

Clean Energy

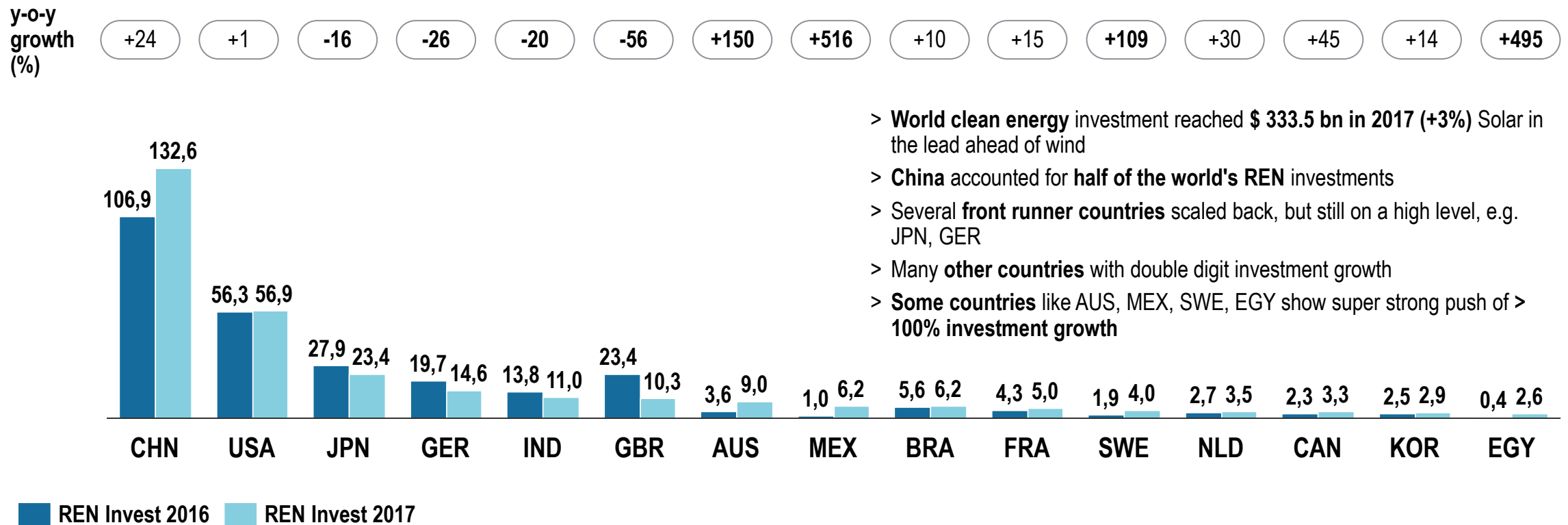
Growth perspectives and
strategies of key players

Atomexpo Sochi
– New Energy Session



REN investment growth continues. Front runner countries keep high level and there are follower countries with very steep growth

Renewables investment in top 15 countries 2017 vs. 2016 [USD bn]



- > **World clean energy** investment reached \$ 333.5 bn in 2017 (+3%) Solar in the lead ahead of wind
- > **China** accounted for **half of the world's REN** investments
- > Several **front runner countries** scaled back, but still on a high level, e.g. JPN, GER
- > Many **other countries** with double digit investment growth
- > **Some countries** like AUS, MEX, SWE, EGY show super strong push of > 100% investment growth

Until 2040 IEA projects ~ \$19 trillion investment in the power sector - ca. 37% of that accounts for renewables (solar, wind, bio, hydro)

What are the drivers of this growth and how are players responding to this?

Major drivers shaping renewables power generation industry going forward

1 Steep decline in REN cost

- > Onshore wind already competitive
- > Offshore wind cost in steep decline
- > PV cost competitive, if installed in adequate environment
- > Technology and auctioning pushes cost further down

4 New approach by Utilities & OEMs

- > Strong emphasis of renewable investments, particularly wind power and also solar
- > Also strong investment in energy storage to benefit from attractive price windows
- > Some players set up separate companies
- > Some first cases of VC split, e.g. RWE / e.on
- > Also OEMs are responding to the transition



Renewable
energy
drivers and
trends

2 COP21 and new regulatory

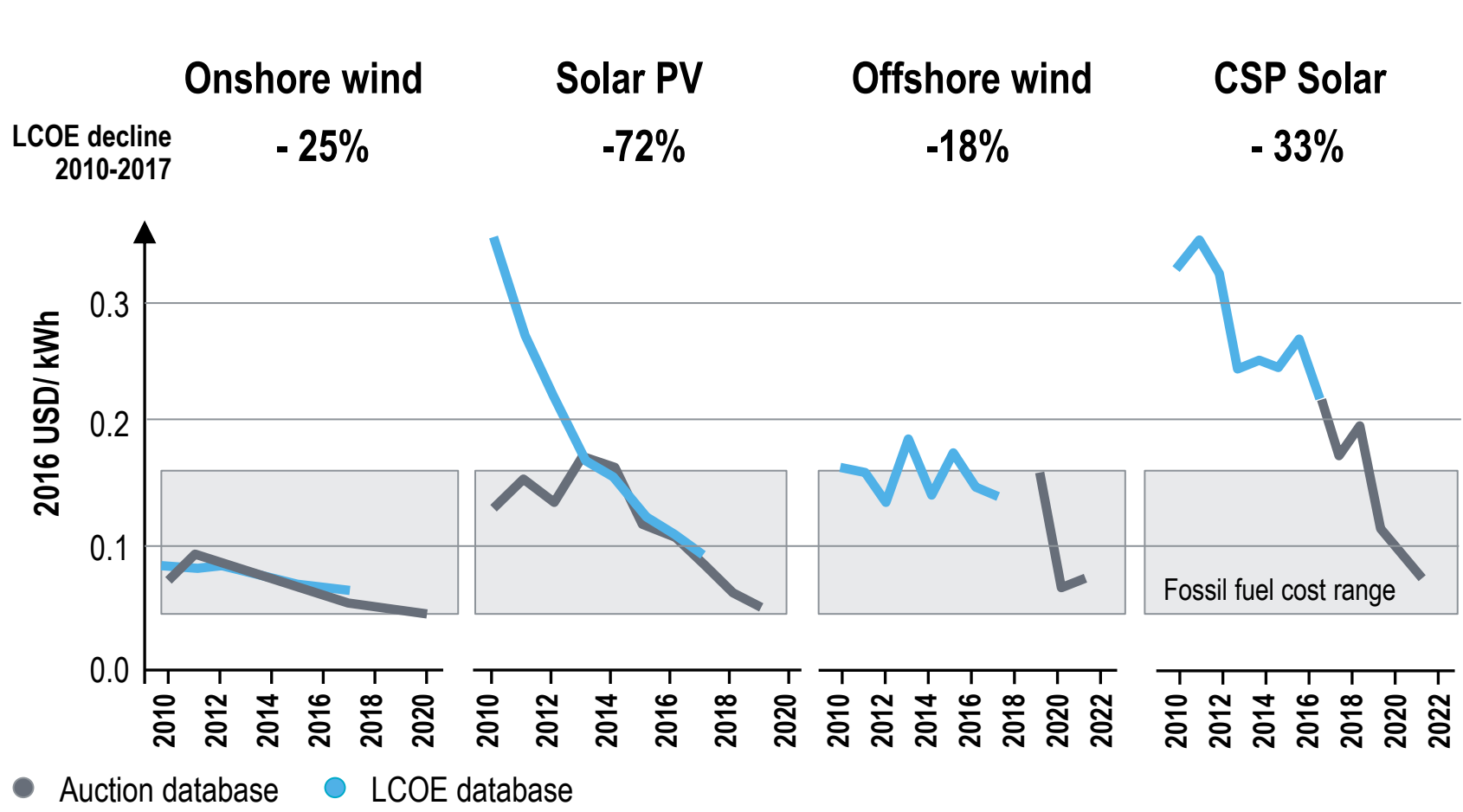
- > More than 170 countries signed agreement
- > Commitments are converted into national laws and policies on a broad basis
- > Low cost allows new regulatory approach
- > This generates large REN markets
- > Also Russian players could benefit

3 Further Technology Innovation

- > Smart digital technologies on the rise
- > Energy storage solutions
 - Battery cost falling steeply – much more expected
 - Thermal storage
 - Power-to-x and gas storage

Massive and ongoing decline in cost will make power from utility size solar and wind consistently cheaper than conventional energy

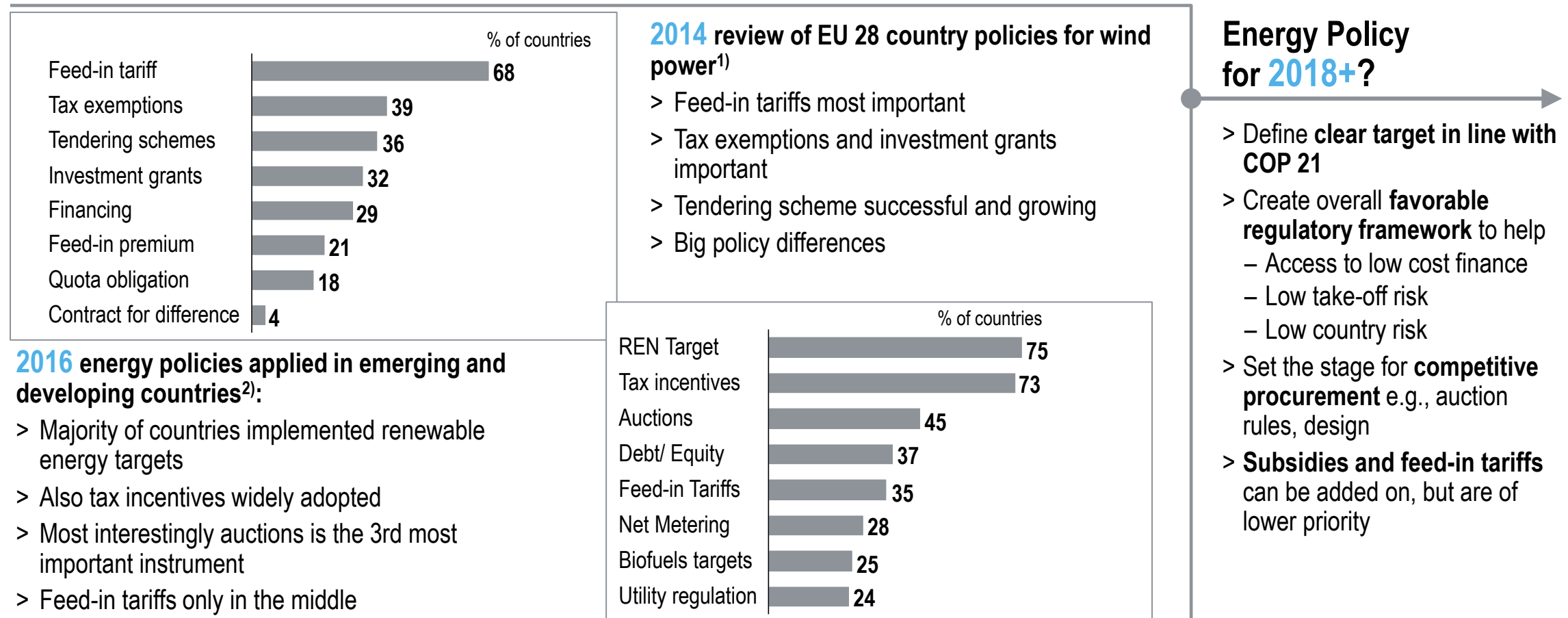
Global levelized cost of electricity (LCOE) and auction price trends from project and auction data, 2010-2022



- > By 2019, the best onshore wind and solar PV projects will be delivering electricity for an LCOE of USD 0.03/kWh or less
- > The decline is continuing
- > CSP solar and offshore wind will provide very competitive electricity from 2020 onwards
- > Because of low cost IEA expects ~4,800 GW extra capacity

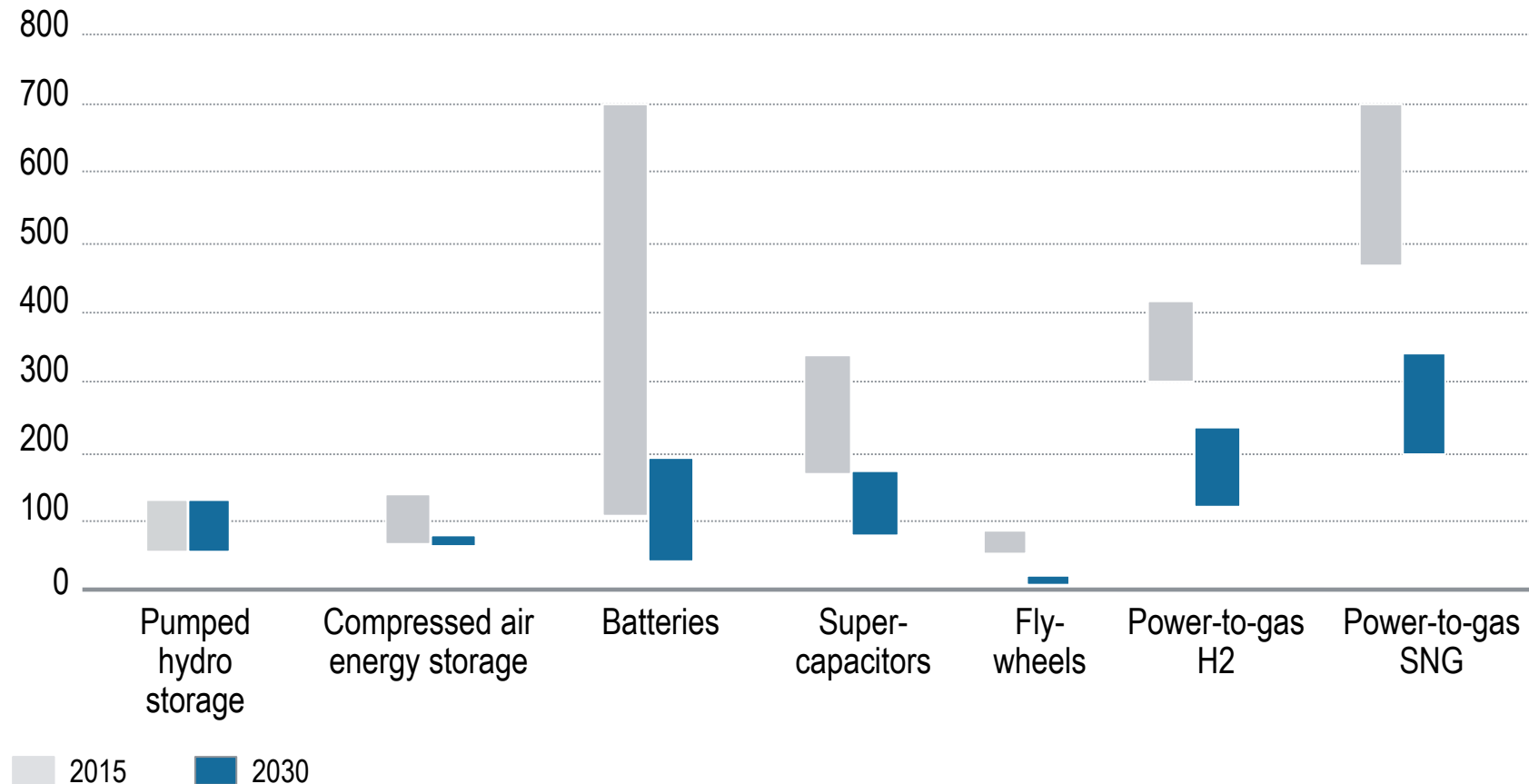
With REN energies being competitive vs. conventional there is also an opportunity to shift emphasis to a new type of policy frameworks

Examples: Clean energy policies currently and in the future



The innovation is continuing: Also for energy storage solutions steep decline of costs is expected

Energy storage: Levelized costs of storage, 2015 vs. 2030 [EUR/MWh, 2014 price level]



- > Also cost for energy storage is seeing many innovations
- > Across the board this results in substantially lower cost
- > **Energy storage** offers many **benefits for utilities**
 - **Stability** to the grid
 - Take advantage of **attractive tariffs**
 - **Serve the customers** also at times of no wind or no sun

Energy storage cost expected to be down by 40 – 70% until 2030

Looking at strategies of leading European utilities players they are all massively pushing renewables and energy storage

Strategies of Selected European Utilities Players

IBERDROLA "Utility of the future"

- > **Focus:** Renewable energy, customer solutions and smart networks – driven by digital, efficiency focus and partnering
- > **Net investments of EUR 32 bn until 2022** (+4 bn vs. 2017) – with 12 bn (37%) in renewables – mostly wind
- > Renewables **capacity** +24%; **energy storage** +25%
- > Energy storage: **Make money when power prices** are good

EDF "Strategy CAP 2030"

- > Strong footprint in carbon free **nuclear - extend lifetime**
- > **Renewables** energy bundled in **EDF Energies Nouvelles (EN)**
- > Clean energy plants in **22 countries** (develop, build, operate)
- > **2016:** Goal to **double renewable energy capacity** worldwide from 28 GW (incl. hydro) to 50 GW **by 2030**
- > **2018:** EDF goal to develop **10GW of additional storage** by 2035 (on top of current 5GW) to **be a storage leader**

RWE

- > E.ON and RWE **badly suffered in the past:** Nuclear phase-out, deregulation, low gas and power prices
- > In **2016 both split activities** into fossil (F) and renewable parts: E.ON (R) / Uniper (f) and RWE (F) / innogy (R)
- > In 2018: Radical swap deal between E.ON and RWE:
 - **RWE focus: Renewables generation, fossil, trading**
 - **E.ON focus: Distribution / grid and customers**

ENEL "Leading the energy transition"

- > **Decarbonization is one of 3 strategic pillars** next to electrification/ demand response and urbanization
- > Targets **for 2020:**
 - **48 GW renewables (+20% vs. 2017)** with investment of EUR 8,3 bn
 - Reduction of 36 GW thermal (-17% vs. 2017)
- > Creation of **600 MW storage capacity**

Taking EDF's energies nouvelles (EDF EN) as example: They are implementing a very ambitious renewables strategy

EDF EN Strategy: CAP 2030 and Solar Power Plan key pillars and execution examples

EDF EN Strategy

CAP 2030: Double the Group's installed for **renewable** energies
28 GW in 2015 to >50 GW in 2030

Key elements

- > **Low-carbon** energy investment
- > **International expansion**
- > **Innovation**
- > **Partnerships**

EDF Solar Power Plan:

Expand solar capacity in France from 7.4 in 2017 to 30GW until 2035

EDF EN Integrated Skills

Development



- > Land search
- > Energy yield assessment
- > Environmental impact
- > Consultation
- > Project management

Construction



- > Engineering
- > Works management
- > Procurement;
- > Logistics

Asset management



- > Asset manager services;
- > Contractor relations;
- > Production monitoring;
- > Asset disposal

Operations and Maintenance



- > Scheduled maintenance
- > Purchasing / Inventory
- > Supervision of power plants
- > High-level engineering

Strategy Implementation (selected examples)

REN Investment

- > **Project acquisitions** in EU, Americas
- > **2017/07 UK** – EDF EN buys 11 wind **farm projects** under development from Partnerships for Renewables
- > **2017/07 EU** – **Futuren** acquisition
- > **2017-06 Brazil** - Acquisition of multiple **projects** in Brazil

Partnerships

- > **2018/02 China** – **JV** with Asia Clean Capital (“ACC”)
- > **2017/11 India** – **partnering** with EREN Renewable Energy for solar
- > **2017/10 Egypt** - **Partnering** with ELSEWEDY ELECTRIC
- > **2016/05 France** - **Partnership** with Enbridge for French offshore wind

International Expansion

- > **2018/05 UAE** - Commissioning of DEWA III solar power
- > **2017/05 RSA** - Entry into South Africa market
- > **2016/07 China** - Market entry by acquisition of majority in UPC Asia Wind Management (AWM)

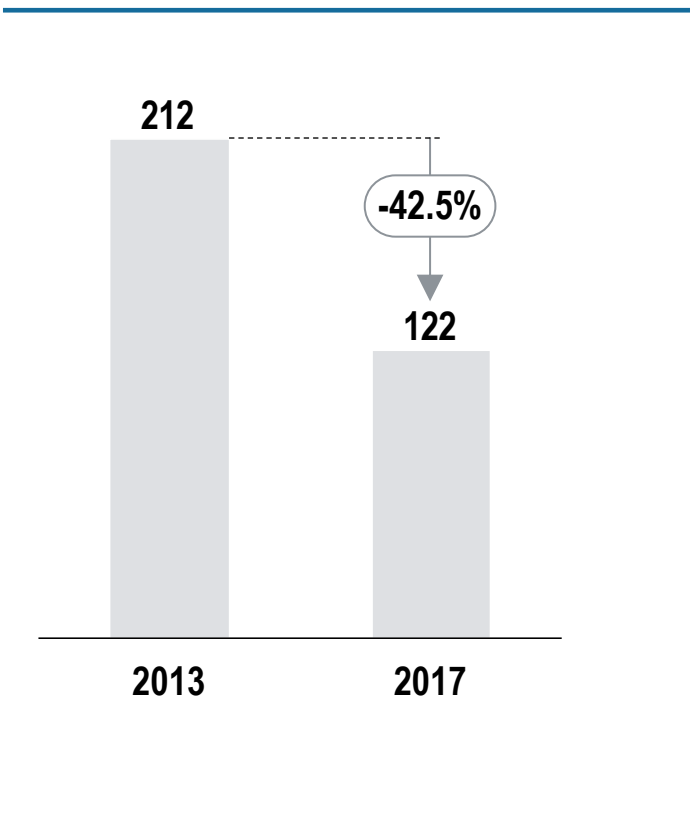
Innovation

- > **2018/01 France/ CAN** - JV of EDF Photowatt (60%) with Canadian Solar (30%) and ECM Greentech Grenoble (10%) to expand ingot and wafer business using **innovative Si crystallization technology** from French INES research institute
- > **2016/02 USA** – **New battery energy storage system** with control system to stabilize the grid

The ongoing transition from conventional power to RES is painful for GE and Siemens as the two dominant conventional turbine OEMs

Examples of GE and Siemens – Shifts in the gas turbines industry

Global large¹⁾ gas turbine orders [#]



1) GTs with capacity over 100 MW

"Struggling units such as GE Power are facing **significant staff cuts**..."

Reuters, November 2017



"The business has been undergoing market changes, and **we haven't changed fast enough** with it"

Jeff Bornstein, CFO of GE, November 2017

"As the cost of solar and wind power have plunged, ... , the **traditional model of the industry has changed**"



Financial Times, November 2017

"Did you know how many large gas turbines were ordered in Germany the **past three years**? I'll tell you, ... **A total of two!**"

Joe Kaeser, CEO of Siemens, November 2017

SIEMENS

"Siemens said it would **shed 6,900 jobs** worldwide — half of them in Germany — to help its power division stay competitive"

Siemens press release, November 2017

Therefore, since the early 2000s, they invested heavily in wind generation to also dominate this industry just as they did in CCGTs

Examples of GE and Siemens – Growing activity in the wind power industry

Wind energy investments – Examples



2002

GE acquires Enron Wind for **USD 350 m** and launches GE Wind Energy



2010

GE doubles its investments in renewable energy, to **USD 10 bn** in 5 years, 75% attributed to wind

2017

GE acquires turbine blade manufacturer LM wind for **USD 1.65 bn**

LM WIND POWER

*“The completion of the LM Wind Power acquisition will support the growth of our wind turbine business, which is the **fastest growing segment of power generation**”*

Jérôme Péresse, President and CEO of GE Renewable Energy

SIEMENS

2005

Siemens acquires wind turbine manufacturer Bonus Energy A/S and launches Siemens Wind Power



2010-2016

Siemens spends over **EUR 1.1 bn** on R&D for its wind power business

2017

Siemens merges with wind turbine manufacturer Gamesa, after paying **EUR 1 bn** to Gamesa shareholders

Gamesa 

*“We have reached a milestone in our path to merge Gamesa and Siemens Wind Power and create a **leading global wind player**”*

Lisa Davis, member of the Managing Board of Siemens AG

Global market shares in turbine production



Wind, 2016¹⁾

14%



Gas, 2015²⁾

46%

15%

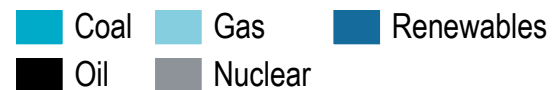
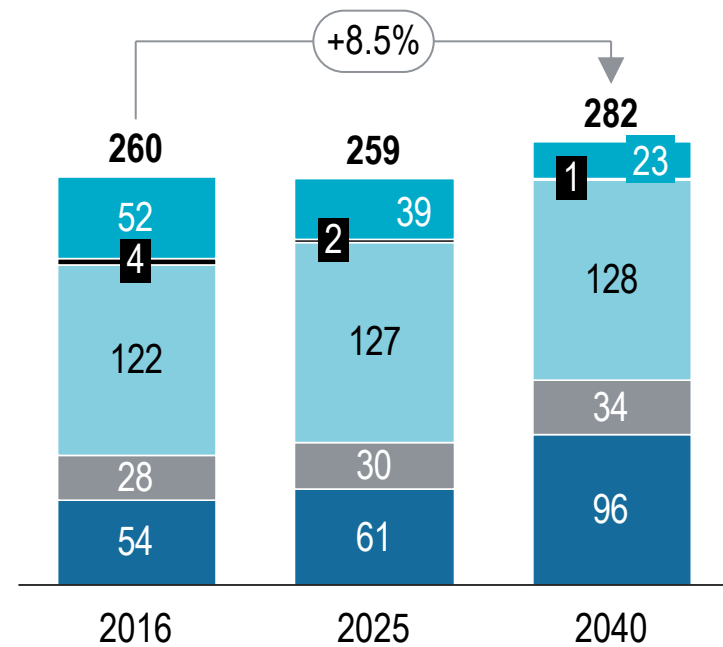
32%

1) Market shares based on additional installed capacity in both onshore and offshore; 2) Market shares based on ordered capacity

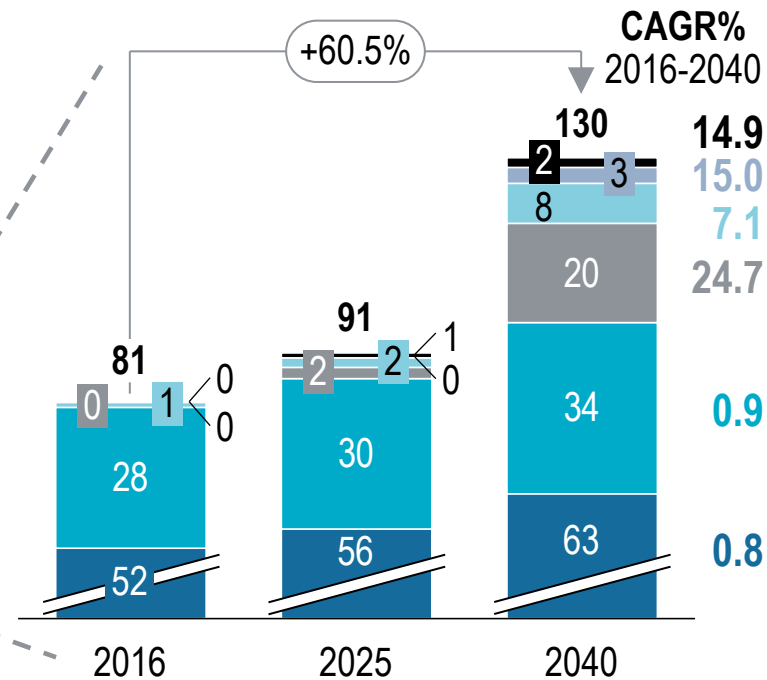
Looking at Russia power generation also here strong growth is projected – particularly for wind power. Who will be the winners?

Russia energy generation capacity current and outlook to 2040 [GW]

Generation Capacity by Energy Type



Generation Capacity Carbon-free



CAGR%
2016-2040

14.9
 15.0
 7.1
 24.7
 0.9
 0.8

Key Questions for Russian Players:

> Russian REN market

- How to tap into the growth potential?
- Accelerate growth?
- Go alone or partnering?

> International REN market?

- developer?
- utilities?
- OEMs?
- policy/ finance?

Renewables are rapidly growing – triggered by cost decline and governments - and adopted in the heart of utility and OEM strategy

Summary and Conclusions

- 👍 There is **strong investment in renewable energies ongoing**. While front runner countries invest in a focused way, there are many follower countries with steep investment growth
- 👍 **Also for the future strong growth is expected until 2040 with renewables** accounting for ca. 1/3 of investments in the power sector overall and **2/3 of generation capex**
- 👍 **Key drivers** behind this massive growth:
 - > Rapid **decline in REN cost - renewables cost competitive** with fossil energy
 - > COP21 triggers **national targets and auctions** in center of new regulatory frameworks
 - > Technology **innovation in energy storage** – cost down by >50% until 2030
 - > **Utilities and OEM strategies** in response to this change push REN and energy storage
- 👍 At the example of **European utility players** we can observe the following **key strategies**
 - > **Massive capex to expand the renewable portfolio** – often wind power, but also solar
 - > **Front runners** now also push **investment to become leaders** in energy storage
 - > Leading players **expand globally** – selectively also **teaming up with local partners**
 - > The **organizational approach is in transition** and discussion:
REN in separate organization ↔ central part ↔ value chain split (e.g., RWE/ e.on)
- 👍 **The renewables OEM industry** has gone through consolidation **due to enormous price pressure and high volatility** – **Leading conventional OEMs target also REN leadership**

Key questions for Russian players:

- > Where to play?
- > How to play?
- > How to win?

Contact



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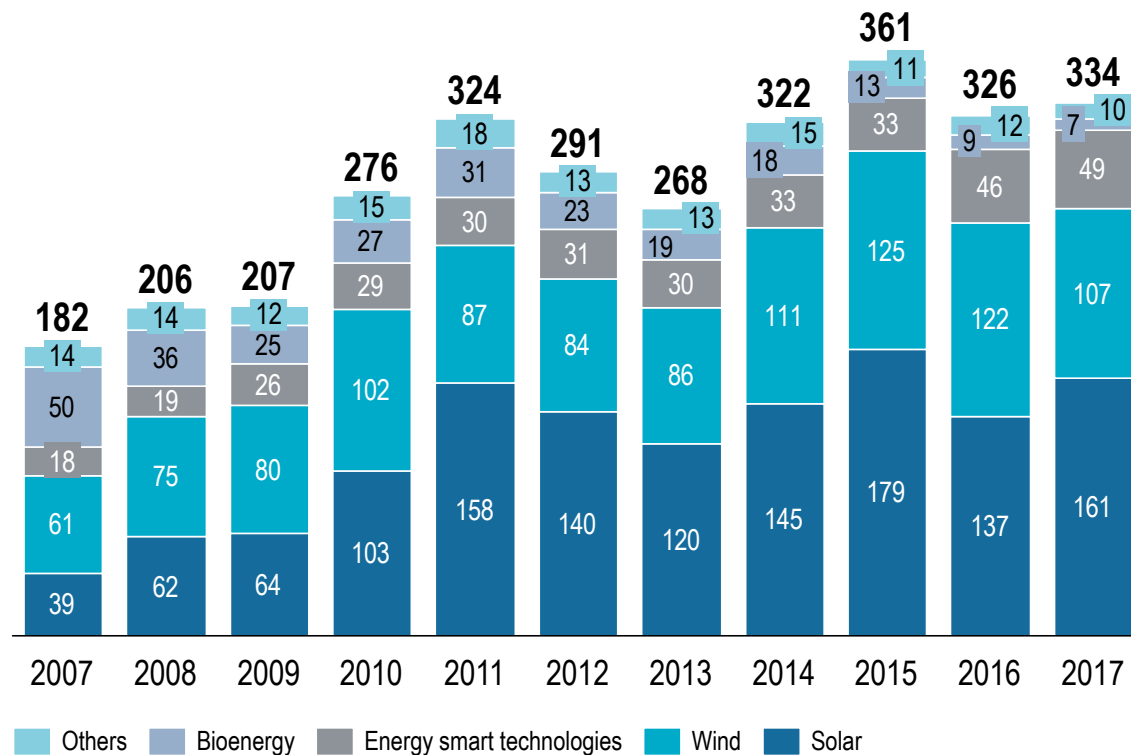
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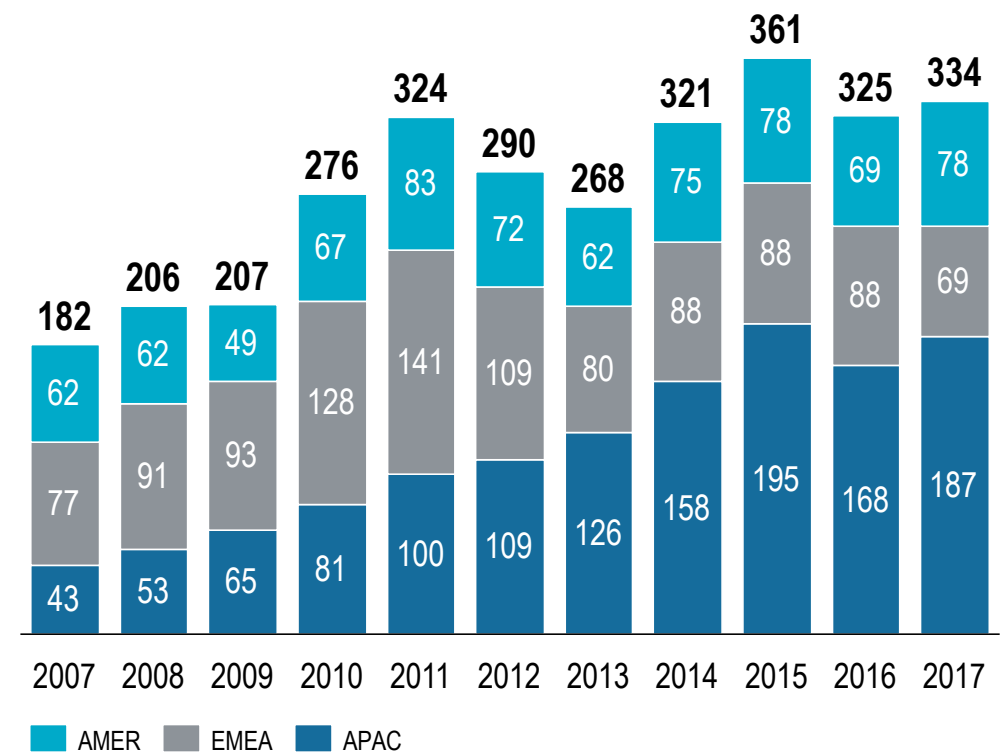
World clean energy investment reached \$ 333.5 bn in 2017 (+3%) Solar in the lead ahead of wind

Global New Investment in Clean Energy 2005-2017 [\$ bn]

By Technology

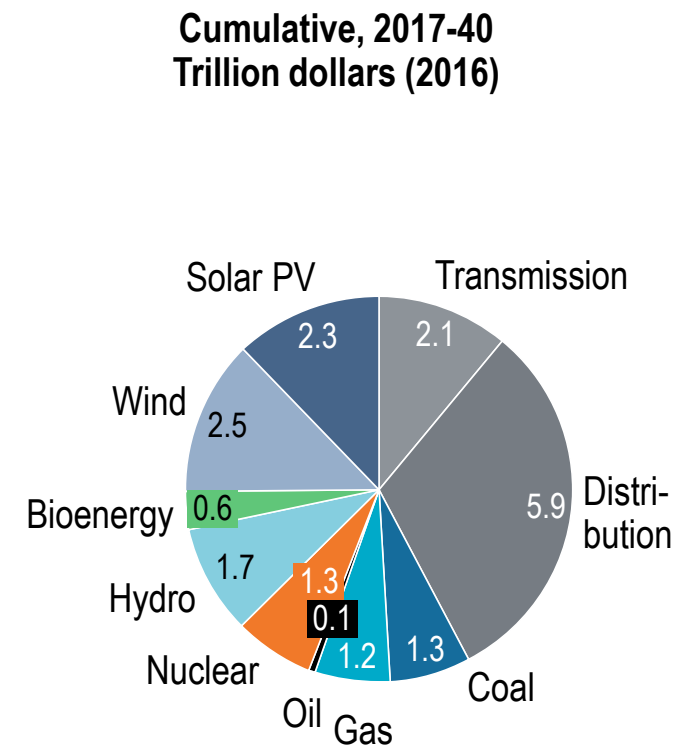
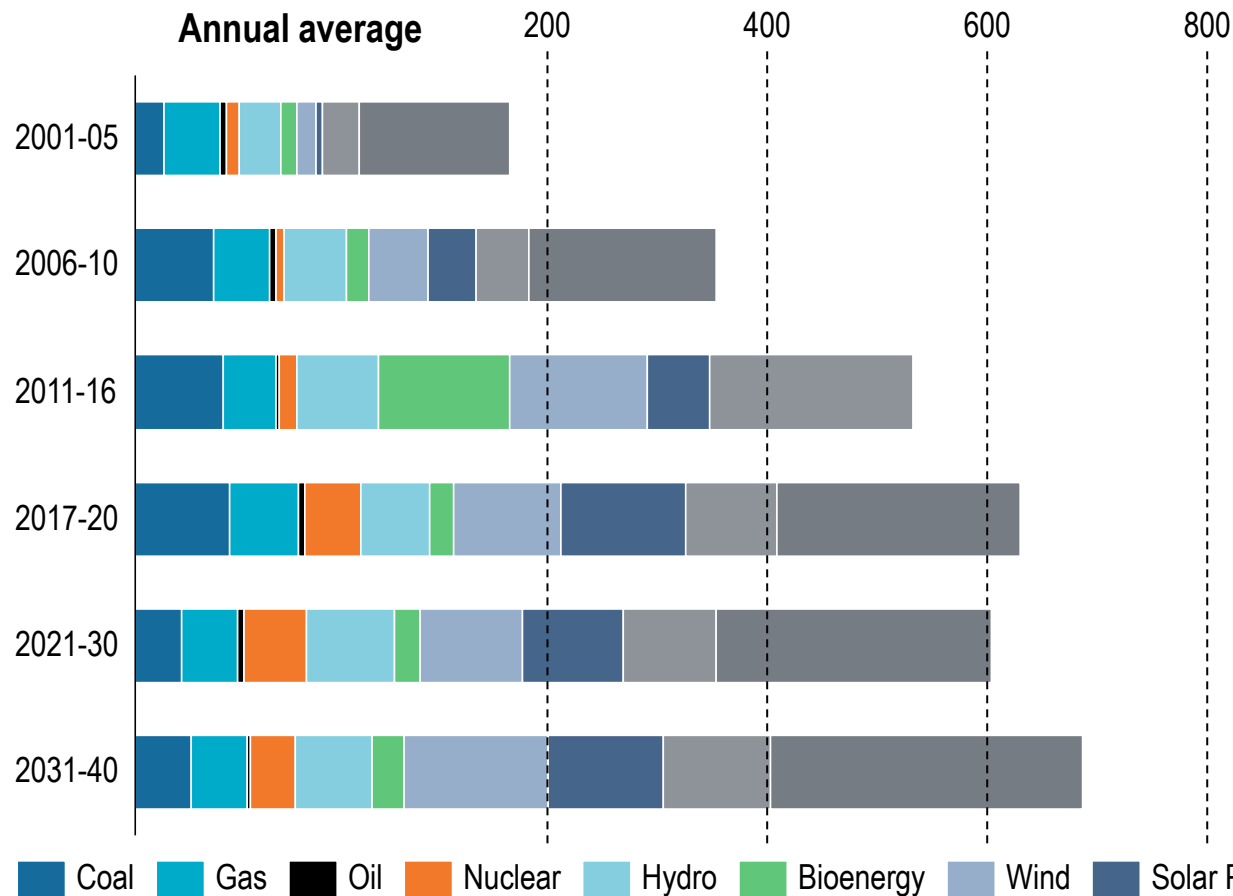


By Region



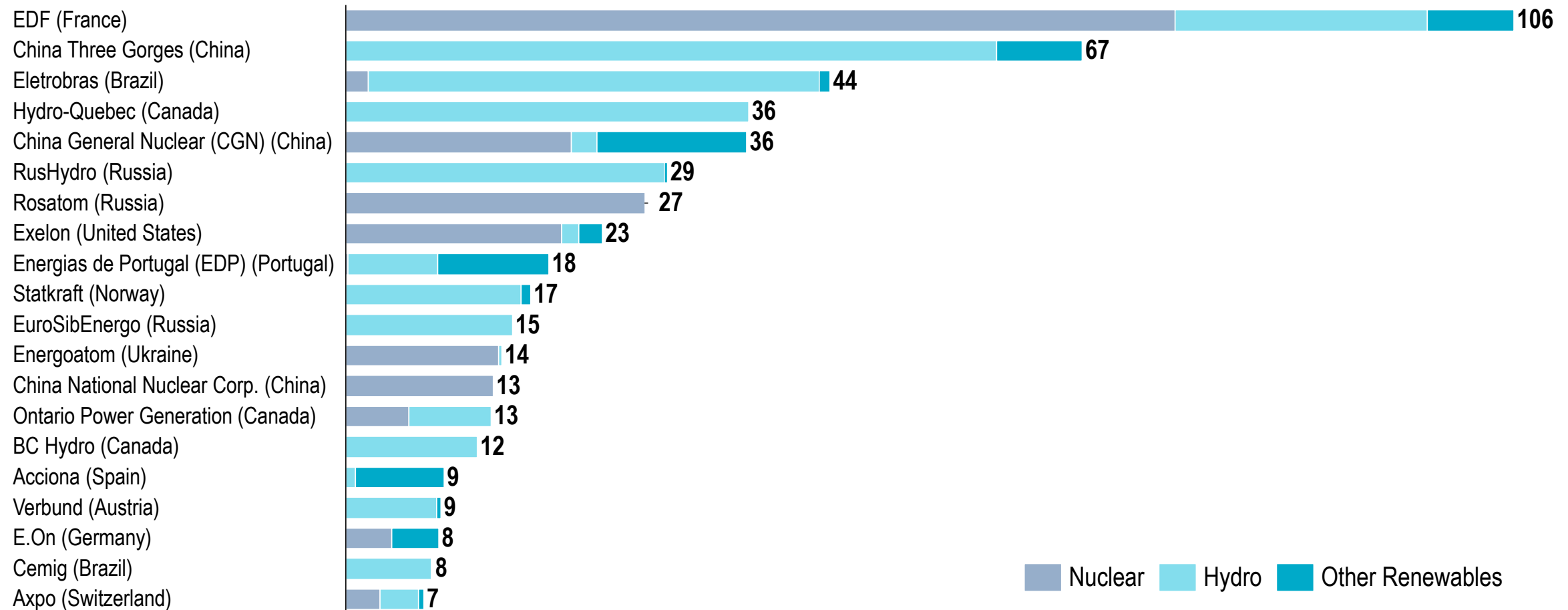
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Global annual average power sector investment and cumulative investment to 2040



If you consider all carbon free power generation capacity, hydro-power and also nuclear capacity the picture clearly changes

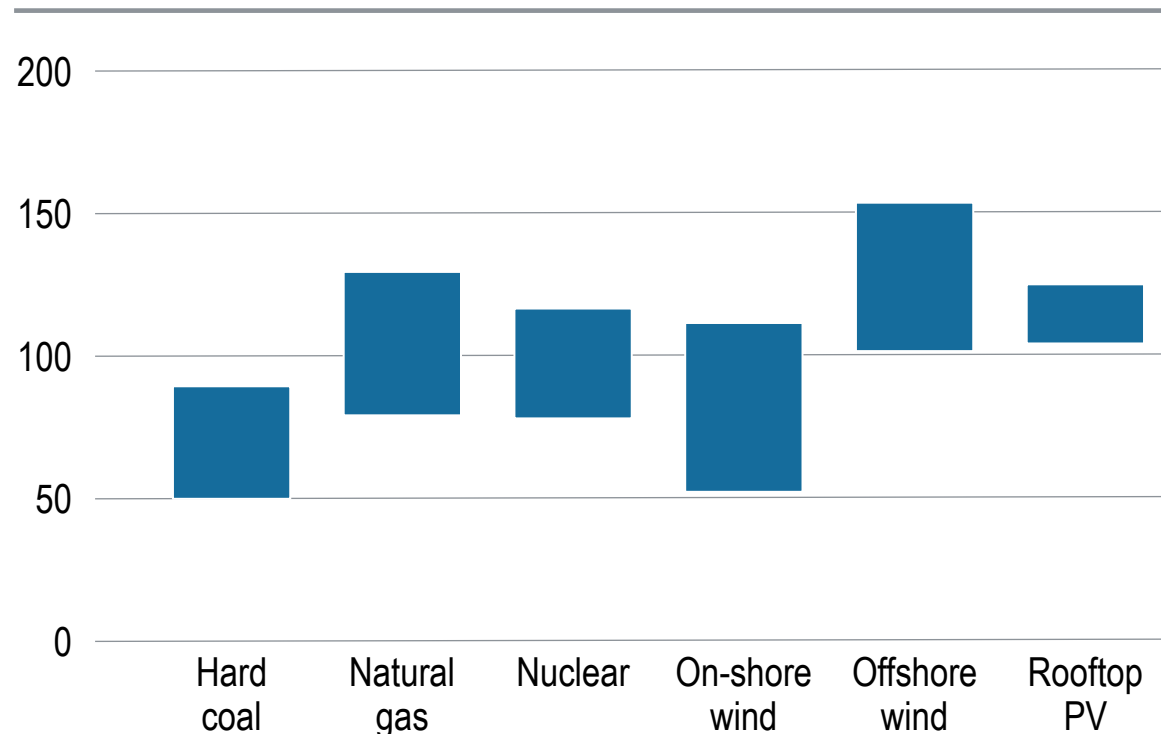
Top 20 carbon-free capacity in electric utilities by source 2017 [GW]



Renewable generation cost declined steeply over the last years and are in some parts already competitive with conventional energy

Steep decline in renewables cost – EU perspective

Levelized Cost of Electricity (LCOE) of major power generation technologies in Europe [EUR/MWh]

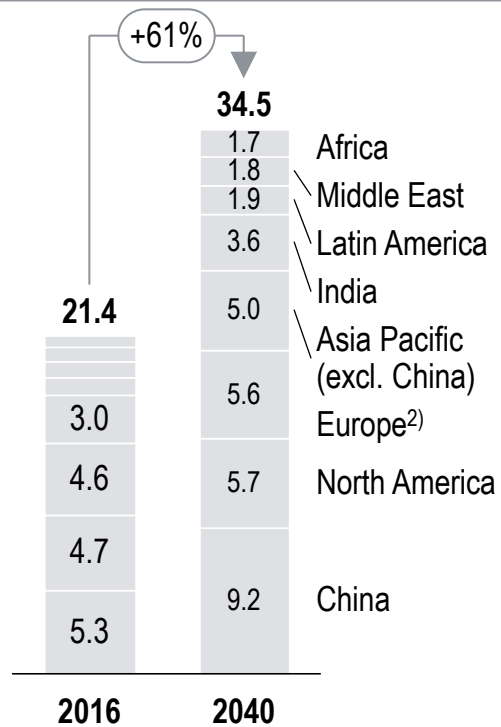


- > Onshore wind with less than €50/ MWh is already competitive with natural gas, coal and nuclear
- > Learning rate of 15% due to installed cost reductions and performance improvements
- > Offshore wind is on a steady cost reduction pathway with expected costs of €100/MWh by 2020 and €85 to €79/MWh by 2025
- > PV modules have experienced learning rates of 18% to 22%, and module prices down by 80%
- > Between 2010 and 2016, the cost of electricity from utility scale solar PV fell 69%
- > **Because wind & PV are (becoming) cheaper than conventional generation IEA expects ~4,800 GW extra capacity**

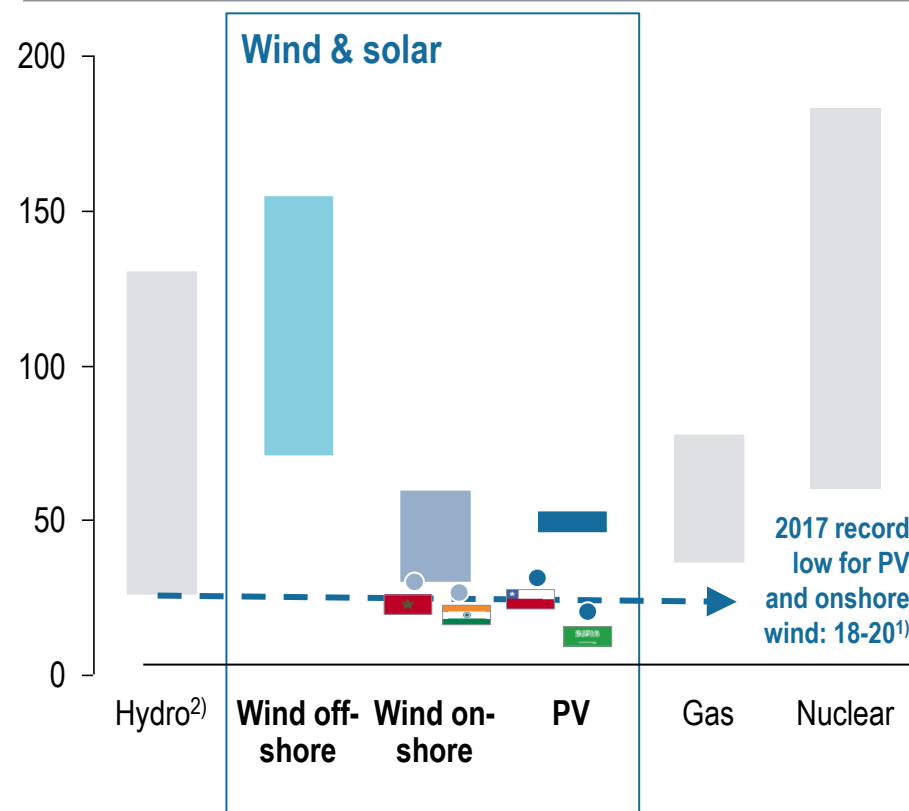
Because wind & PV are (becoming) cheaper than conventional generation it will grow tremendously, IEA expects ~4,800 GW extra

Electricity demand, LCoE evolution, cumulative gross PPs capacity additions by region¹⁾

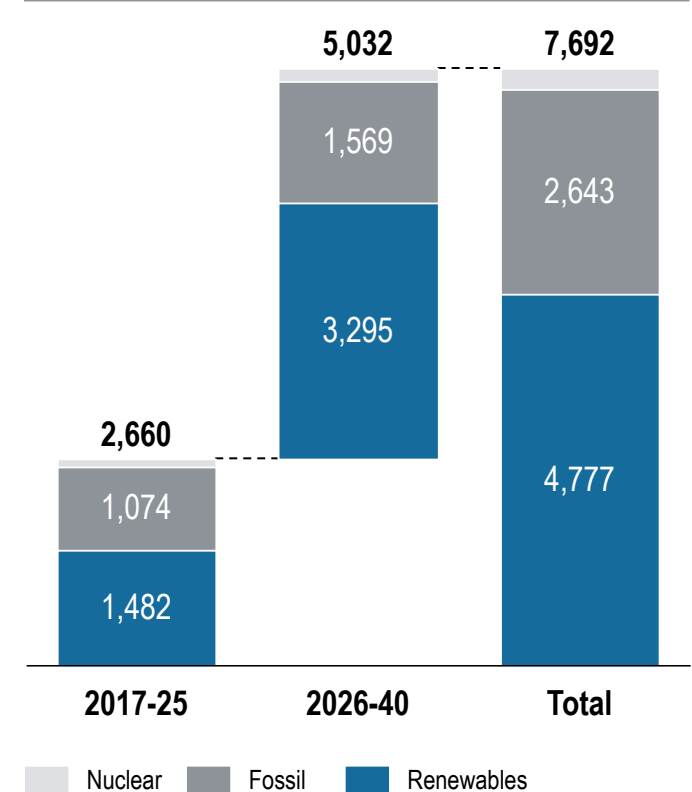
Electricity demand [PWh]



LCoE ranges 2017 [USD/MWh]



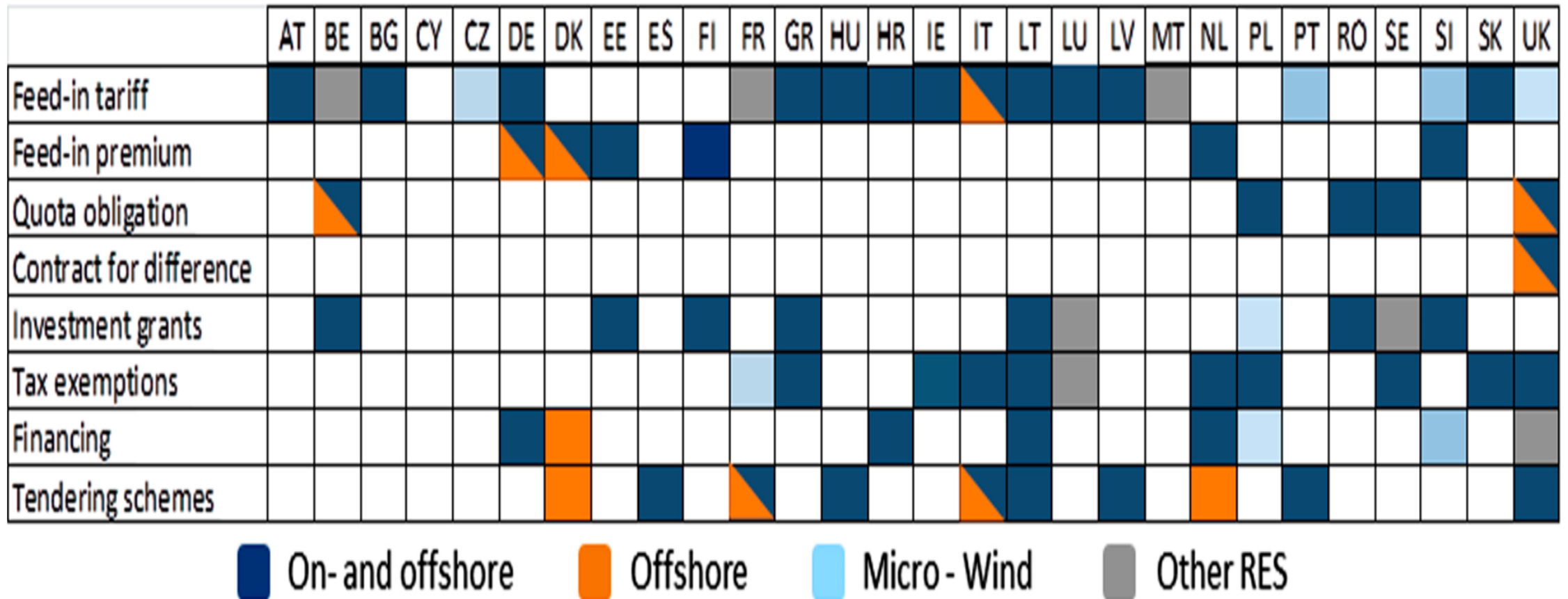
Extra power capacity [GW]



1) In IEA's New Policies Scenario, excl. replacement for retired capacity, 2) 2015, 3) USD 18 / MWh in Saudi Arabia 2017; USD 20 / MWh in India 2017

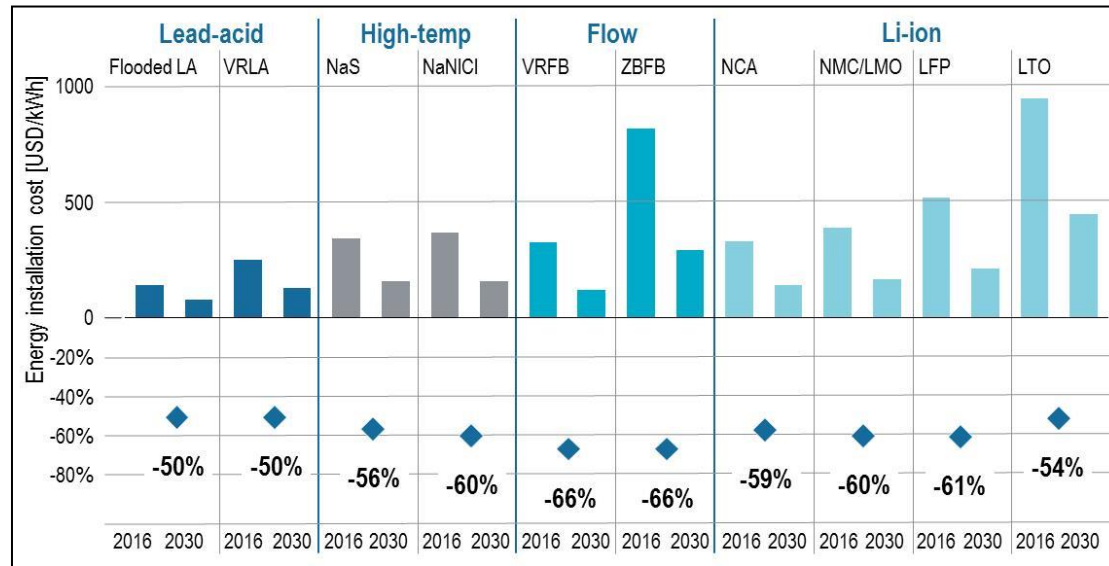
While EU is formulating an overall target each country has its own approach to select their policies mix

Example: 2014 EU countries policies for wind

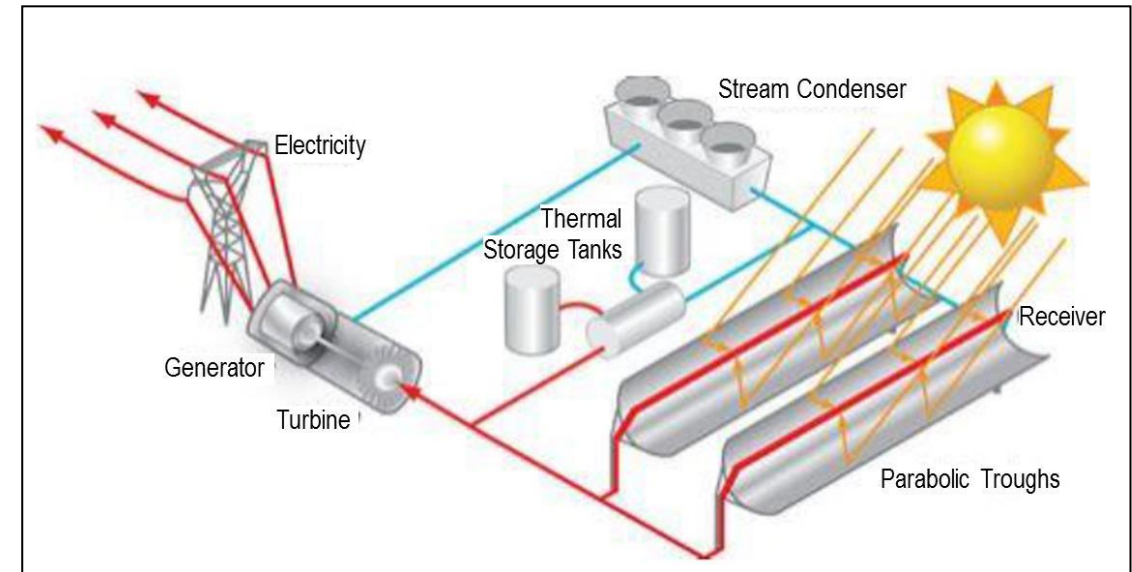


Growing capabilities to store energy and to take advantage of excess power help to make renewables even more attractive

Energy storage innovation and technology development



Battery cost expected to fall by more than 50% until 2030 across all technologies

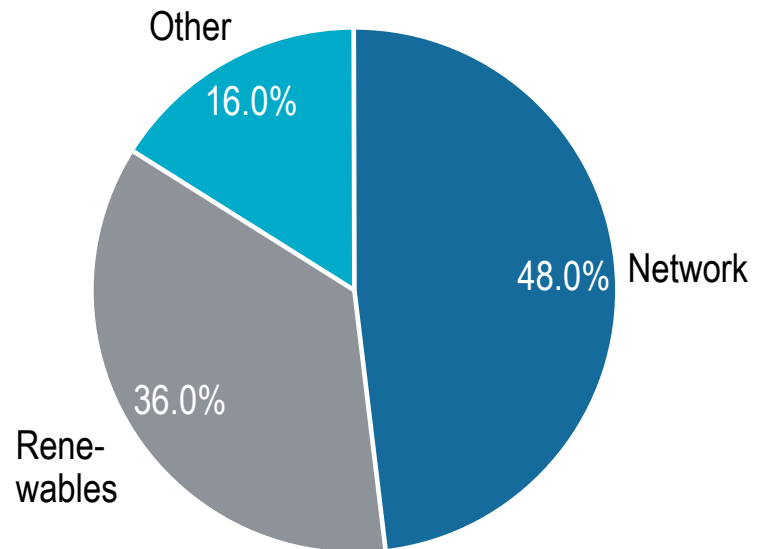


Thermal storage helps CSP solar power generate electricity for way into the night - targeting 24 hours

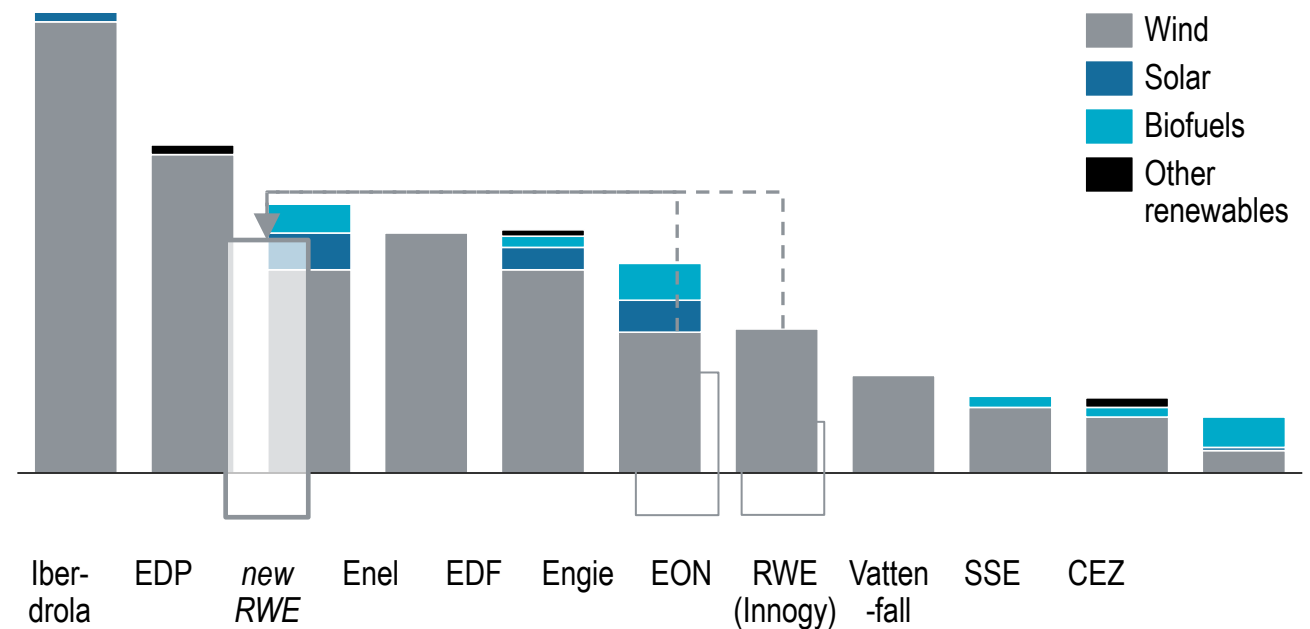
For the near term until 2019 ca. 36% of EU utilities CAPEX will be allocated to renewables, only surpassed by network investments

Near term EU Energy Capex and portfolio

Projected CAPEX for the largest European Utilities 2017-2019



New renewable energy portfolio for the largest European Utilities expected for 2019

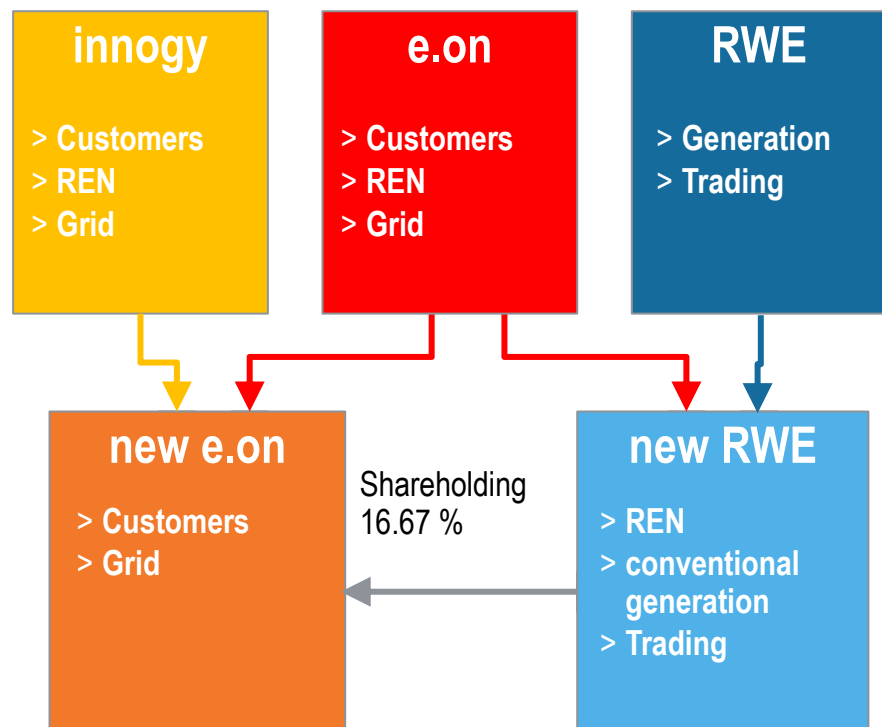


Many EU utilities are benefitting from strong government support in the early days of renewables when it was pushed by front runner countries, i.e., feed-in tariffs and subsidies

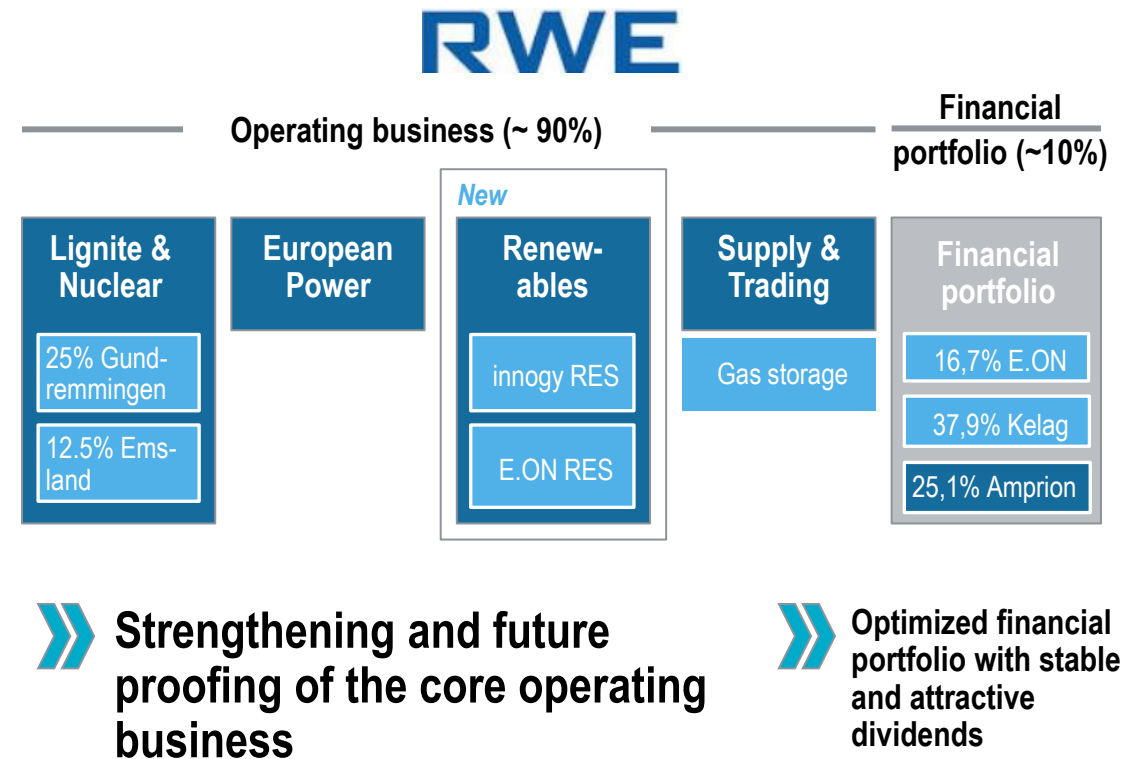
In the essence of the deal e.on is taking over the customers and the grid business while RWE is focusing on all generation and trading

The e.on/ RWE deal - taking a closer look

Basic elements of the deal ...



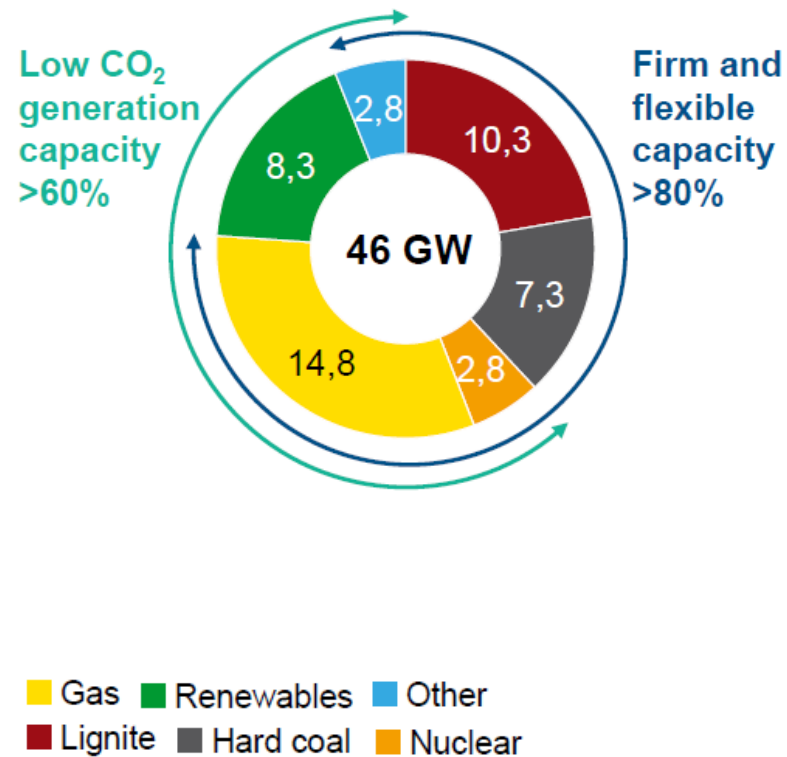
... expected results for RWE business



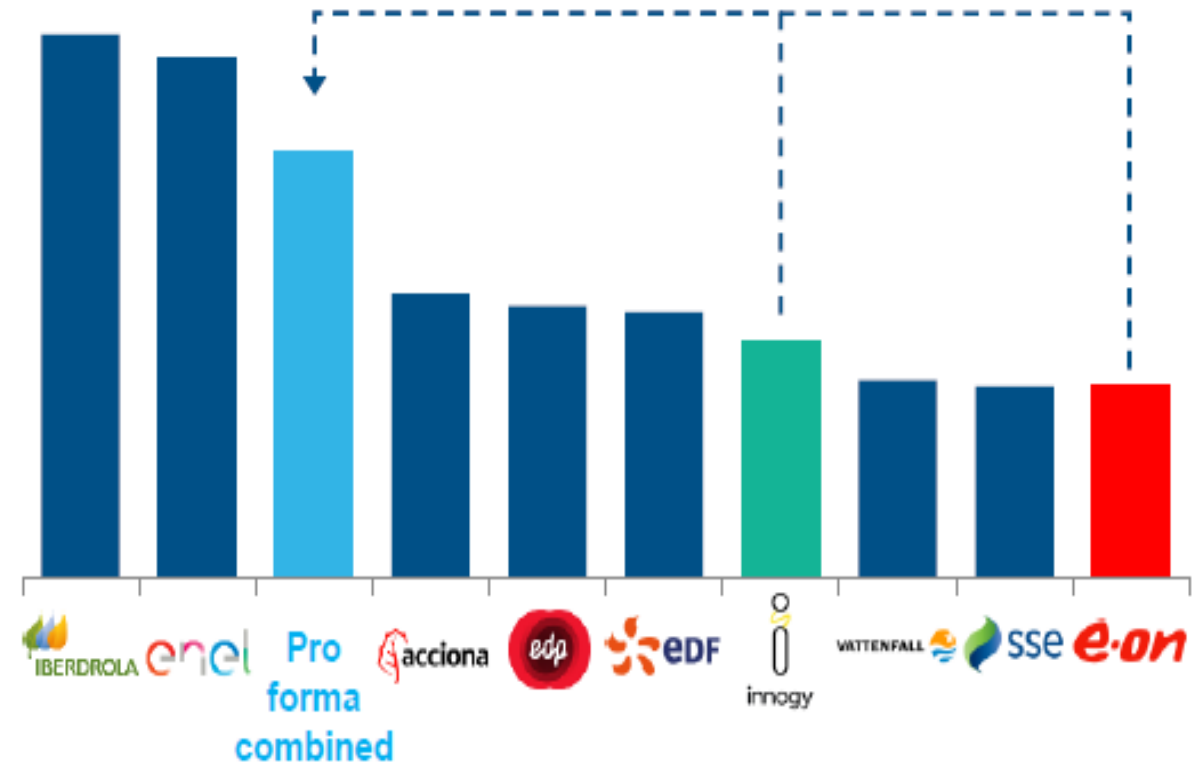
If the deal is executed as it is currently planned, RWE would establish the #3 REN generation capacity position in Europe

e.on/ RWE deal: Pro forma new generation capacity in New-RWE and REN position

New-RWE pro forma generation capacity



New-RWE would be #3 in EU REN



Roland
Berger

THINK:ACT

