



Renewables investment boost in a global uncertain context

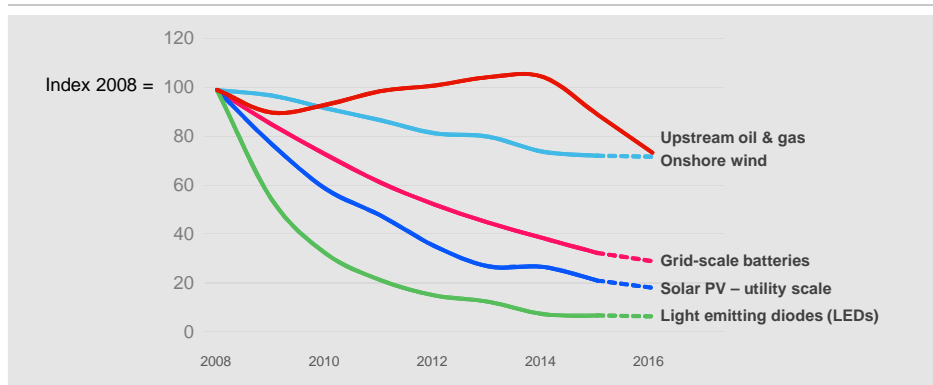
31/03/2017 Claudio Machetti



Technology cost reduction



Cost evolution for selected technologies 2008-2016



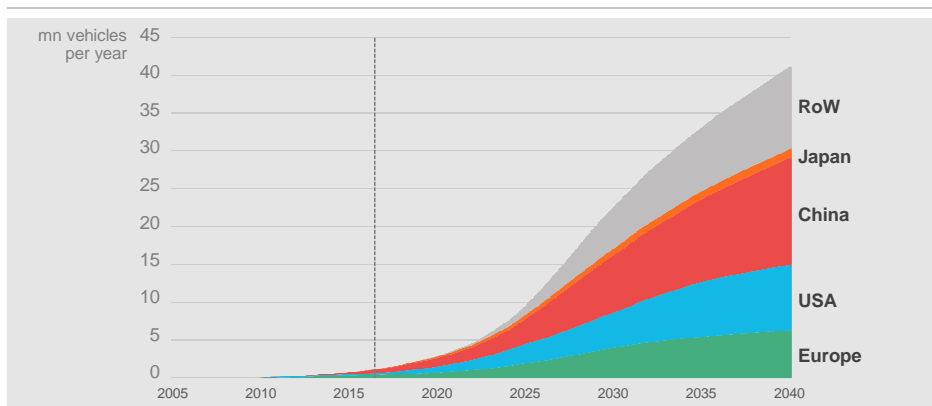
Rapid technology evolution strongly affects the energy sector

Source: IEA, World Energy Outlook, November 2016

Electric vehicles deployment



Global Electric Vehicle Sales 2005-2040



Electric Vehicles sales driven by rapid progress on technology

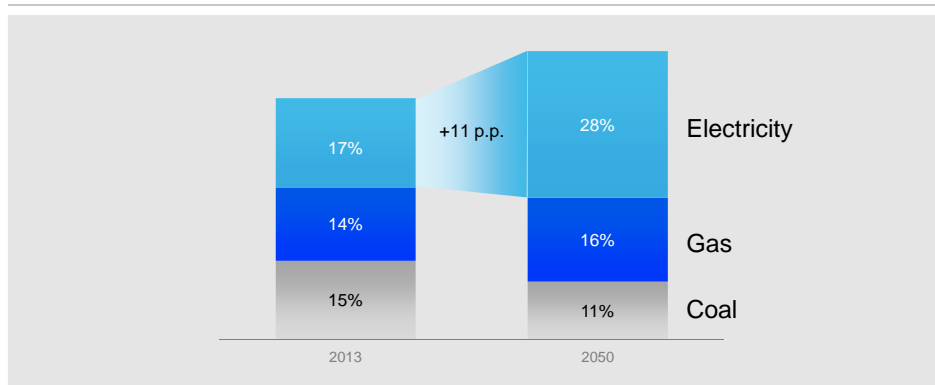
Source: BNEF, The future of electricity demand, June 2016

3

Energy demand trend



Final consumption by source (%)



Increasing use of electricity due to the switching from other sources

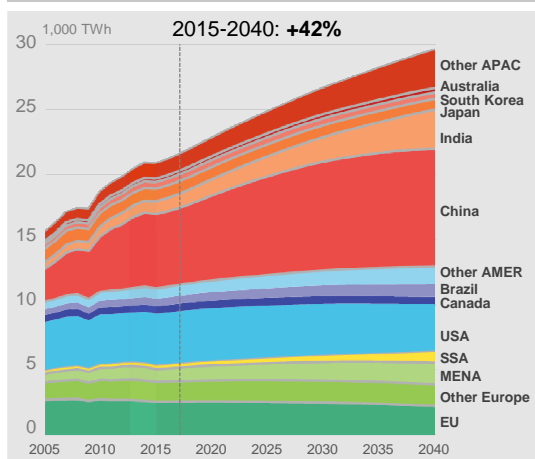
Source: IEA, Energy Technology Perspectives 2016

4

Electricity demand trend

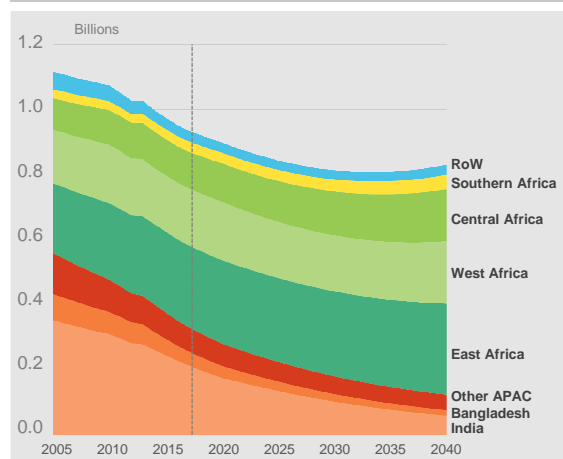


Global electricity consumption, 2005-2040



Source: BNEF. Note: MENA=Middle East and North Africa, SSA=Sub-Saharan Africa

World off-grid population, 2005-2040

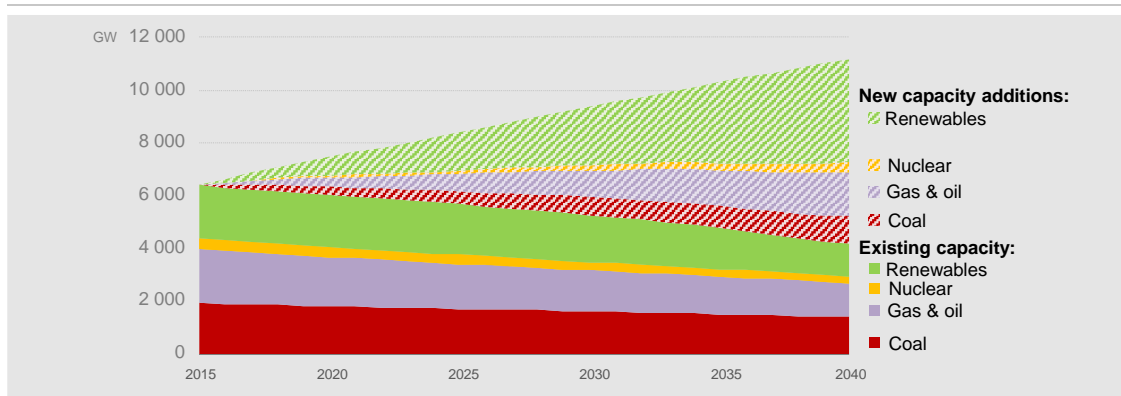


Source: Eurostat, BNEF

Supply mix evolution



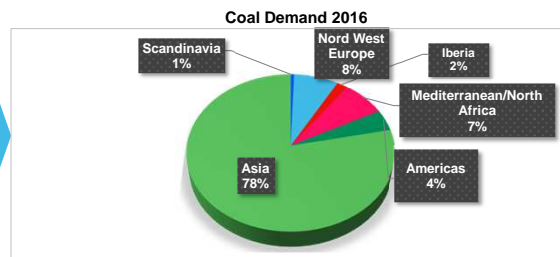
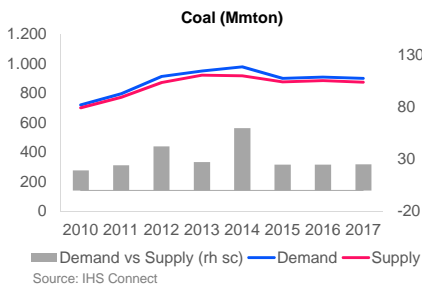
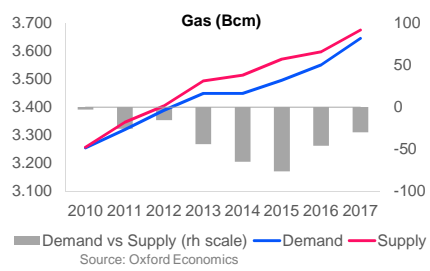
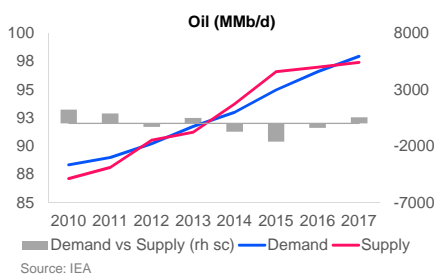
Global installed generation capacity



Renewables take centre stage to meet tomorrow electricity demands

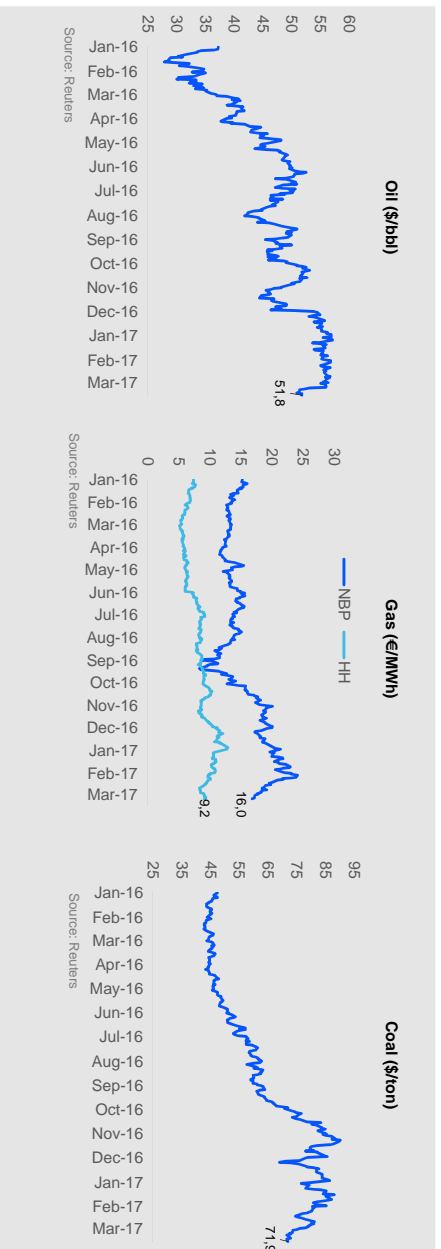
Source: IEA, World Energy Outlook, November 2016

World Commodity Balance



World Commodity Prices

Spot commodity prices

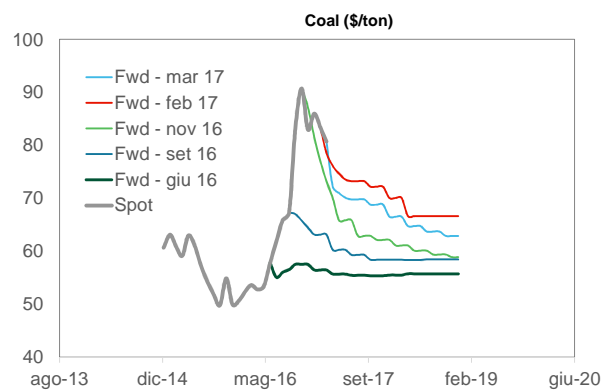


Chinese environmental concerns shapes the coal price dynamics



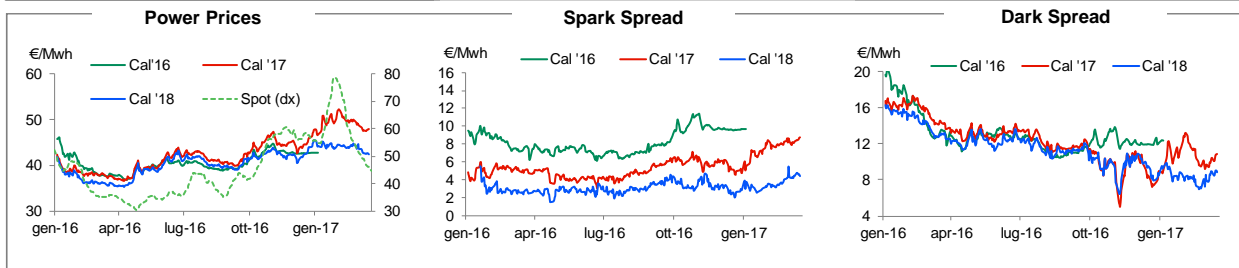
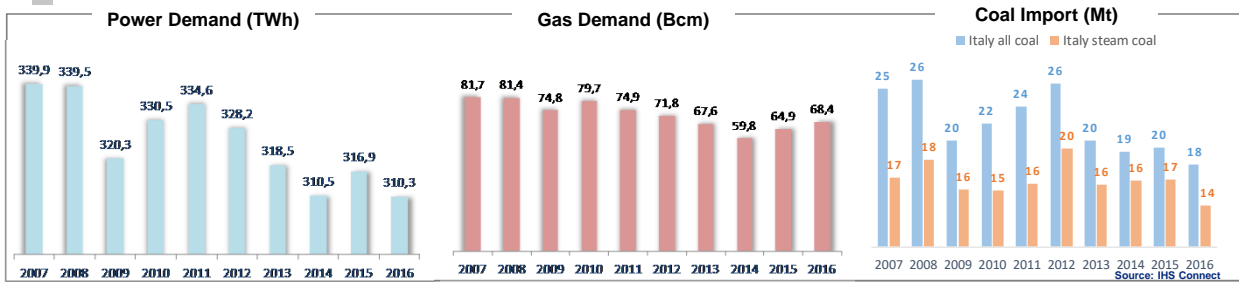
The Chinese environmental concerns has relevant effects on the coal price; in particular:

- The announced **cuts of domestic coal production** is increasing the tightness in the spot prices
- **Measures call for delaying or cancelling coal-fired power projects** and the **planned expansion of renewable power capacity** reduce the price expectation for the future



Focus Italiy

Demand & Prices Power, Gas, Coal

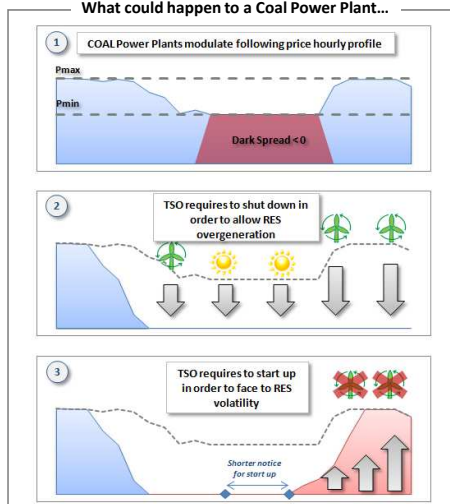


Coal Power Plants

Born to be BaseLoad...Acting as a Peaker



What could happen to a Coal Power Plant...



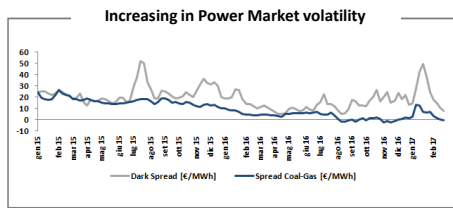
How RES generation and reduction in demand/Dark Spread have affected Coal Power Plant exploitation:

- Increasing in load modulation (higher machines consumption)
- Average operational load lower than the design one (lower efficiency)
- Lowering Minimum Power in order to reduce costs when Dark Spread < 0 (hardware investments)
- Increasing in shut down/start up for each produced TWh (higher machines consumption)
- Reducing in ramp rate timing (redesign of shut down/start up procedures and hardware investments)

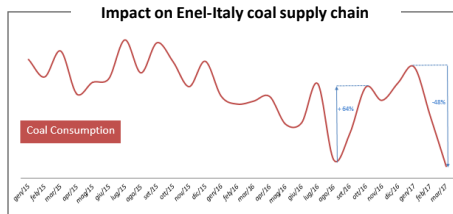
Catch market opportunities oblige to an higher complexity in technical and commercial management of Coal Power Plants

Coal Power Plants

POWER volatility affects COAL supply chain



- KEY DRIVERS:**
- Decrease in power demand
 - Growth of renewables
 - Gas to coal competition
 - Hydraulicity
 - Unpredictables (i.e. decrease of nuclear production in France)



- MAIN IMPACTS:**
- Fast changing production/consumption forecasting versus longer sourcing timeframe of reaction
 - Limited storage capacity management
 - New coal supply chain operational and commercial challenges

New paradigm of high consumption volatility address new operational and commercial challenges in the coal supply chain

Boosting power plant flexibility with energy storage

An innovative project concept currently under study



What battery energy storage can do, where compliant with local regulatory framework

- Provide frequency regulation services, allowing a steadier operation of conventional machinery, thus increasing lifetime
- Improve power plant response time to ancillary services, going beyond the state of the art performance of conventional plants
- Allow the power plant to run closer to its optimal efficiency, storing any excess power until needed by the grid and thus contributing to lowering emissions
- Minimize power plant unbalances vs. scheduled programs, contributing to reduce ancillary services needs procurement by the TSO
- Allow the power plant to temporary power boosts, above its current nominal power

Countries of potential application¹



1) Regulatory framework for Energy Storage Systems still under definition in ALL target Countries. Evaluations in progress.