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WEMO

World Energy Markets Observatory

20th Edition

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Agenda

- **Volatile commodities (oil, coal, gas) prices**
- **Climate change objectives are threatened**
- **Energy Transition is progressing but the road is bumpy**
- **Adequacy of supply is still fragile**
- **Retail markets are competitive**
- **China Energy transition strategic levers**

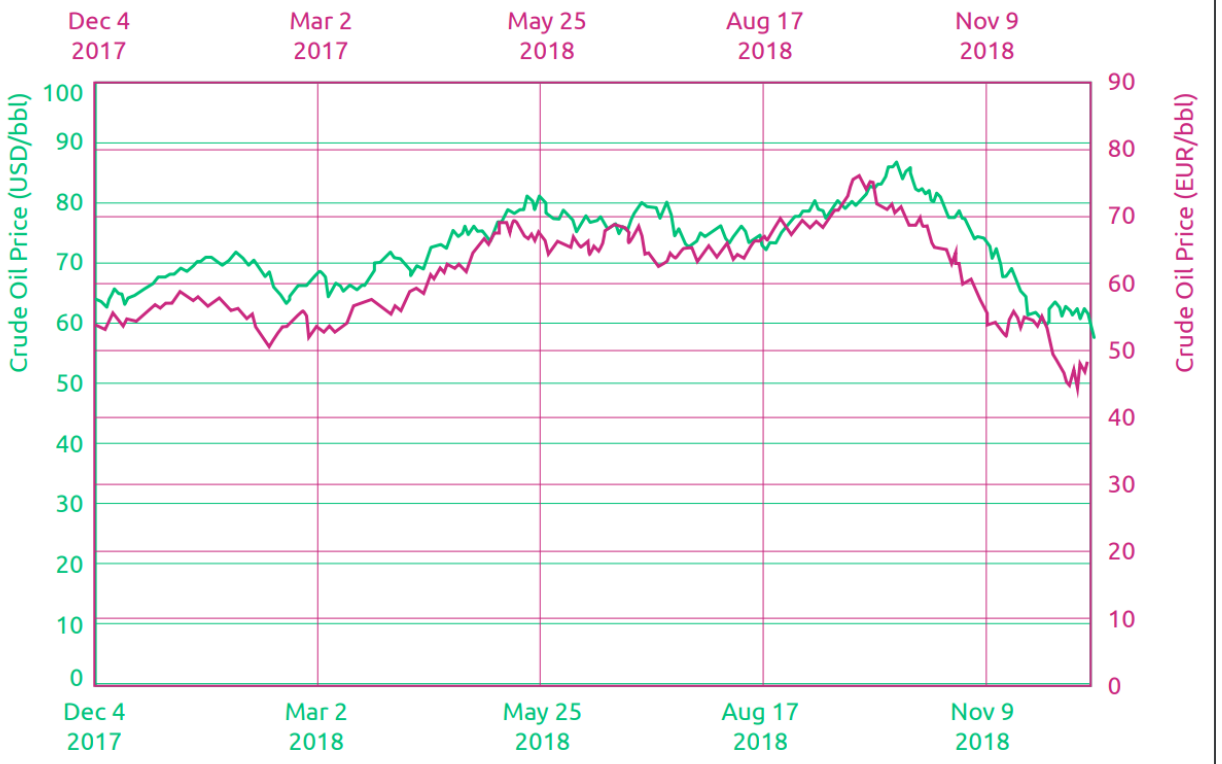
Volatile commodities prices

Volatile oil prices

In October 2018, oil prices rose to more than $80/b (first time since 2014) before falling below 60$/b at year-end

- Main reasons for oil price growth :
  - Economic growth
  - Geopolitical risks becoming significant (sanctions on Iran's oil exports, fall of Venezuela's oil output, unstable situation in Middle East …)
  - Limitation of OPEC and Russia supplies in order to push up the oil price
- Main reasons for oil price decline:
  - Global economy slow down
  - Waivers on Iran oil sanctions given to certain countries
  - The December 2018 OPEC/ Russia meeting decisions, failed to push prices up

Crude oil price evolution

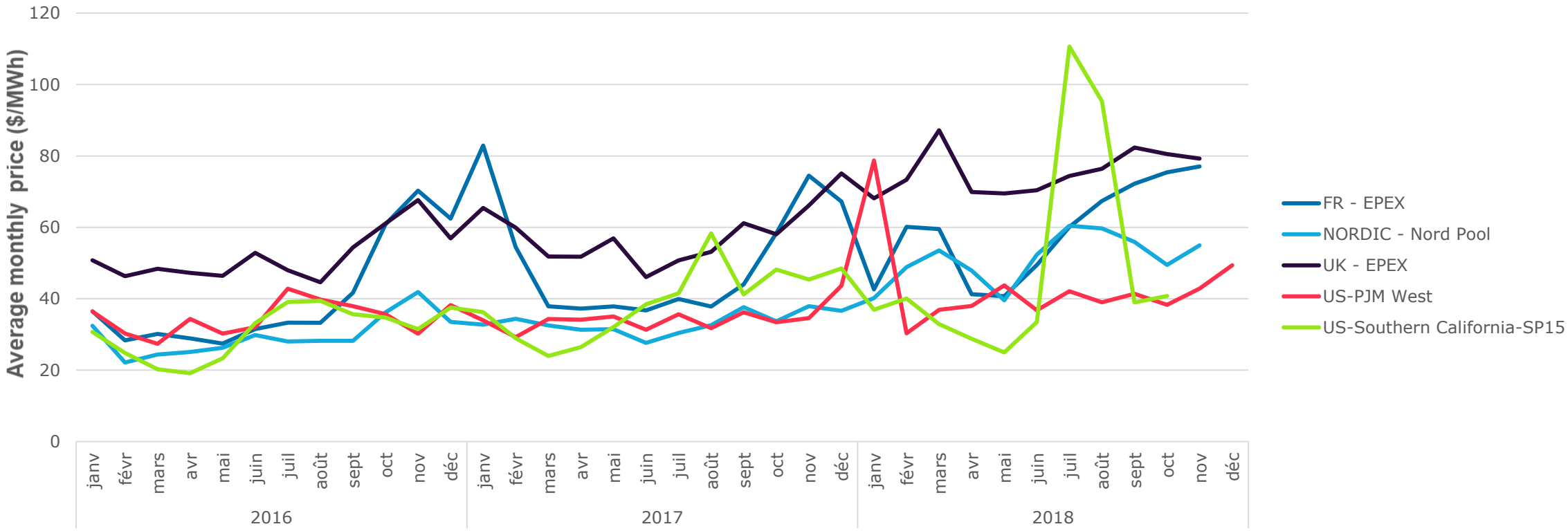


Source: http://www.infomine.com/investment/metal-prices/crude-oil/

Gas prices followed oil prices, coal prices were stable

A strong increase in carbon prices (from 7€/ to 23€/t) pushed electricity prices up. increase and supply/demand effects

Electricity spot prices on the main European and US markets (2017 and 2018)

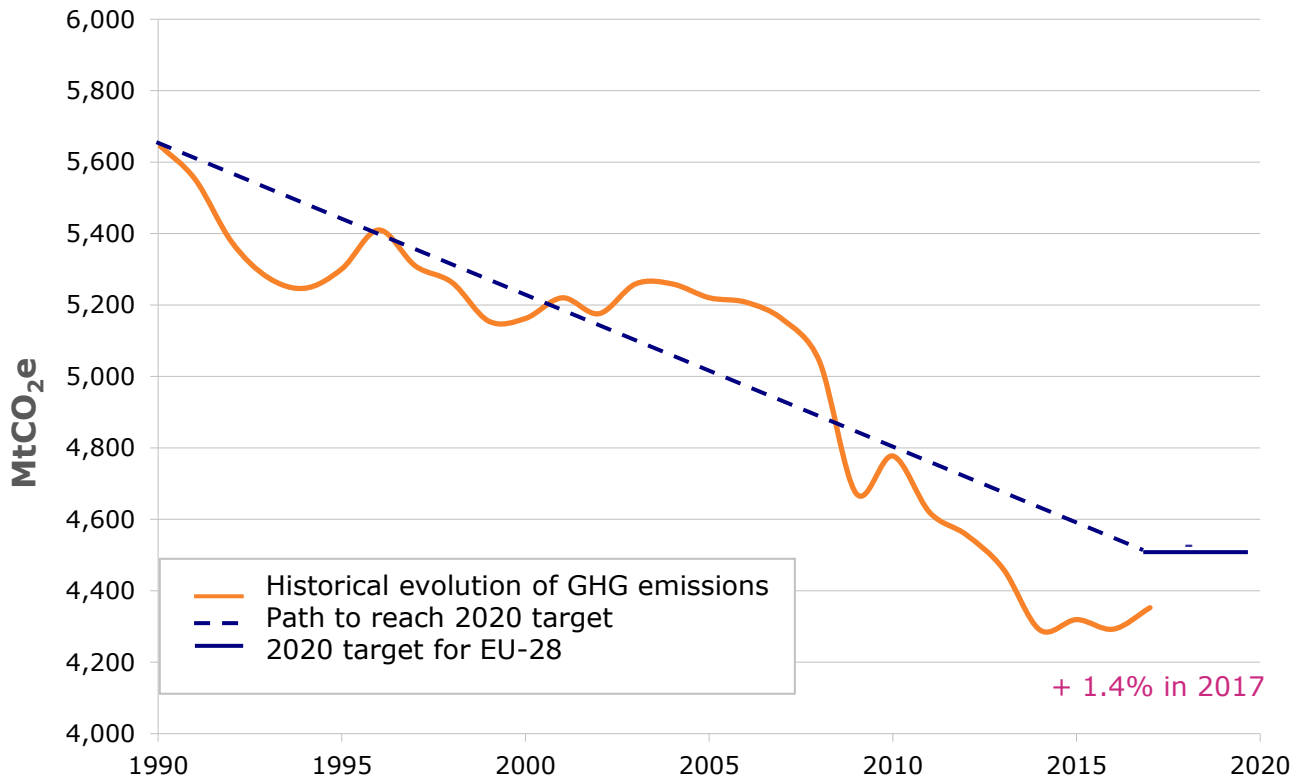


Electricity spot prices are sensitive to supply and demand adequacy and in Europe French nuclear plants availability is a key factor

Climate change objectives are threatened

Rebound of Green House Gas emissions questions the energy climate package efficiency

Greenhouse Gas Emissions evolutions and targets 2020



Source: Eurostat 2018 with data from the European Environment Agency and the European Commission 2018

+1.4 % emissions growth in 2017 triggered by economic rebound, pointing out insufficient energy efficiency measures and the need to reform the ETS

Utilities are decreasing their power CO_2 intensity

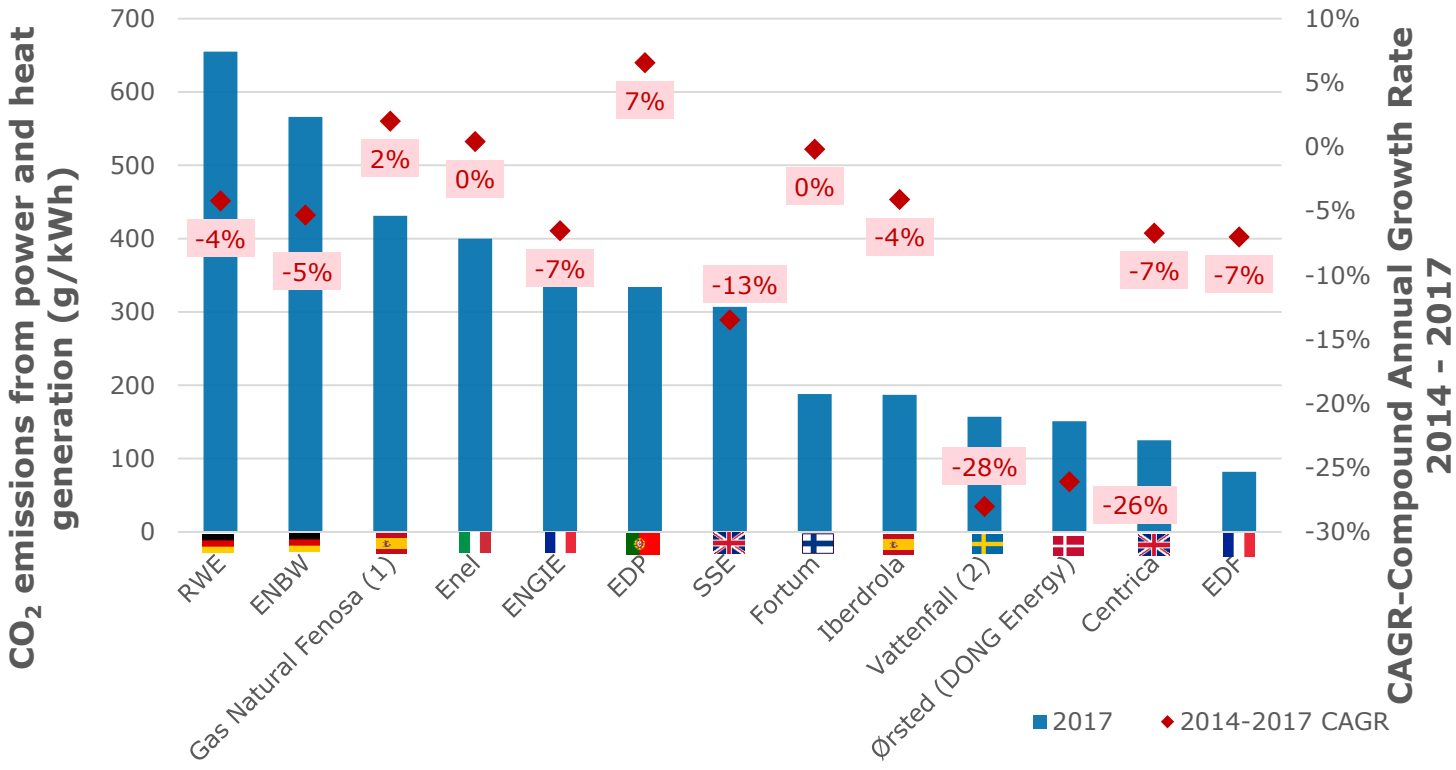
Carbon intensity decreasing, except for Naturgy* and EDP

- In France, combination of nuclear and hydropower leads to the lower CO_2 generation intensity (82g/kWh)
- German Utilities have the highest intensity due to their coal generation plants (655g/kWh)

*formally Gas Natural Fenosa

Except in Germany and Poland, Coal plants phase out is decided

CO_2 emissions from power and heat generation

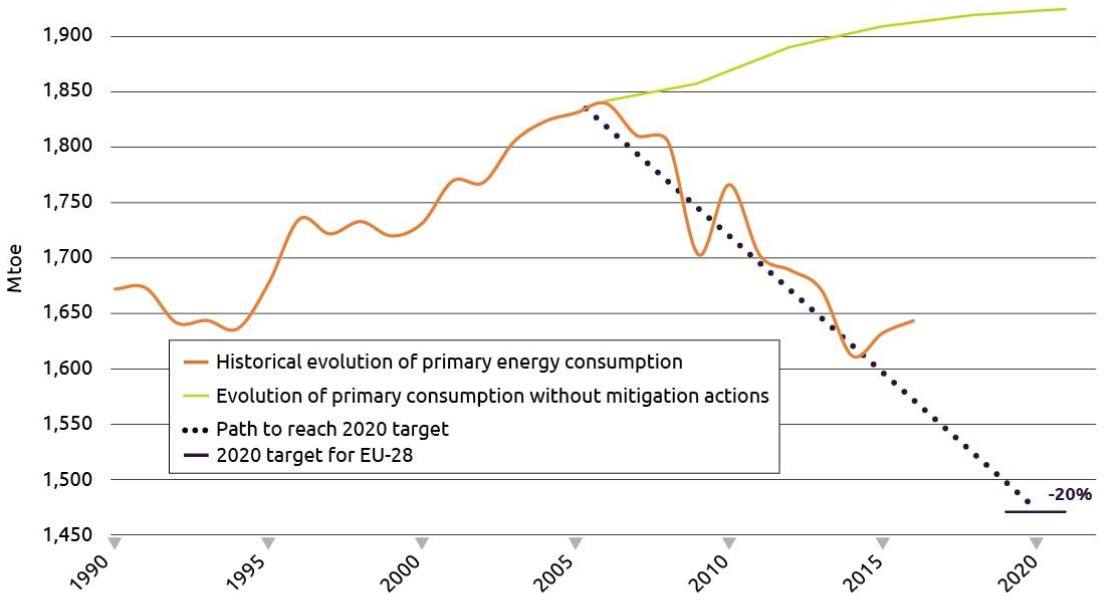


Sources: companies 2017 and 2018 annual reports.
2017 indicators calculated from CO_2 emission and generation reported in the annual report as companies don't communicate anymore on the CO_2 intensity.
(1) Gas Natural Fenosa has excluded generation from nuclear sector in its average CO_2 emission calculation. Nuclear representing 10% of the company mix for power generation, the total 2016 average CO_2 emission figure might be slightly lower.
(2) Vattenfall has reported its figures exluding lignite operations starting from 2015 despite divestments happened early 2016.

Energy Transition is progressing but the road is bumpy

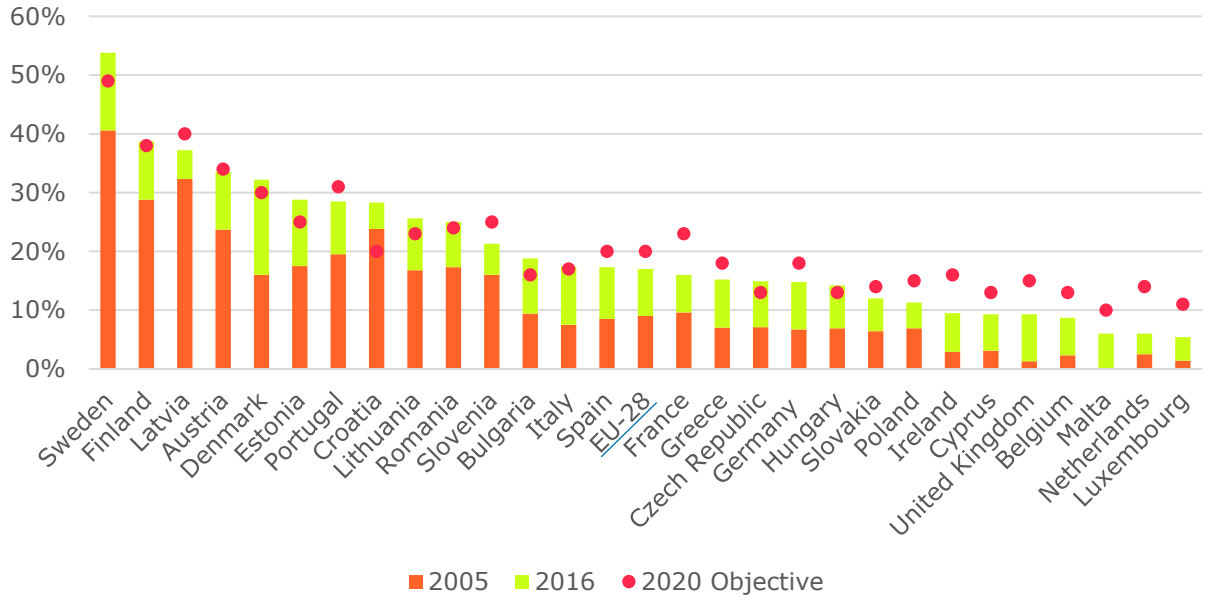
Recent results are worrying

EU primary energy consumption evolution and target to 2020



Source: Eurostat, Capgemini consulting WEMO2018I did

Share of Renewables in the Member States gross final energy consumption



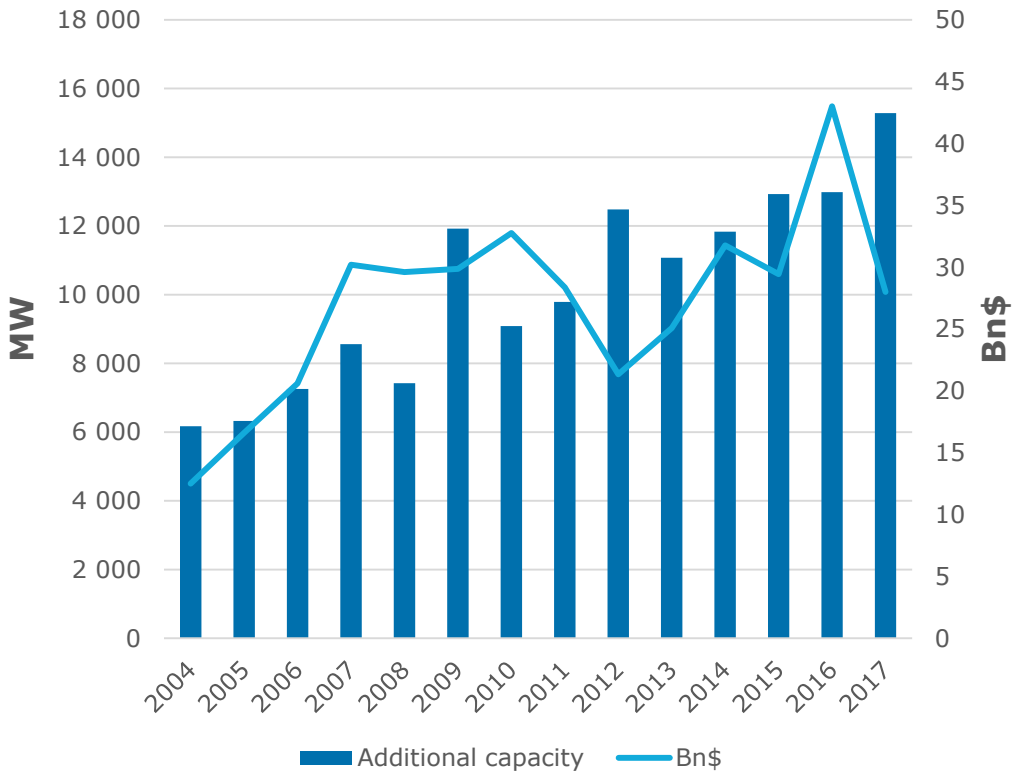
Eurostat 2018-2016 figures

The EU is likely to miss its 2020 energy efficiency target

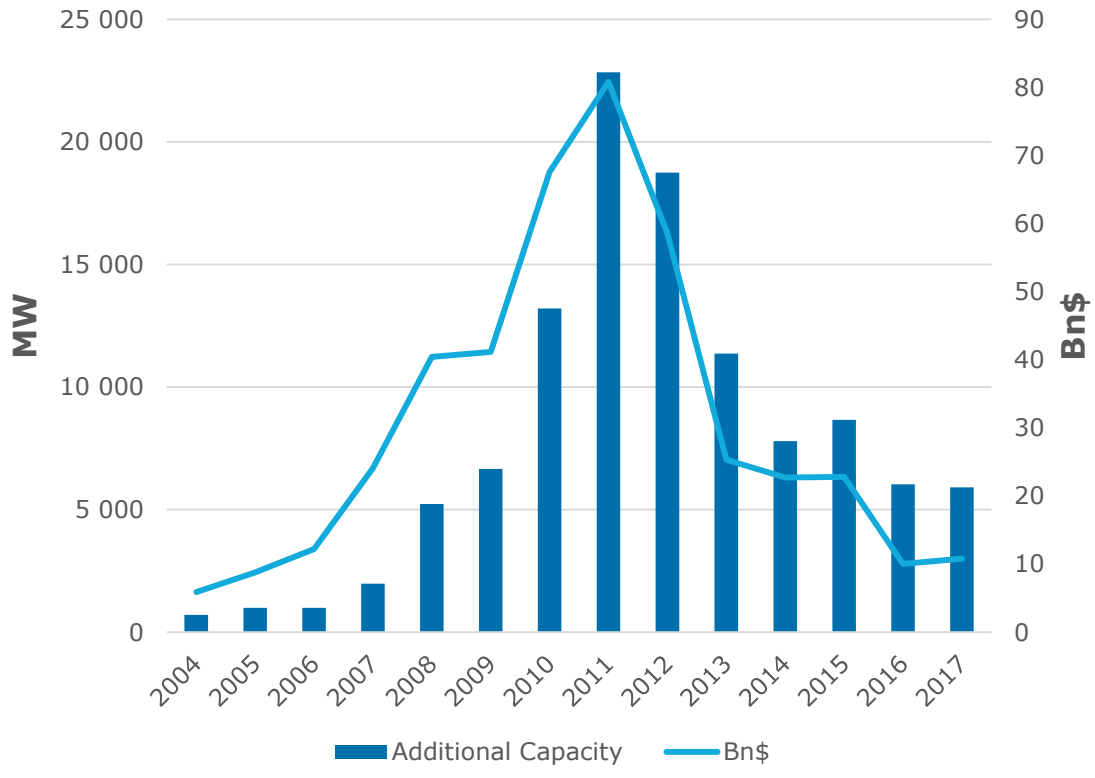
The EU is on track to meet its 2020 renewables target even if the achievements vary from one country to another

Thanks to costs decreases, despite a slow down in Europe renewable investments, commissioned capacity grew

New Onshore Wind investments in Europe 2004-2017



New PV investments in Europe 2004-2017



Source:
IRENA 2018

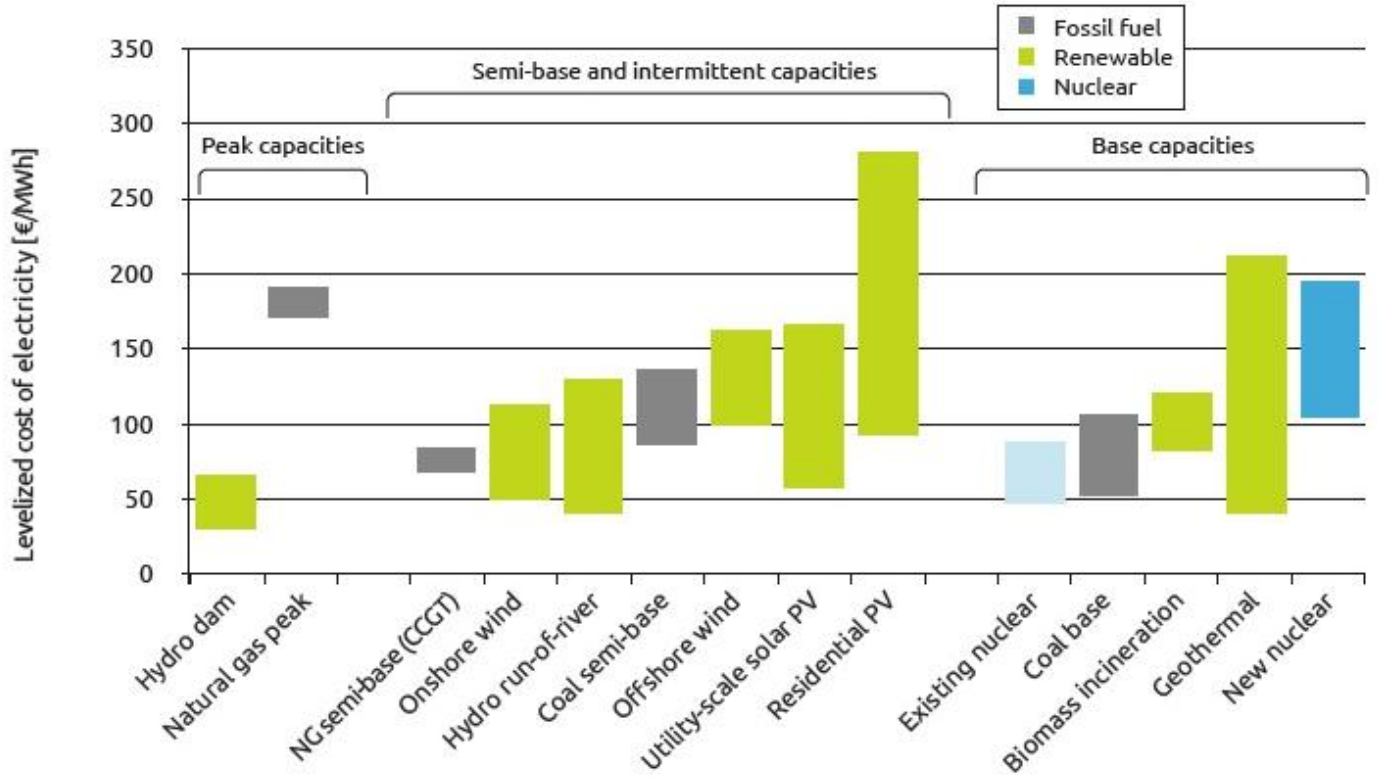
Onshore wind investment decreased related to lack of suitable sites and local oppositions

Average wind and solar utility scale farms costs have come down in 2017 by ~20% compared to 2016

Onshore wind and solar PV are most cost-competitive sources of power generation for semi-base generation

- Rapid fall of system costs/ costs reduction were more limited for onshore wind than for Solar PV
- China is a dominant supplier of PV panels: while US decided to impose custom tariffs on Chinese PV panels, EU has lifted them
- Existing nuclear generation is the most cost-competitive baseload generation
- The first EPR (1600 MW) started commercial operations at Taichan (China) on June 2016

Levelized cost of electricity (LCOE) comparison - selected power generation sources in Europe



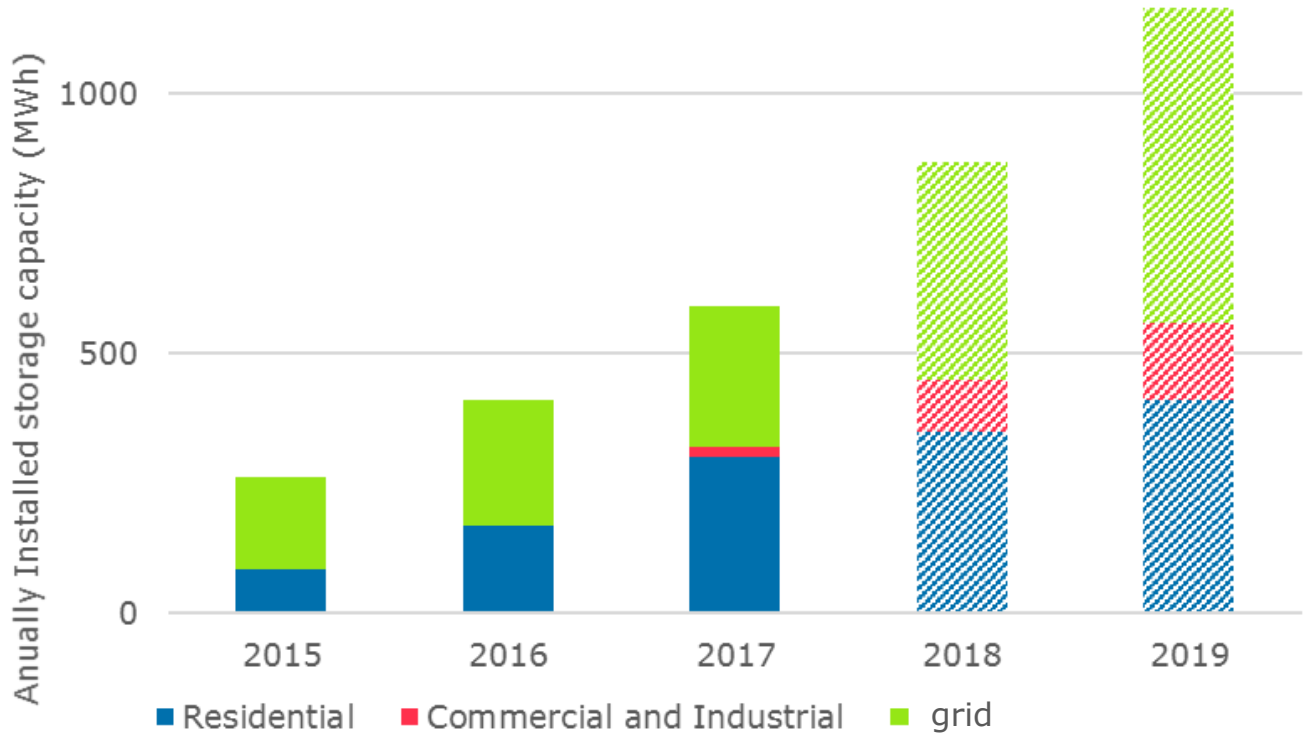
Intermittent renewables increase by 15-40% the grid management costs

The electricity storage market continues to grow; different usages and business models are developing

Battery technologies are progressing quickly triggered by electric vehicles and large stationary batteries development

- Lithium-ion is today the reference technology but there are others technologies including solid state batteries that are developing
- Future battery challenges are:
  - recycling
  - safety
  - energy density increase
  - weight decrease
  - increased number of possible cycles
  - quick charging
  - rare metals availability

Annually Installed Electrical Energy Storage Capacity (MWh)



Battery costs were divided by 5 in 10 years and should continue to decrease from around $200/kWh in 2017 to below $100/kWh in 2025-2035 if commodity prices remain stable

Source: European Market Monitor on Energy Storage (EMMES), EASE and Delta e-e

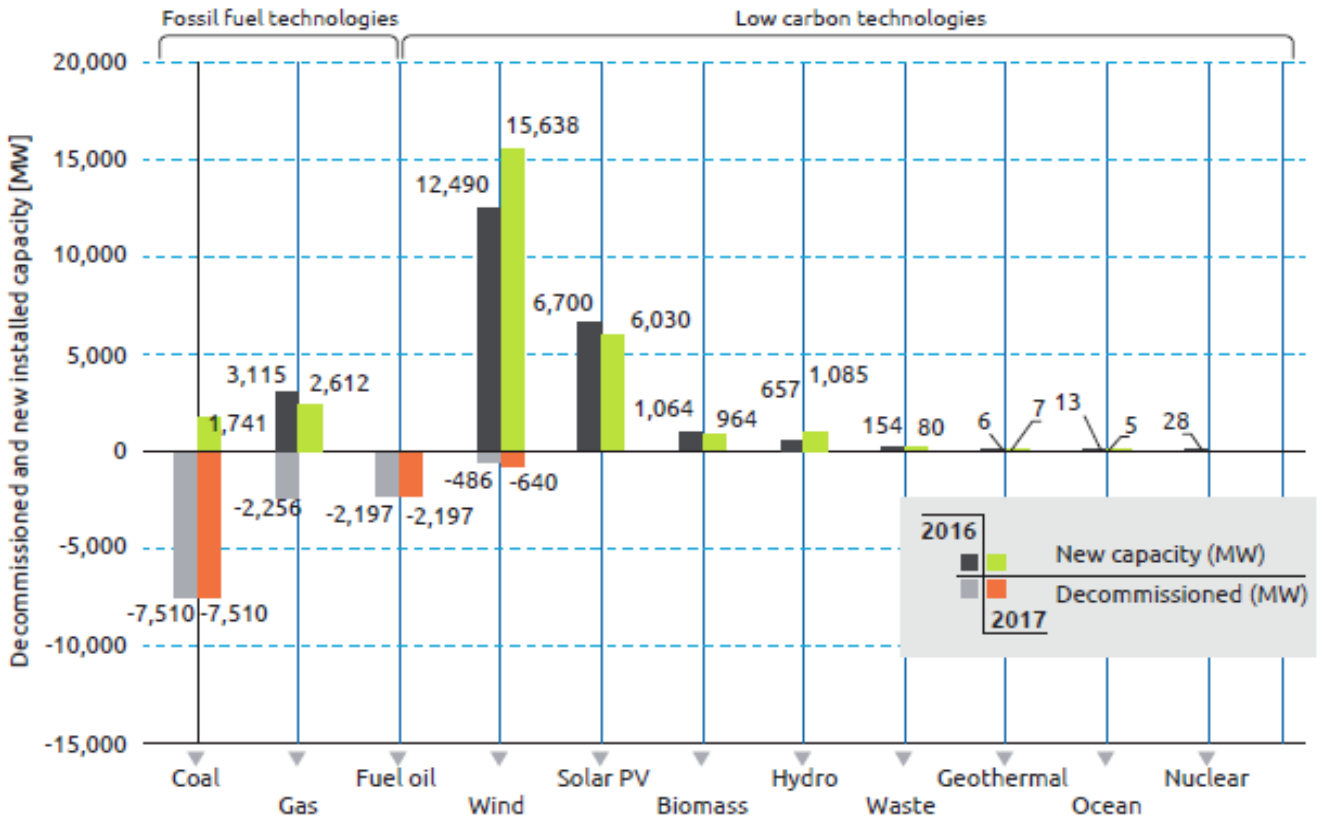
Adequacy of supply is still fragile

Net EU power capacity increased by 17.8 GW (1.8%) in 2017 but schedulable capacity decreased

10.3 GW fossil fuel capacity decommissioning was compensated by 28.1 GW of new capacity

- With 15.6 GW capacity installed in 2017, wind broke a new annual record
- Fossil fuel capacities continue to be decommissioned in the EU, with a decrease of 10.3 GW in 2017
- No gas plants decommissioning in 2017 led to a 2.6 GW net capacity increase

Installed and decommissioned generation capacity per type of source (2017 versus 2016)



Source: WindEurope Annual Statistics 2017

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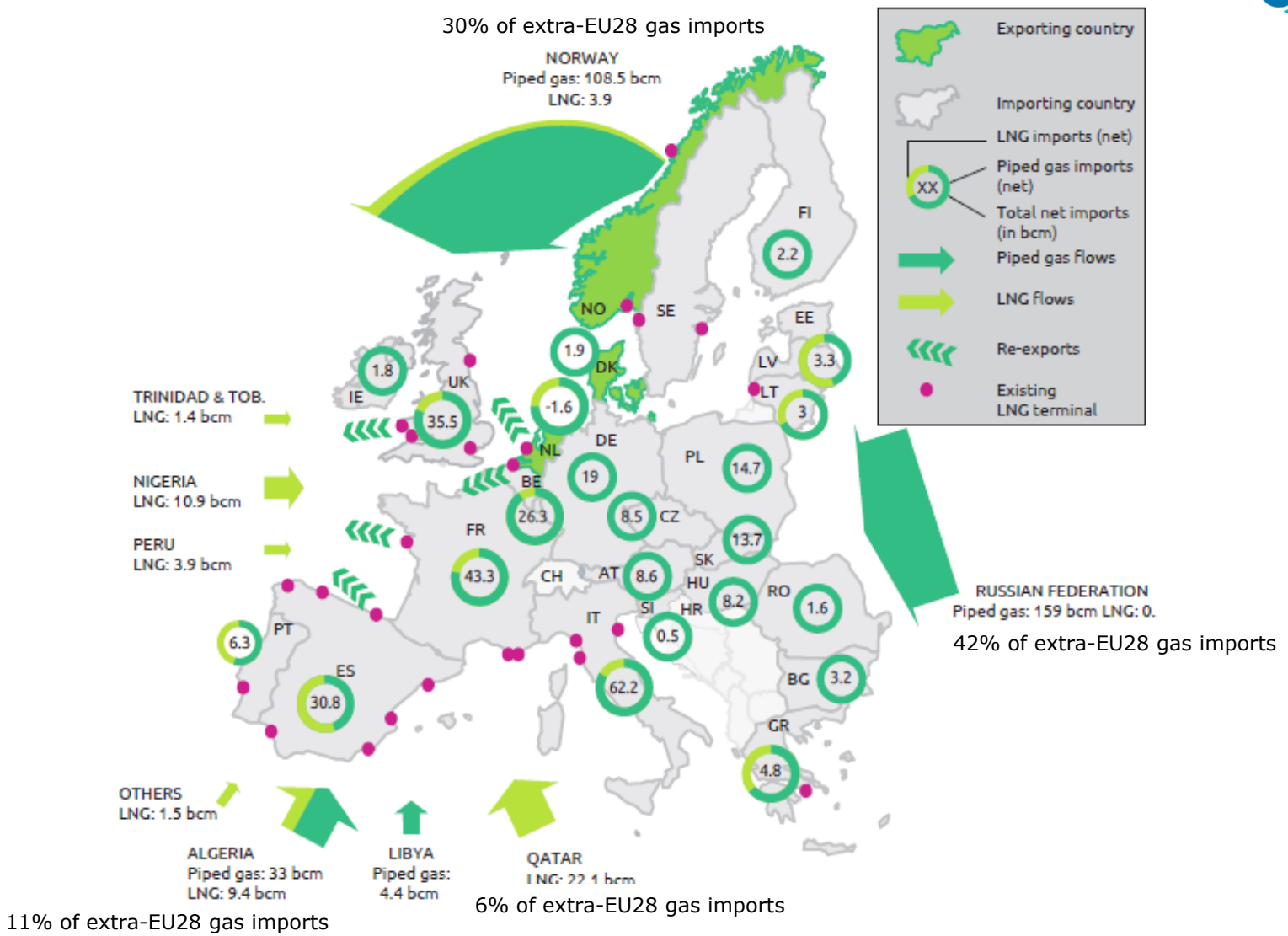
EU28 is more and more dependent on Russian supplies

- EU28 (Norway excluded) gas security of supply decreased with increased importations (69% in 2017)
- Gazprom increased its market share to 35% of consumption (+8% compared to 2016)
- Nordstream 2 works started by mid-2018. When completed it will reinforce Europe dependency on Russian gas
- LNG regas terminal are used at only 25% of their nominal capacity



If Germany phases out its coal generation plants, it will become even more dependent on Russian gas

Note: Others = Brazil, Equatorial Guinea, Egypt, Angola, United Arab Emirates
Source: BP statistical review of world energy 2018, GIIGNL – Capgemini analysis, WEMO2018

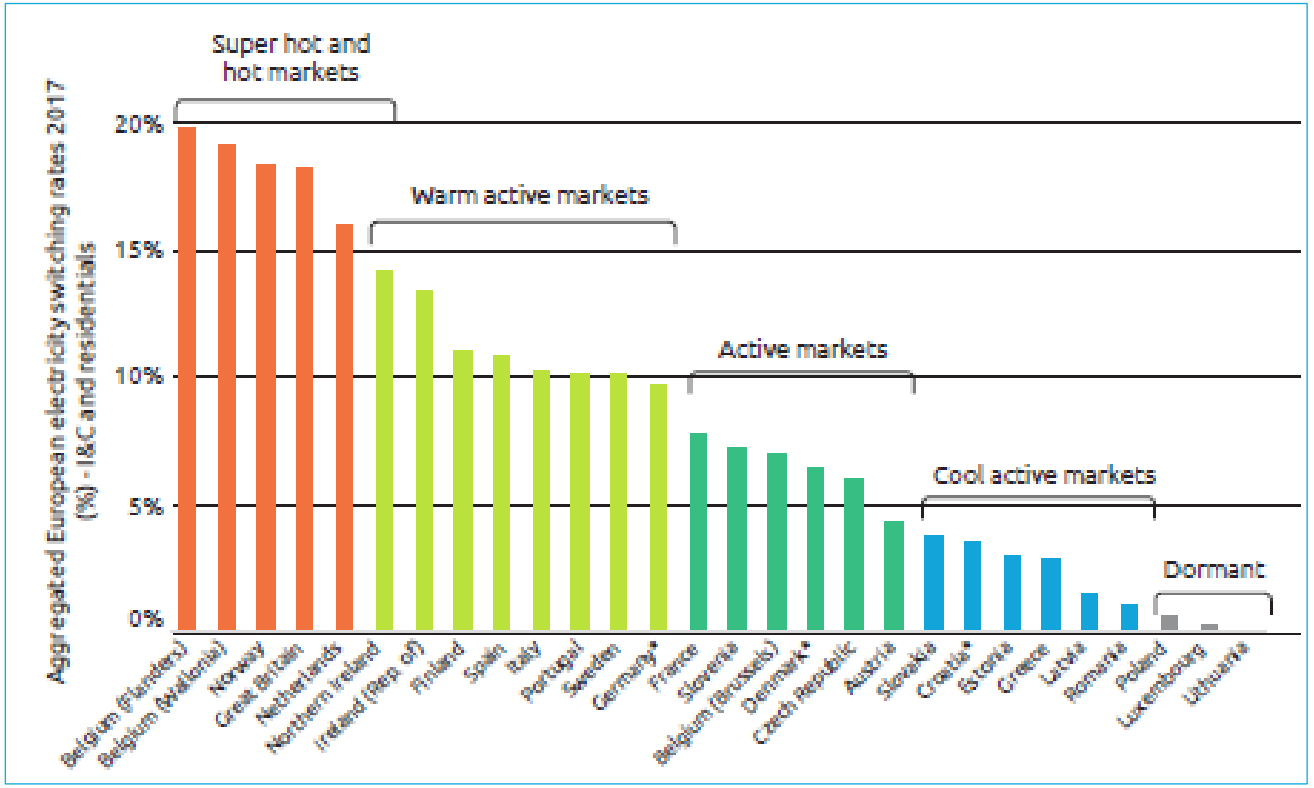
Retail markets are more competitive

Electricity retail markets are more competitive

0,5% overall average increase Year on Year

- Flanders, Norway, Netherlands and Great Britain remain the most active markets in Europe
- In the active markets, France progressed from the 3rd rank to the 2nd one
  - In France, the number of alternative electricity suppliers increased from 32 (in 2015) to 38 (in 2017)
  - Big companies as Total are confirming their presence in the retail market

Electricity European switching rates

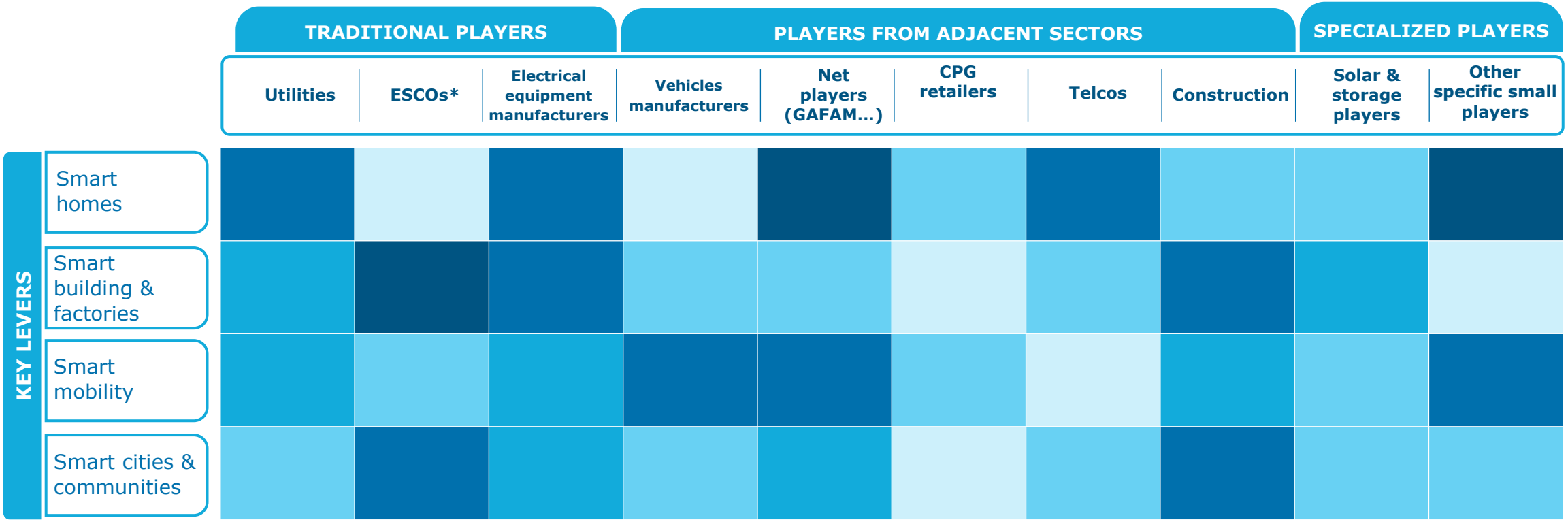


Source: VaasaETT Utility Customer Switching Research Project

Will medium size alternative players survive or will they be absorbed by larger groups?

Electricity retail markets players are already diverse today

Players types heatmap on key levers



*ESCOs: Energy Service Companies

Level of activity of the players → 0 1 2 3 4

Cooperation, eco-systems and digitization are key success factors

Source: WEMO 2018 – Capgemini Consulting Analysis

China Energy transition strategic levers

China is becoming an electricity European player

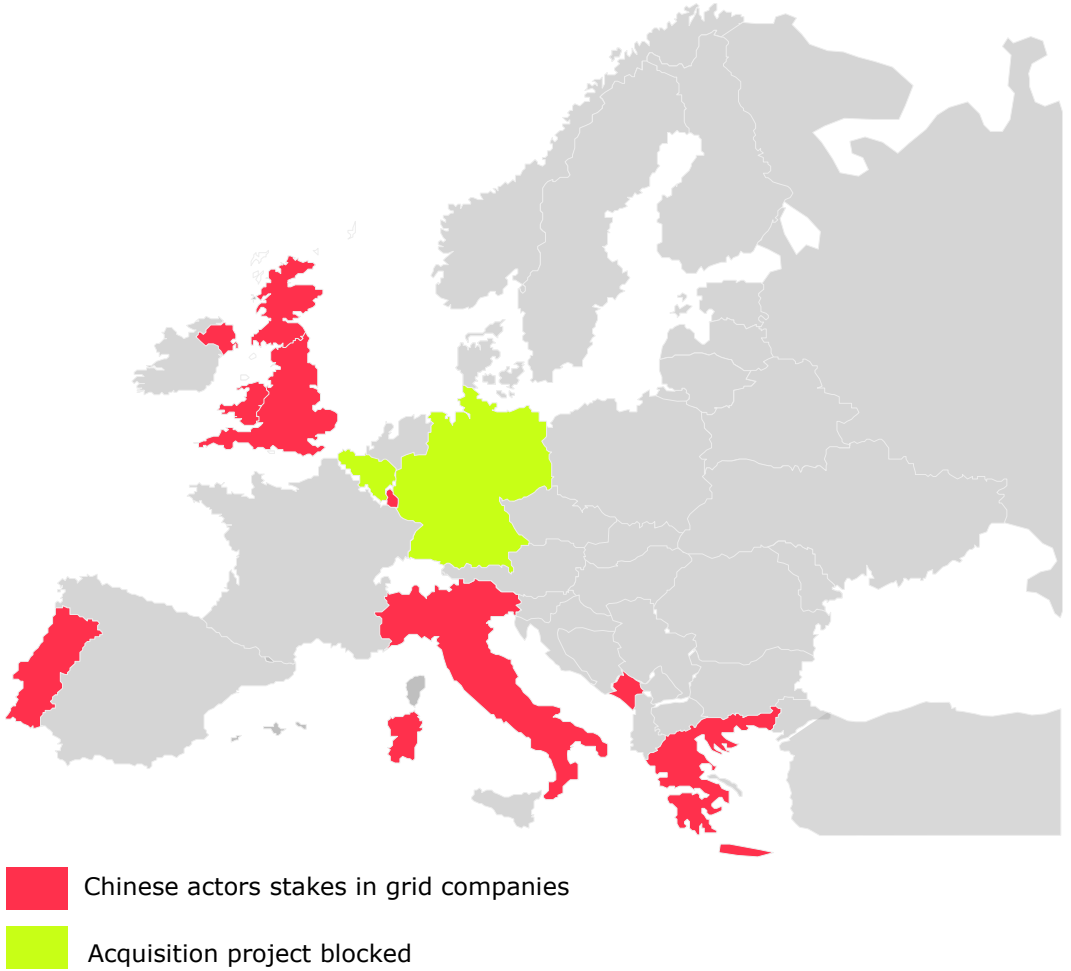
2012 — Acquisition of 25% of REN (PT)

2014
- Acquisition of 35% of CDP Reti (IT)
- Acquisition of 3% of Enel (IT)
- Acquisition of 33% of EneMalta (MT)

2016
- Acquisition of 11% of National Grid (GB)
- Acquisition of 24% of Public Power Corp. (GR)

2017
- Acquisition of 75% of Copelouzos (GR)
- Acquisition of a minority stake in EDP (PT)

2018 — Acquisition of 24.9% of Encevo (LU)



With a long-term policy, China is investing in European electricity grids

Source: Note 16/18, Fondation pour la recherche stratégique, 2018

China is a dominant player in energy transition

- China is the second largest energy consumer and the first largest GHG emitter
- Rare earth and rare metals: 30% of worldwide reserves and 95% of production
- The first exporter of:
  - coal plants
  - PV solar panels
- The largest investor in electricity batteries
- A significant player in wind power and nuclear energy

China has perhaps an ambition to add to road, maritime, rail road, an electrical BRI (Belt & Road Initiative)

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Thank you!