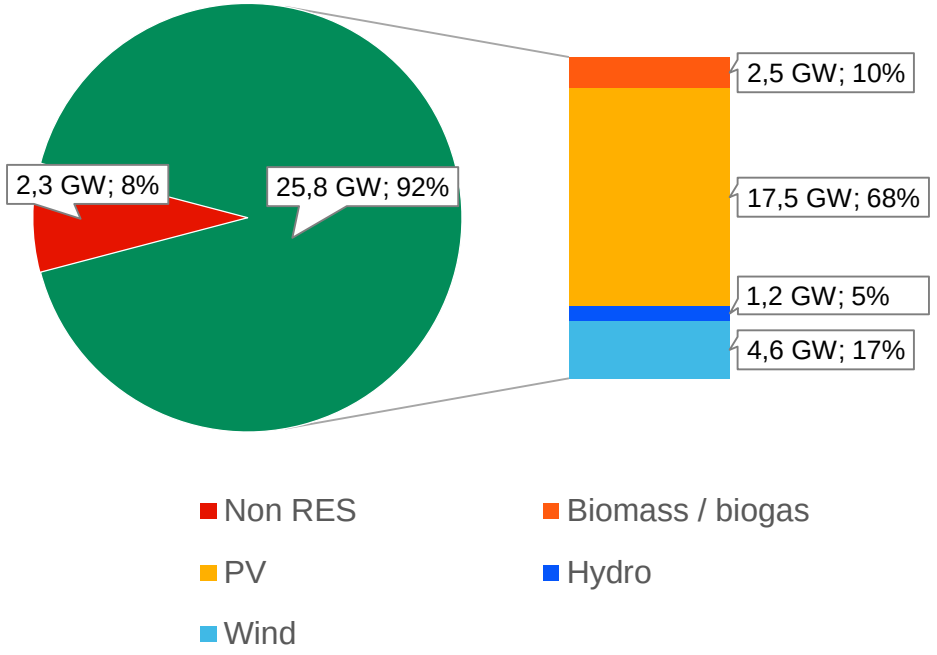
Load duration and RES connections



Maximum power on e-distribuzione network: **34 GW**

Minimum power on e-distribuzione network: **3,4 GW**

Power connected to e-distribuzione network – Year 2017



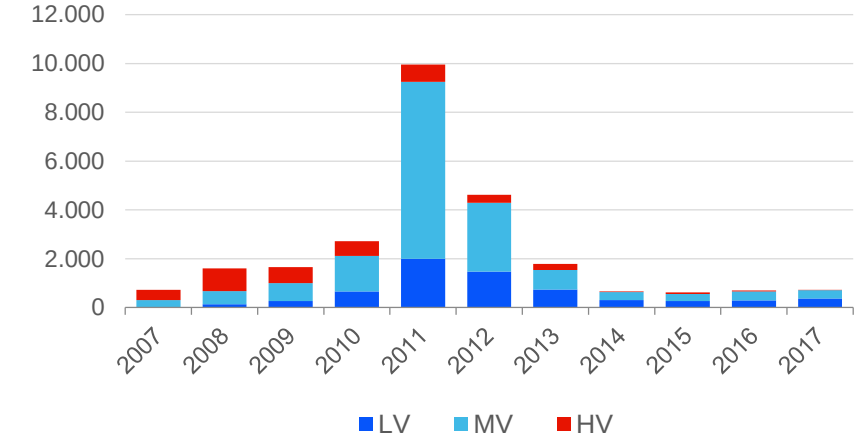
Fonte Terna

High flexibility of distribution network and RES integration

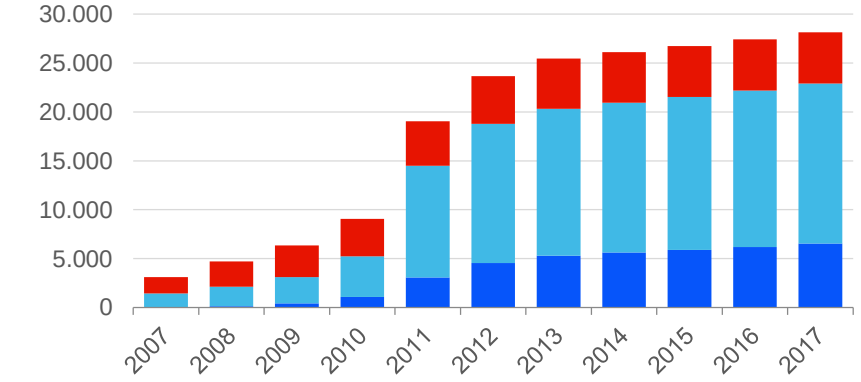
RES Integration

Connections

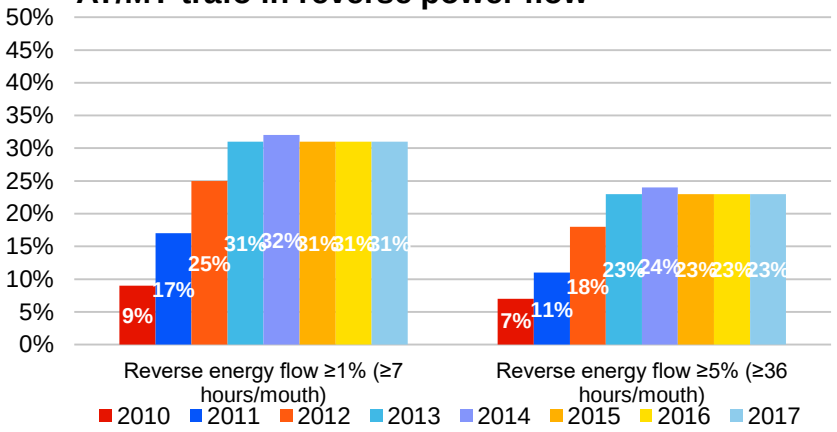
Power connected [MW] – Annual data



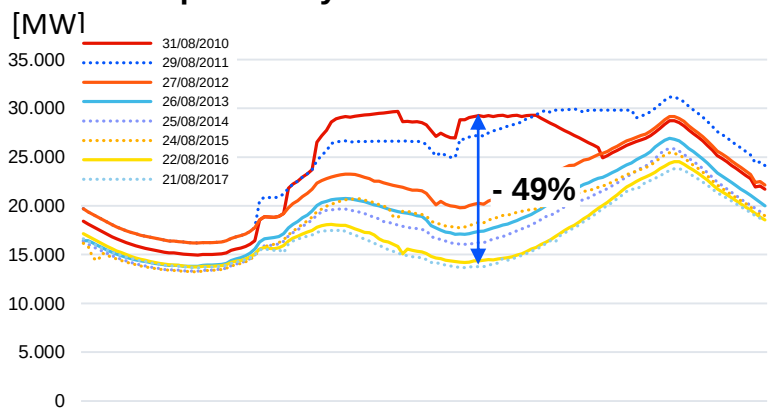
Power connected [MW] – Cumulative data



AT/MT trafo in reverse power flow



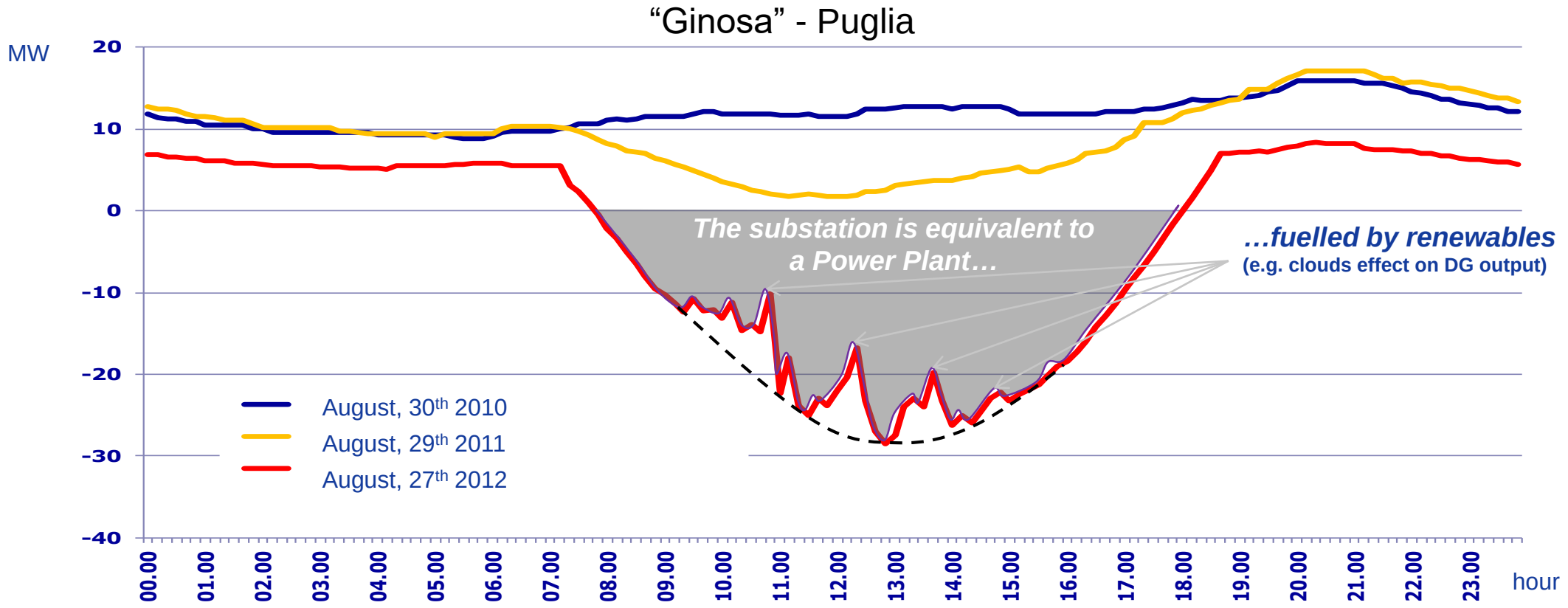
Net load requested by distribution network



28 GW of RES connected on distribution network

RES Integration

HV/MV substation with RES – reverse power flow



Increased flexibility of network plants

How to deal with this without jeopardizing system's security

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Monitoring

- enhanced RES remote control capabilities
- automatic optimal network configuration
- real-time data exchange with RES and TSO

Planning

- renewable DG modeling and prediction
- probabilistic vs. deterministic approach
- Demand Response

Dispatching

- from *fit-and-forget* to *smart integration* of RES
- local activation of RES (e.g. voltage regulation and congestions management)
- ancillary services provisioning

DSO-TSO interoperability

Regulation and innovation

- **28 GW of Distributed Generation**, mainly RES, are today connected **to MV and LV networks**
- This **capacity will double** to meet **EU targets** (55%-62% generation from RES by 2030)
- The **Distribution Network will be a strategic asset** to change the paradigm of energy consumption (renewables, prosumers, electric vehicle, demand response, etc)
- The **DSO must supervise and coordinate the activation of distributed resources connected on its network** in order to provide ***safe, secure and reliable energy*** to all customers
- Moreover, EU and local policies foresee the **possibility for DSO to buy "local flexibility services" from Aggregators, BSPs and Distributed Resources** (load, prosumers, distributed generators, etc)
- **Data exchange and cooperation between DSO and TSO** must be transparent and open, **with respect to *reciprocal roles and responsibilities***

Active Demand

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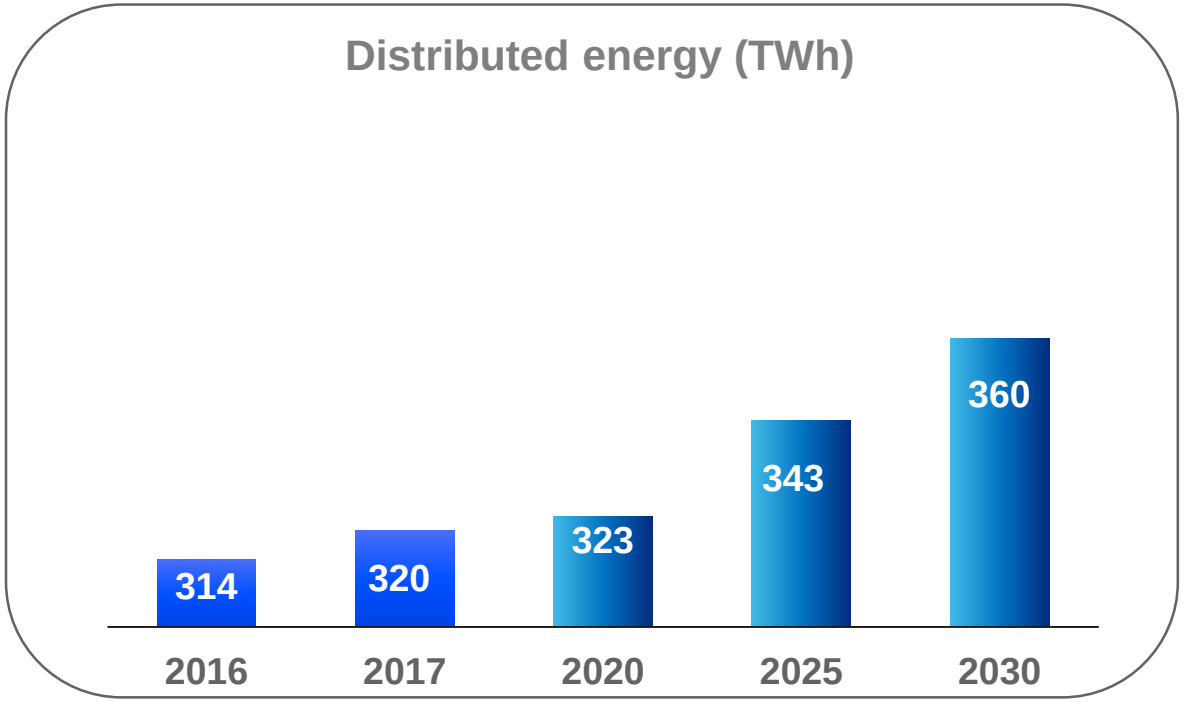
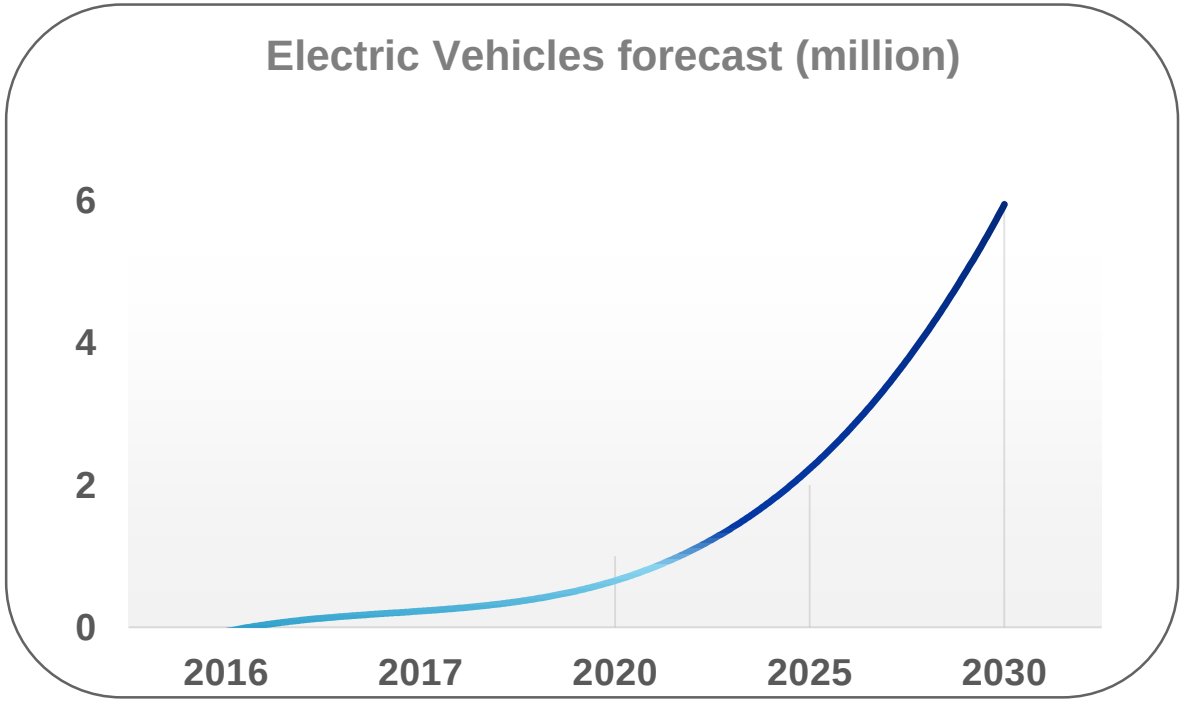
New market scenarios





SEN forecast

Scenarios description document – Terna 2018

Demand increase and electric mobility impact

Second generation Digital Meter

4,1 Billion investment in 2017-24

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Open protocol for meter informations access

Support to dynamic prices based market models

Availability of daily load curves

Enabling new value-added services

Support to advanced network management

Open technology for Active Demand

Future role of distribution network

Resilient platform for a smarter world

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2G Electronic Meter
- Enabling new value-added services, open protocol
- 15 minutes daily load curves
- advanced network management

Electric Mobility
- Vehicle-to-Grid
- Fast-Charge
- Distributed Storage

Secondary substation as data hub
- Sensors network
- IoT Hub
- Multi-metering

Resilience
- Probabilistic analysis of network risk
- Impact evaluation of extreme events
- response capacity in emergency conditions

Renewables Integration
- RES Dispatching
- Monitoring and Remote control
- Ancillary Services for TOTEX

Optical Fiber
- Improved TLC performance
- Advanced Automation (IoT, Smart Fault Selection)

Active Demand
- Flexibility management
- Demand Response
- Smart Grid management

Resilient platform for a smarter world

Thank you