



Power Market Study 2030

A new outlook for the energy industry

Management summary

1

General market environment: The traditional utilities business remains under significant pressure; major trends identified in Deloitte's 2015 Power Market Study remain valid for generation, distribution and consumption

2

New drivers of change: Major players have made necessary adjustments, but new market realities have emerged – generation is driven by consolidation and recovering wholesale prices, distribution by the interplay between high-voltage transportation requirements and need for new revenue streams, and consumption by changing customer expectations and transformation needs

3

Implications: Based on the new market environment, utilities have to re-prioritize their business model portfolio and investment decisions, as well as to adjust their Target Operating Model into an even clearer set-up

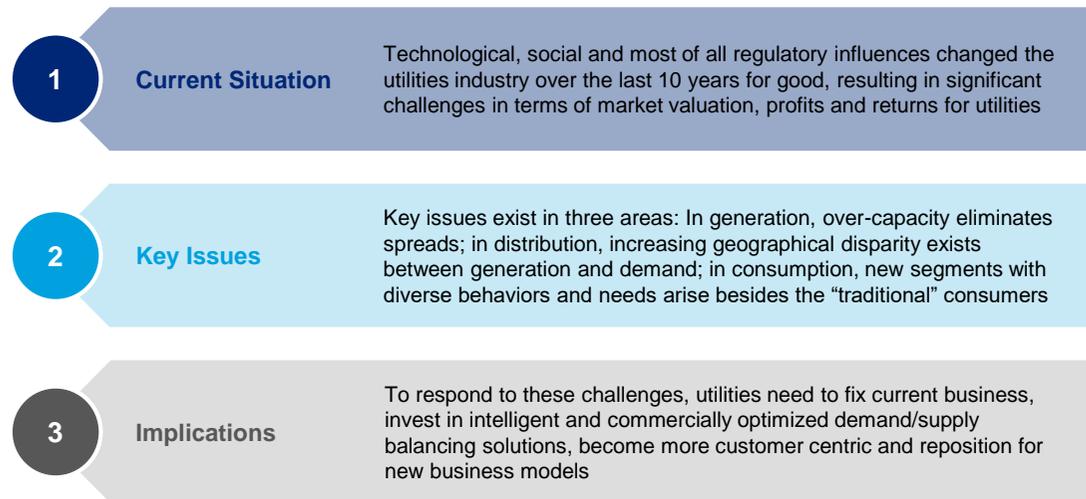
Recap: Power Market Study 2025 (1/2)

Main challenges and trends of Deloitte's Power Market Study 2025 published in 2015 have been confirmed over the last 2 years and are largely still valid

Power Market Study 2025

Power Market Study 2025

The traditional business model for utilities is gone, let's talk about how to build the future



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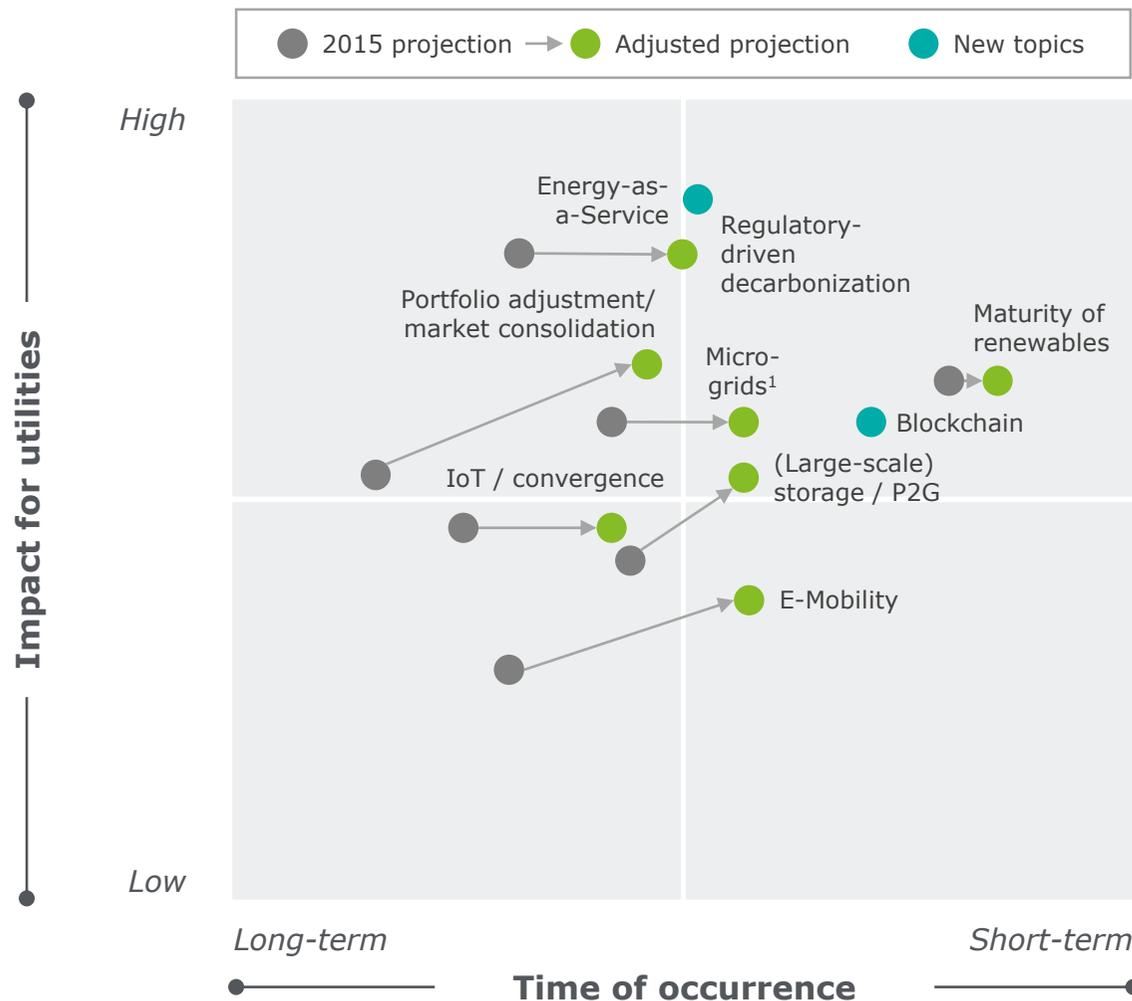
Implications

- Deloitte's 2015 study has been focusing on the future of the power market
- Main challenges remain:
 - **Generation:** Ongoing margin pressure as over-capacity is only slowly reduced
 - **Distribution:** Imbalance of consumption and generation remains a challenge, increasing number of dispatching incidents
 - **Consumption:** Customers have the option to choose preferred technology for power generation
- Consequences are being realized (e.g. through portfolio adjustments), the industry seems to have bottomed out

Recap: Power Market Study 2025 (2/2)

The good old days are gone for good – a mere evolution is not sufficient, a real transformation is required

Major trends and their development



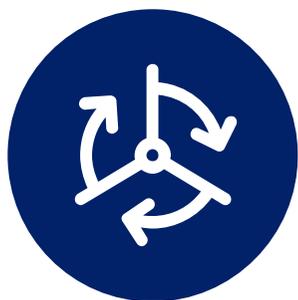
Observations

- **General confirmation** of Power Market Study 2025, however, some “surprises” have occurred:
 - **Very effective auction model** for renewables
 - Extent of **portfolio adjustments** across all major utilities
 - Speed of **storage technologies** to become relevant
- Regulatory-driven **decarbonization** (introduction of CO₂ taxation and potential lignite phase-out) no longer a vision of the future
- **Further consolidation** in large-scale traditional generation expected

Challenges have **not diminished** – **new market realities** have appeared to which utilities have to adjust.

Overview

The three major value chain segments are still a valid basis for industry analysis



Generation

- Further **regulatory push towards decarbonization** (Paris Agreement), over-capacities will decrease (nuclear, lignite phase-out)
- **Recovering wholesale market prices** (50-60 EUR/MWh); renaissance of natural gas (“stranded assets”) to provide system services

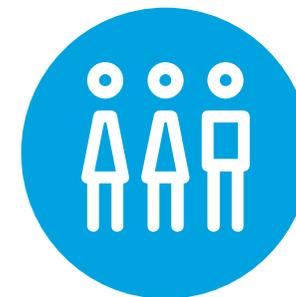
Consolidation in large-scale generation, market forces relevant again



Distribution

- Inexpensive renewable energies and maturing storage solutions push **importance of micro-grids**
- **High-voltage transmission** still essential to balance **unequal supply and demand**
- **Convergence of infrastructures** (power and gas, telecommunication, data, mobility)

Relevance of Micro-grids, extension of (critical) infrastructure ecosystem



Consumption

- Traditional **commodity business not profitable** (for B2B no margin recovery, for B2C potentially slight increase through automation expected)
- **Shifting customer needs** and industry convergence require transformation and cost-effectiveness

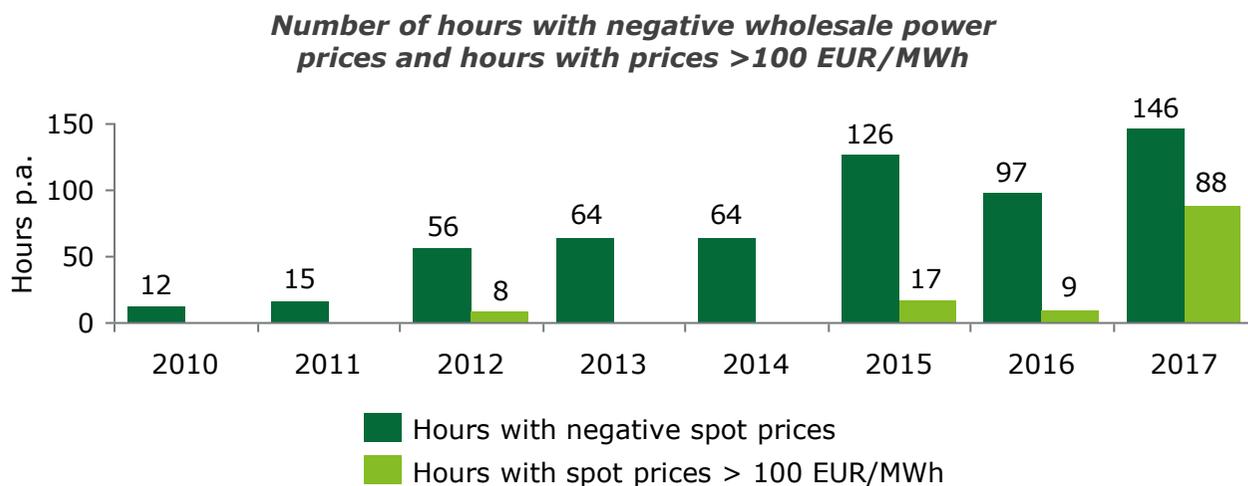
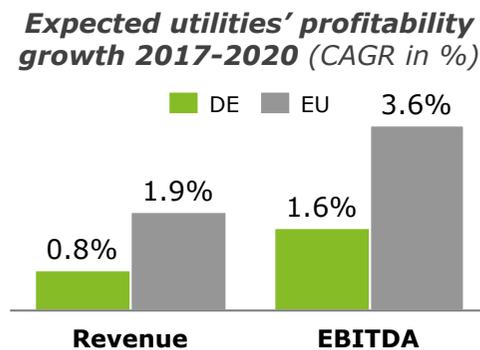
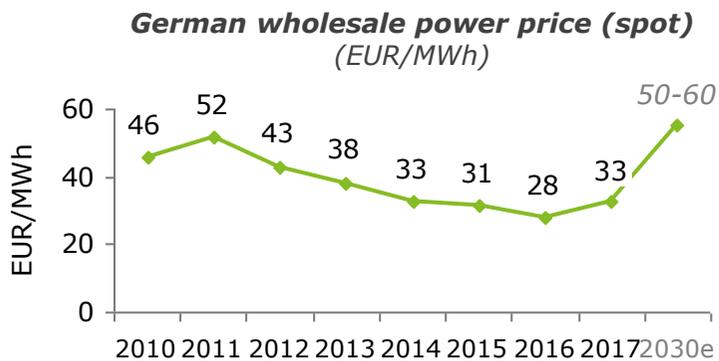
De-commoditization, convergence and service cost reduction



Generation | Price development

Wholesale prices are improving – relieving the profit situation for utilities

Price development



Considerations

- **Germany** will potentially see **upturn in wholesale power prices** (nuclear phase-out by 2022 + potential coal/lignite)
 - **Nuclear phase-out:** remaining nine nuclear plants shut down by 2022 latest
 - **Limited future for coal:** §13g EnWG already leads to shut-down of approx. 10% of coal plants by 2019
- **Price fluctuations on spot market** more pronounced
 - 2017: **negative prices** during 146 hours (most ever recorded); many hours with prices >100 EUR/MWh
 - **volatility on intraday market** high as well; shows increasing need for flexibility due to rising PV & wind capacity



Generation | Consolidation in fossil generation

However, large-scale conventional generation will be subject to further consolidation, while their relevance for system stability remains

Developments in fossil generation

Reuters
April 18, 2016

Vattenfall sells German lignite assets to Czech EPH

Czech investor EPH has agreed to buy lignite mines and associated power plants from Vattenfall as it expects power prices to rise in Germany at the start of the next decade.

Financial Times
January 8, 2018

Eon sells Uniper stake to Finland's Fortum

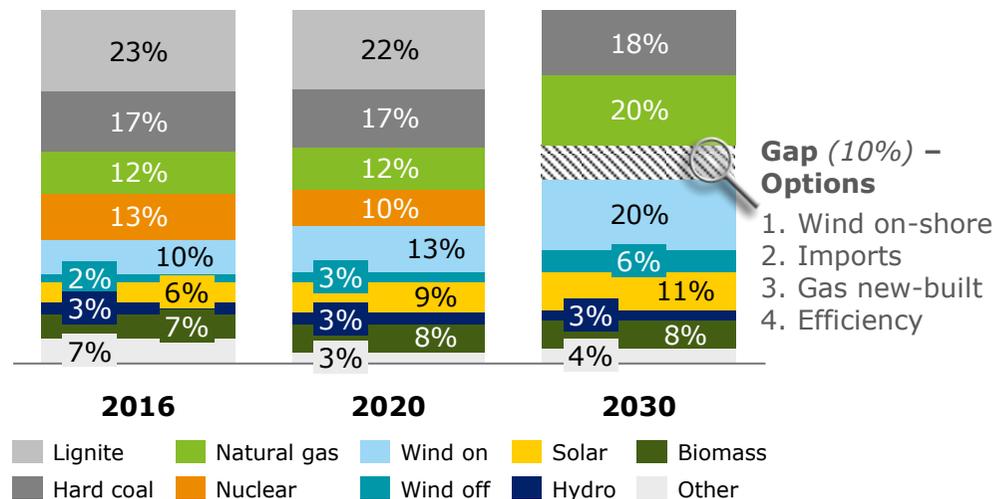
German utility Eon confirmed that it is selling its 47 per cent stake in Uniper to Finnish rival Fortum.

Handelsblatt
March 11, 2018

RWE eyes EnBW's coal and natural gas power plants

RWE, Germany's largest electricity producer, is considering buying coal- and gas-fired power plants from its competitor EnBW.

Gross electricity generation, generation mix (%)



Considerations

- Traditional **vertically integrated** utilities **business model** is increasingly **challenged**
- **Merger wave** in conventional generation
- Capital-intensive business, **large players will set the pace**
- **Need for new (gas) power plants** for security of supply – at least 2022 after finalization of nuclear phase-out; conventional generation will become profitable again as wholesale power prices rise
- **Remaining gap in generation mix** will have to be filled by additional wind power generation in order to meet carbon reduction targets

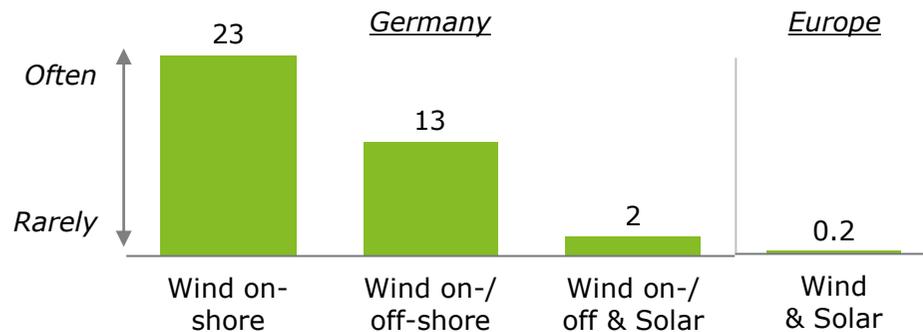
Generation | Development of “dark doldrums” (*Dunkelflaute*)



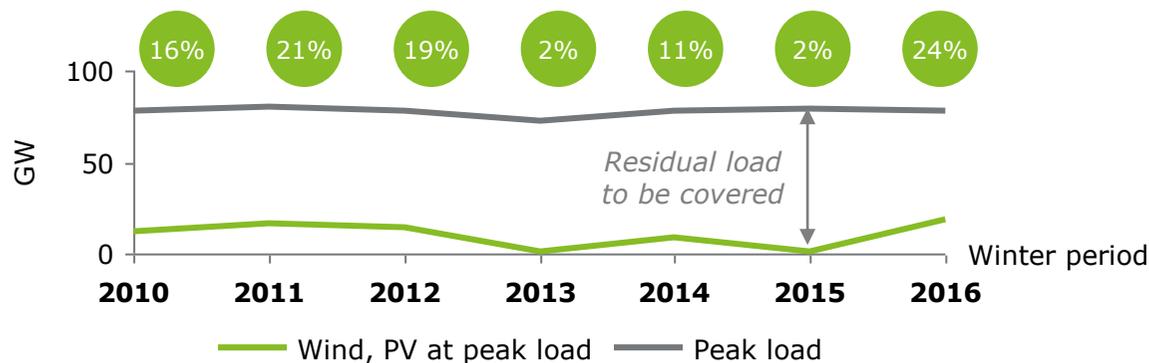
The rising variability of residual load – due to fluctuating renewables – requires balancing mechanisms that complements conventional generation

Impacts of high renewable energy share

Number of situations p.a. during which average wind and solar generation is < 10% of nominal capacity for period of 48 hours



Wind and solar generation at peak load, peak load (GW)



Considerations

- Recent studies indicate that situations with **prolonged yield losses** of fluctuating renewables are **rare**, viewed **over time** – but **when occurring, large spreads** need to be covered
- So far**, dark doldrums (times during which solar or wind power generation is very low) **covered** by **conventional generation** and **electricity imports**
- Considering a lignite phase-out, **cross-border capacities** might **not** be **sufficient** to ensure security of supply during “cold dark doldrums” (coincidence of low wind and solar generation and high electricity demand during winter months)
- Need for balancing**, e.g. via capacity mechanisms or price peaks to incentivize use of flexible gas power plants

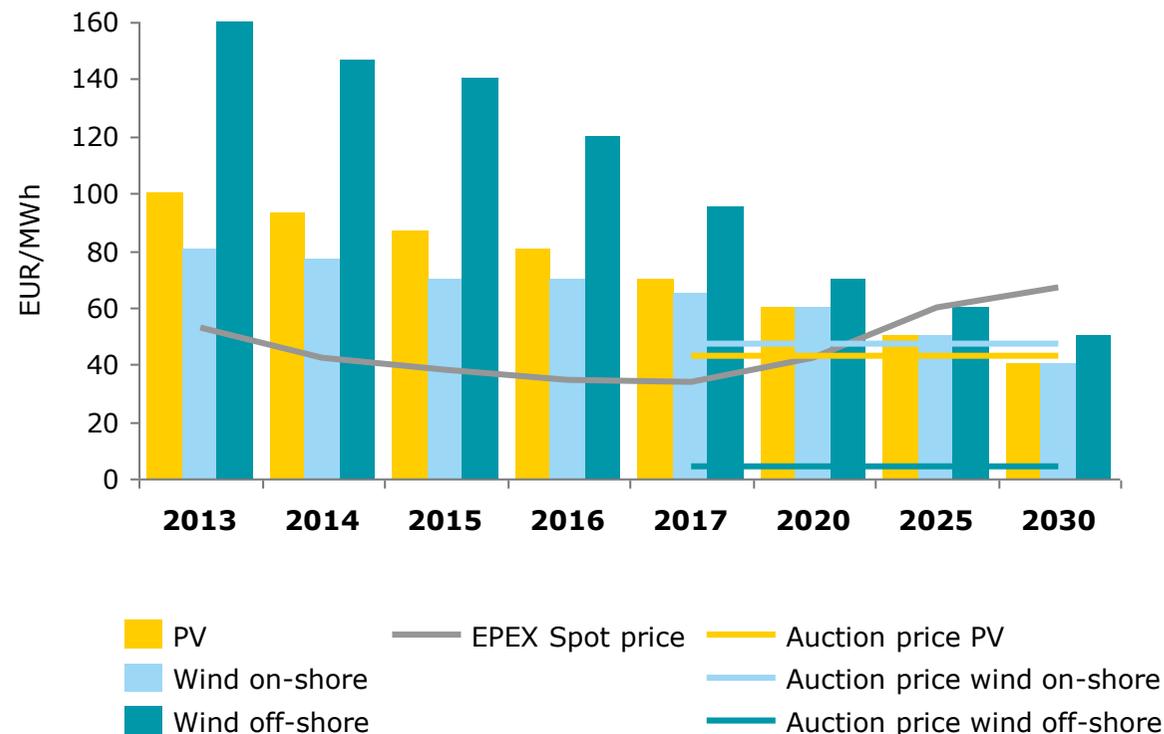


Generation | Renewables

The growth of renewables is increasingly backed by its superior cost position that will make merchant marketing the norm in the mid-term

Profitability of renewables

Levelized Cost of Electricity (LCOE), average auction prices, wholesale electricity price (EUR/MWh)



Considerations

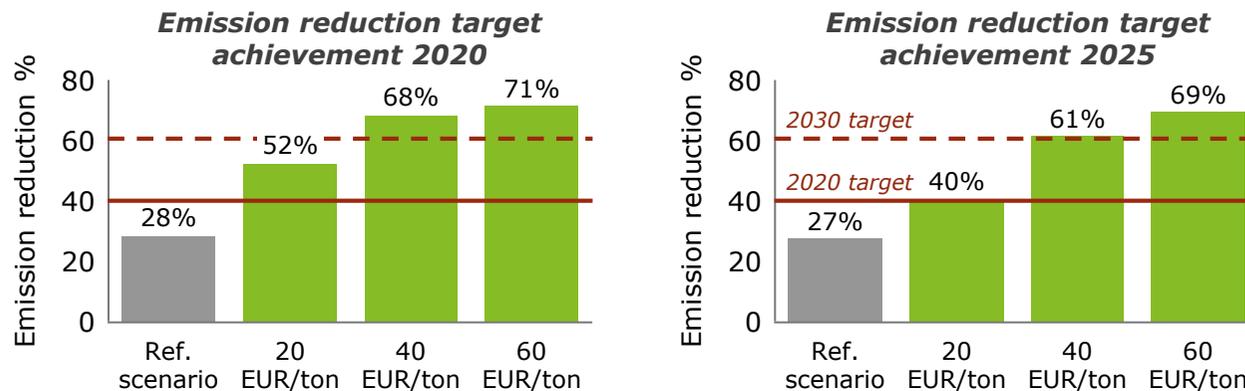
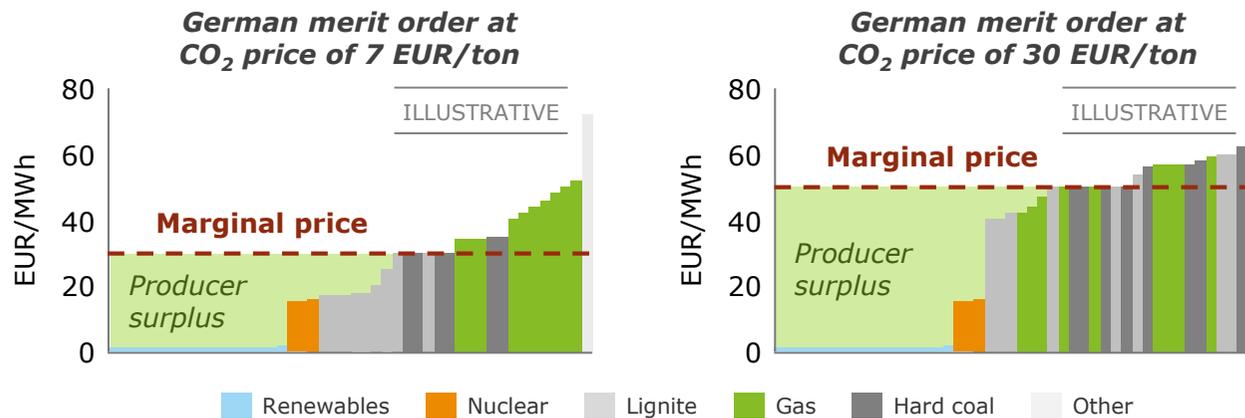
- Switch to **tender process for renewables** with Renewable Energy Act ("EEG") amendment 2017
- Constant **decrease in auction prices**, also reflecting decline in renewable costs (LCOE)
- Expected wholesale market price development implies that it **might become more profitable to market renewable capacities via merchant markets** than to rely on subsidies (remuneration according to submitted tender price)



Generation | Market uncertainties

This development is underpinned by higher, potentially tax-based CO₂ prices that ensure required wholesale price levels of about 60 Euro/MWh

CO₂ price effects



Reference scenario: CO₂ reduction through planned development path of renewable energy generation
Reduction targets: 40% across all sectors by 2020; 61% in energy sector by 2030 (both comp. to 1990)
Slight emission increase in 2025 through increased full load hours of coal due to nuclear phase-out

Considerations

- **CO₂ price** is added to each plant's marginal costs and thus **increases** the **overall wholesale price**: an increase of 1 EUR/ton CO₂ results in a rise of wholesale prices of 0.7 EUR/MWh
- In order to **achieve** Paris Agreement targets and EU and German **climate protection goals, increased carbon pricing** seems imperative; German Climate Protection Plan:
 - total emission reduction of 40% by 2020 (compared to 1990)
 - reduction of energy sector emissions of about 60% by 2030
- Recent studies imply that **mere anticipation** of strict CO₂ pricing **triggers divestment** in CO₂ intensive generation (especially coal), prevailing over the "green paradox"¹ and thus effectively reducing emissions



1

Decarbonization will be the major driver influencing the future generation landscape and shaping sector consolidation

2

Centralized, conventional generation is not “dead”, though, as it is required to balance the system at least for the next decade

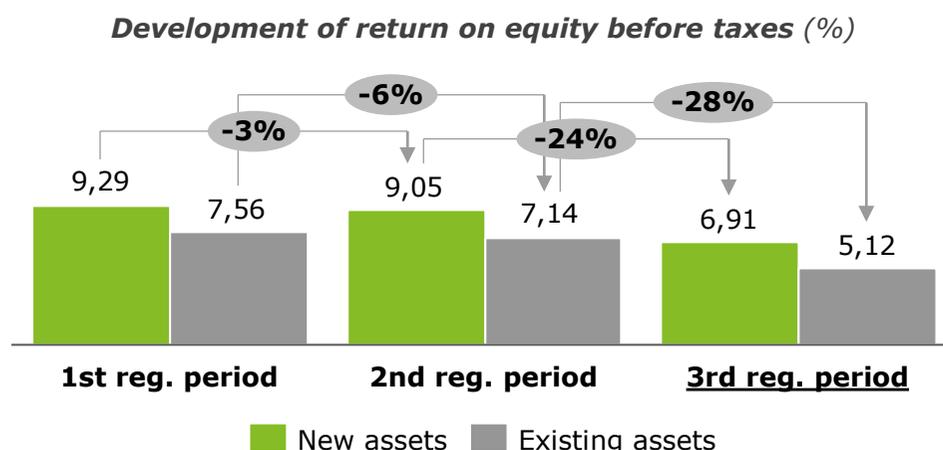
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Key to a more healthy generation system are recovering wholesale prices that need to be underpinned by increasing CO₂ prices allowing for merchant marketing of further technologies

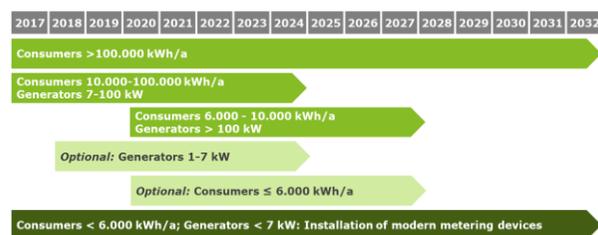
Distribution | Regulatory environment

Changing realities in regulation create pressure on earnings – at the same time regulators are pushing for investments in smart grids

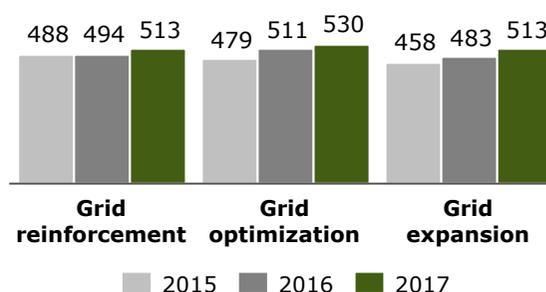
Remuneration and investment of grid operators



Smart meter rollout path
(according to the 2016 "Law on the Digitization of the Energy Transition")



Number of DSOs investing in grid improvement measures
(according to §12 EEG, §11 EnWG)



Considerations

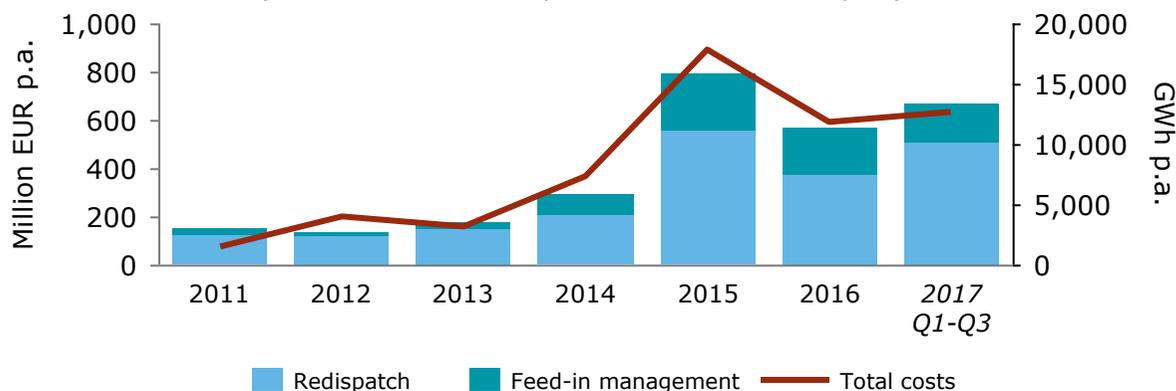
- **Probable switch** towards **Yardstick regulation** after 3rd regulation period in 2024 (e.g. capital expenditure per grid kilometer)
- **Margin pressure** due to decreasing return on equity – importance of **new revenue streams** from **competitive grid services and digitalization** (e.g. energy consulting, demand response, gateway administration)
- The growing importance of renewables and the changing customer behavior (e.g. prosumers, communities, peer-to-peer platforms) lead to **increased innovation-driven investments**
- Local regulations on **data protection** and **data security** are still a **main obstacle for innovations**, especially in the development of smart grids

Distribution | Grid expansion

To maintain security of supply, grid expansion remains an inalienable imperative

Grid expansion requirements

Development of measures for grid congestion management
(costs in million EUR p.a., duration in GWh p.a.)



Progress grid expansion (%)



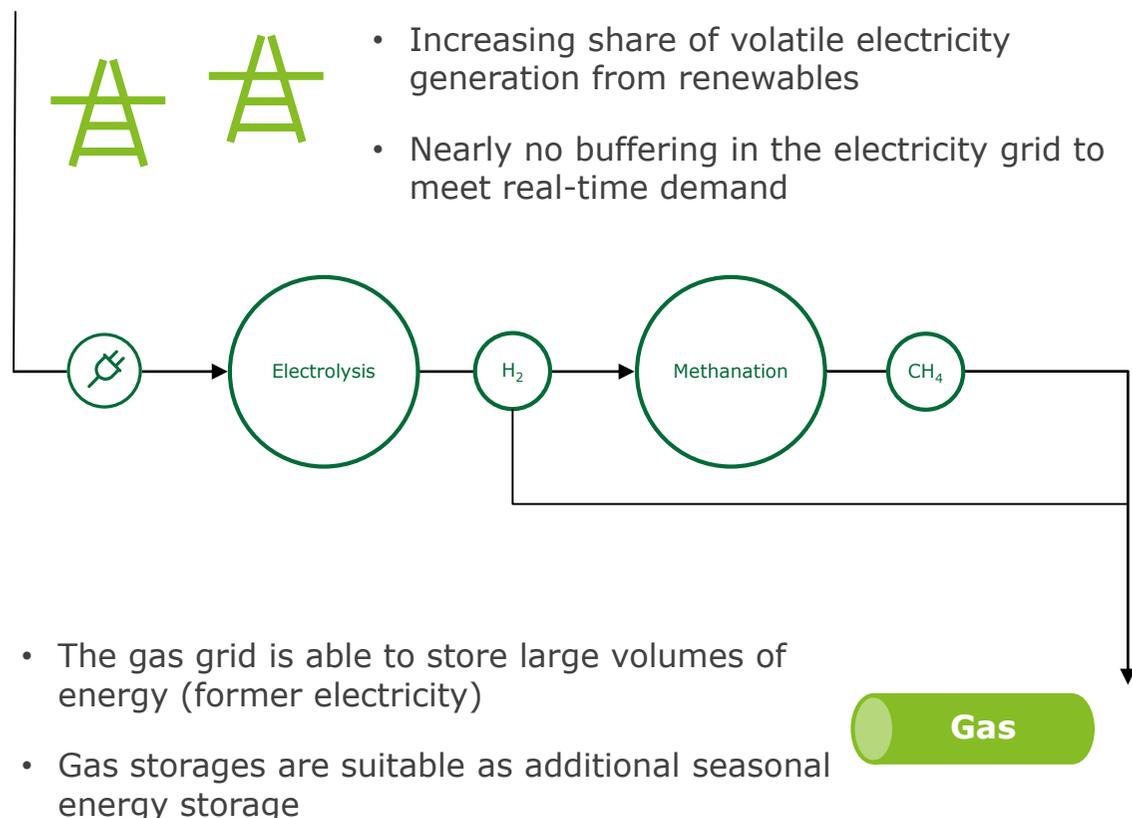
Considerations

- Due to energy transition, **cost for congestion management measures**, i.e. redispatch (contractually-based adjustment of electricity feed-in from power plants) and feed-in management (curtailment of electricity generation from renewables and combined heat and power plants) **increased significantly** over the last years
- Further **funding** and **adjusted regulation** to ensure adequate RoI seem required to foster grid expansion, thus responding to public sensitivity for **security of supply** and **EU requirements** (assurance of cross-border exchange capacity)
- Grid **expansion investments** can **reduce pressure on earnings** for grid operators – nevertheless the number of **delayed** or **rescheduled investment shows** the **complexity** of upgrading existing grids

Distribution | Excursus: Power-to-Gas

By using large-scale storage technologies to relieve the grid, investment needs for grid expansion can be reduced

Integrated energy view on Power-to-Gas



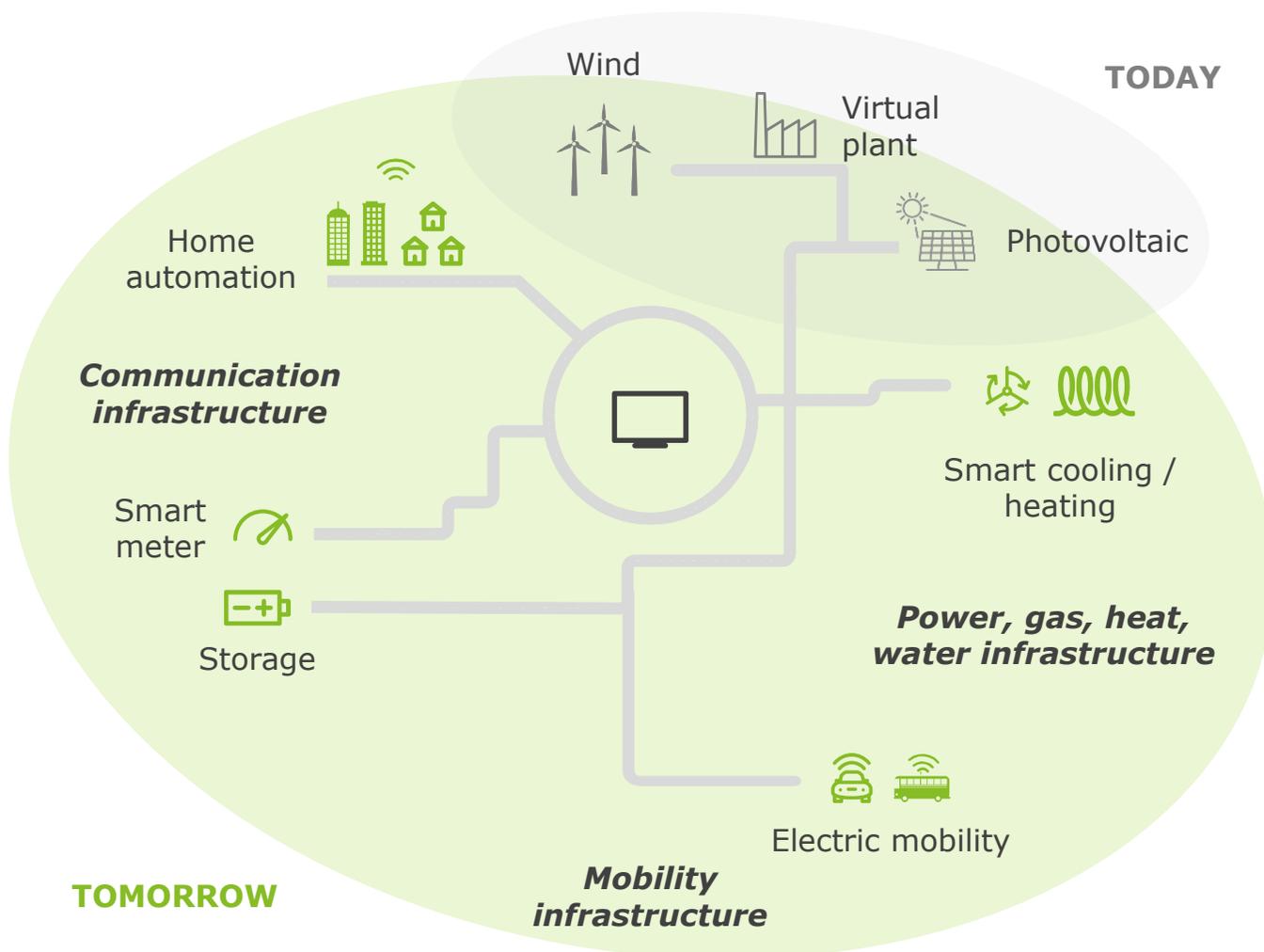
Considerations

- **Ready technology:** More than € 70 m are invested in more than 100 Power-to-Gas plants globally
- **Infrastructure relevance:** Power-to-Gas is able to relieve the electricity grid
- **Need for regulation change:** Make Power-to-Gas more attractive (e.g. by exempting from taxes and levies)
- **Supply change:** Due to increasing renewables, the all-electric society is coming closer using PtG as carbon-free fuel source
- **Climate change contribution:** Power-to-Gas enables the decarbonization of the heat sector

Distribution | New services

Companies need to identify further on- and off-grid solutions to benefit from the changing client behavior and to respond to pressure on earnings

Evolution of the electricity grid



Considerations

- **New infrastructure systems** become **relevant** for utilities – existing infrastructure is digitally optimized (e.g. equipment of lines with sensors) and new infrastructure is built (e.g. charging infrastructure)
- **Strategic considerations** by utilities to **focus on (critical) infrastructure** (instead of end-customer products and services) or expand the portfolio towards the end-customer needs
- Support of self-consumptions and local micro-grid with **external advice** and **energy consulting**
- Constant **increase of complexity** and opportunities for the end-customer – a comprehensive **end-to-end package** (via partnerships) as a potential unique selling proposition

Distribution | New services: Use case "Landau Microgrid Project"



Utilities can benefit from micro-grids by offering data-driven and customer-oriented services – and avoid being reduced to pure infrastructure providers

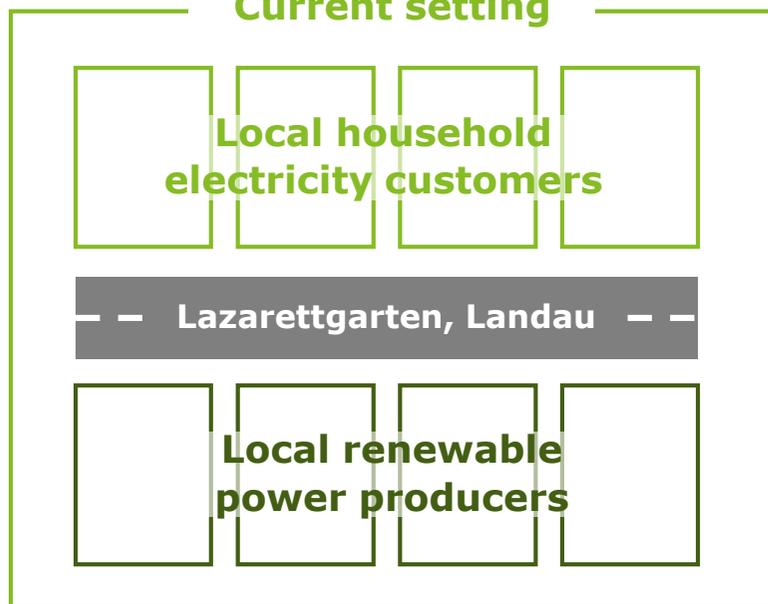


Objective:
Automation of transaction in local energy systems

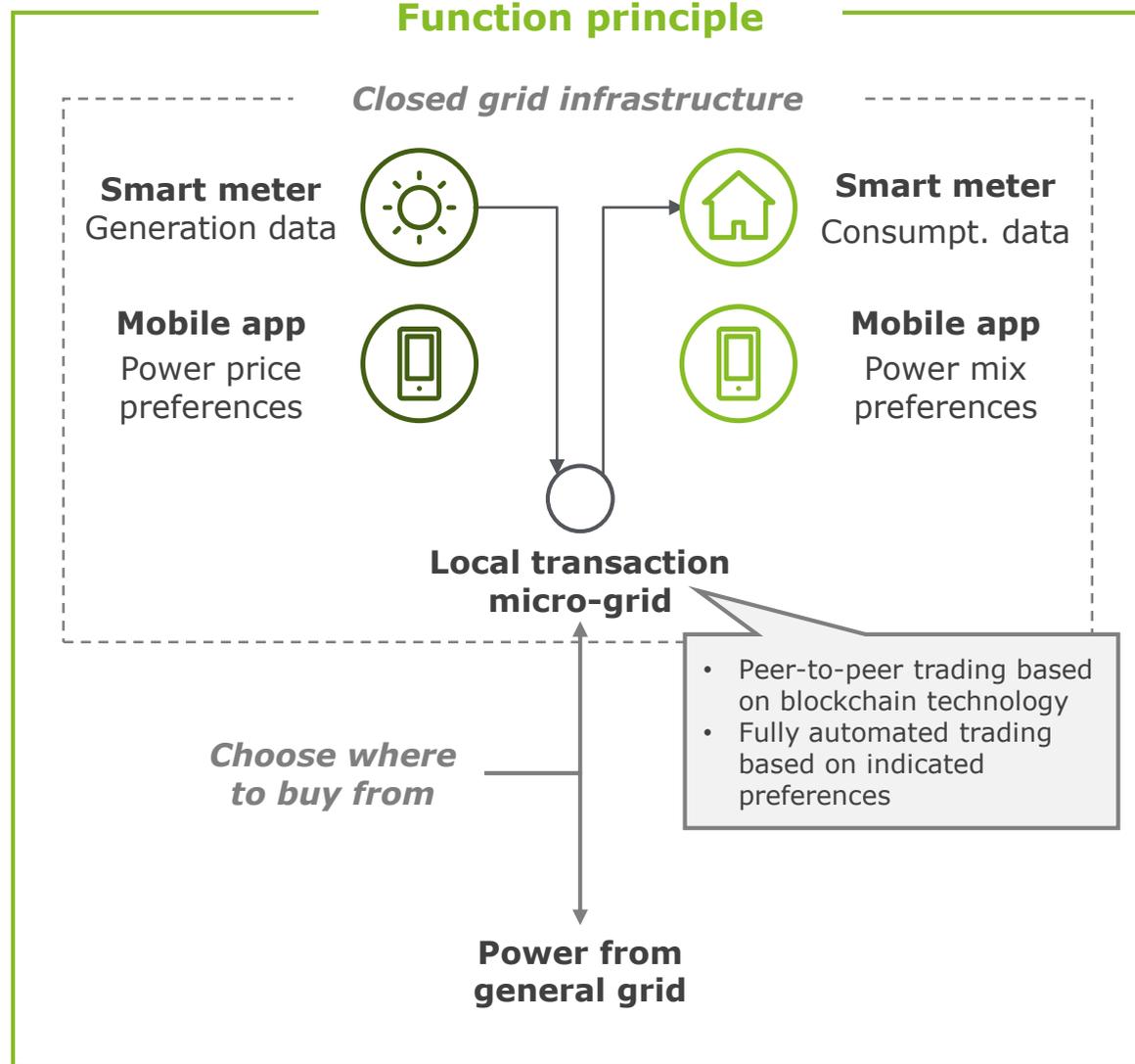


Partners:
Karlsruhe Institute of Technology (KIT),
Energie Südwest AG,
LO3 Energy

Current setting



Function principle





1

Grid expansion stays relevant with more innovation-driven investments to push for sustainability and digitalization along the entire power value chain

2

Grid operators have to tap into alternative revenue streams, based on changing end-customer behaviors and evolving local opportunities (e.g. storage, micro-grids)

3

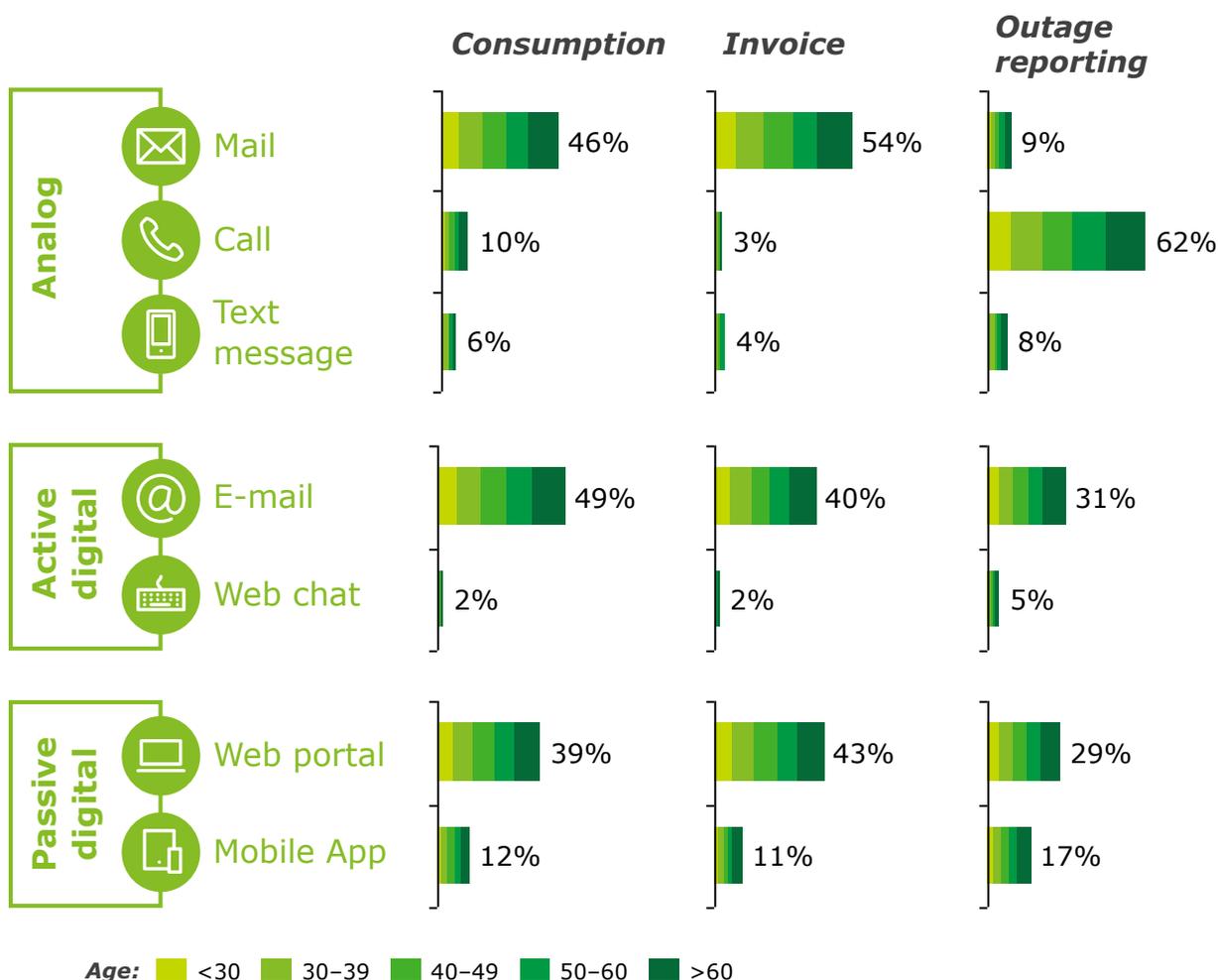
Focus on (critical) infrastructure might be reasonable – but utilities have to develop competences and build partnerships with regard to new infrastructure systems



Consumption | Customer expectations

Customers are expecting change – as our surveys are demonstrating

Preferred customer channels by age group



Considerations

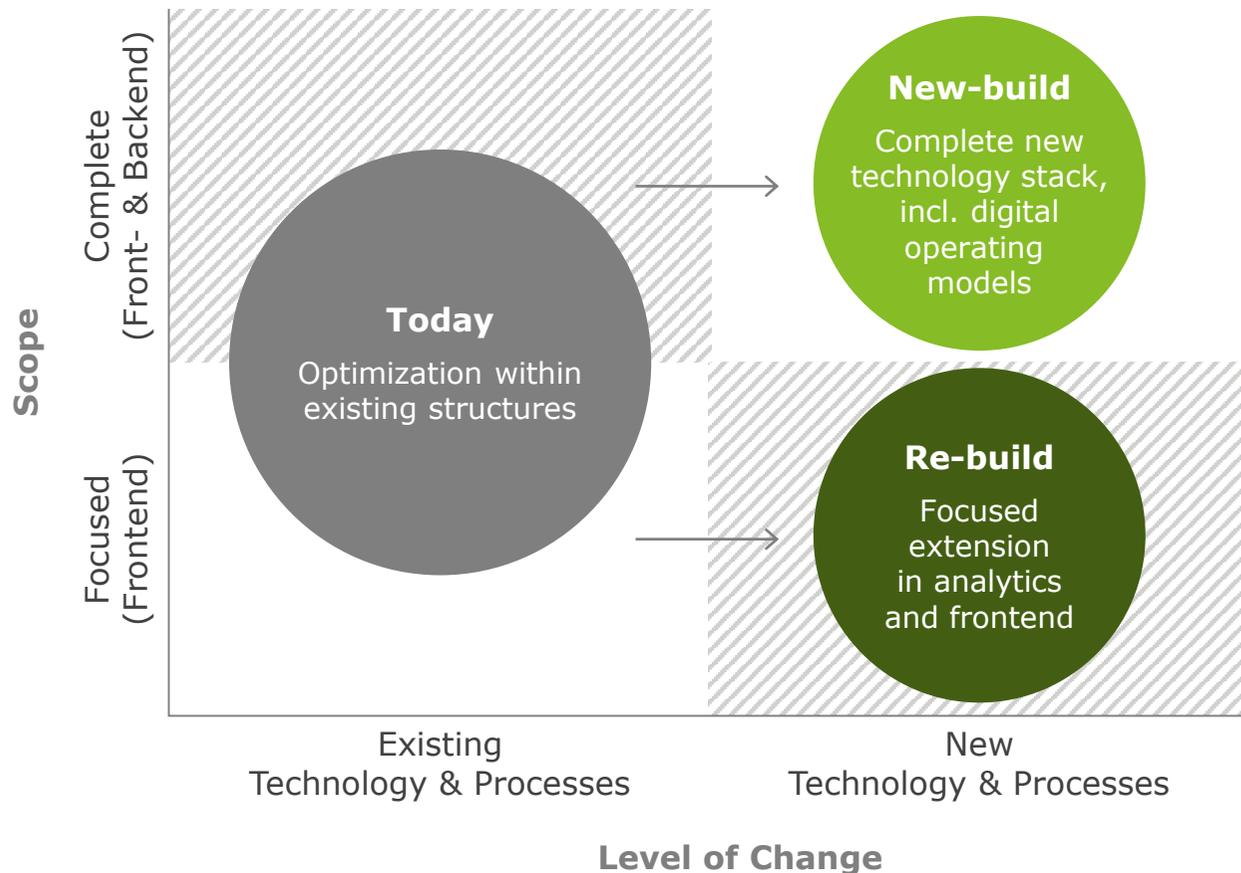
- Customers show their readiness for change by embracing user friendly opportunities to connect with energy and their utility
- Traditional **mail, e-mail** and **web portal** are the **preferred contact channels** for consumption and invoice to easily store provided data
- **Mobile app** is used by 10-20% of participants – integrating other digital channels, the app has the **potential** to become **favorable digital channel** in the future
- **Age** does **not** play a **major role** for contact channel preferences
- Digital readiness of customers **unlocks** future **digitalization** and therefore **cost reduction potential** for **consumption** and **invoice** related information



Consumption | New requirements

To satisfy customer expectations, new requirements have to be addressed – either through re-build or new-build

Approaches to address customer expectations



Considerations

To meet and exceed new customer expectations and achieve competitive cost levels, existing structures require re- or new-build

Main changes & challenges new-build:

- High investment and migration cost
- ... but opportunity to achieve leading cost-to-serve levels and respective long-term competitive edge

Main chances & challenges re-build:

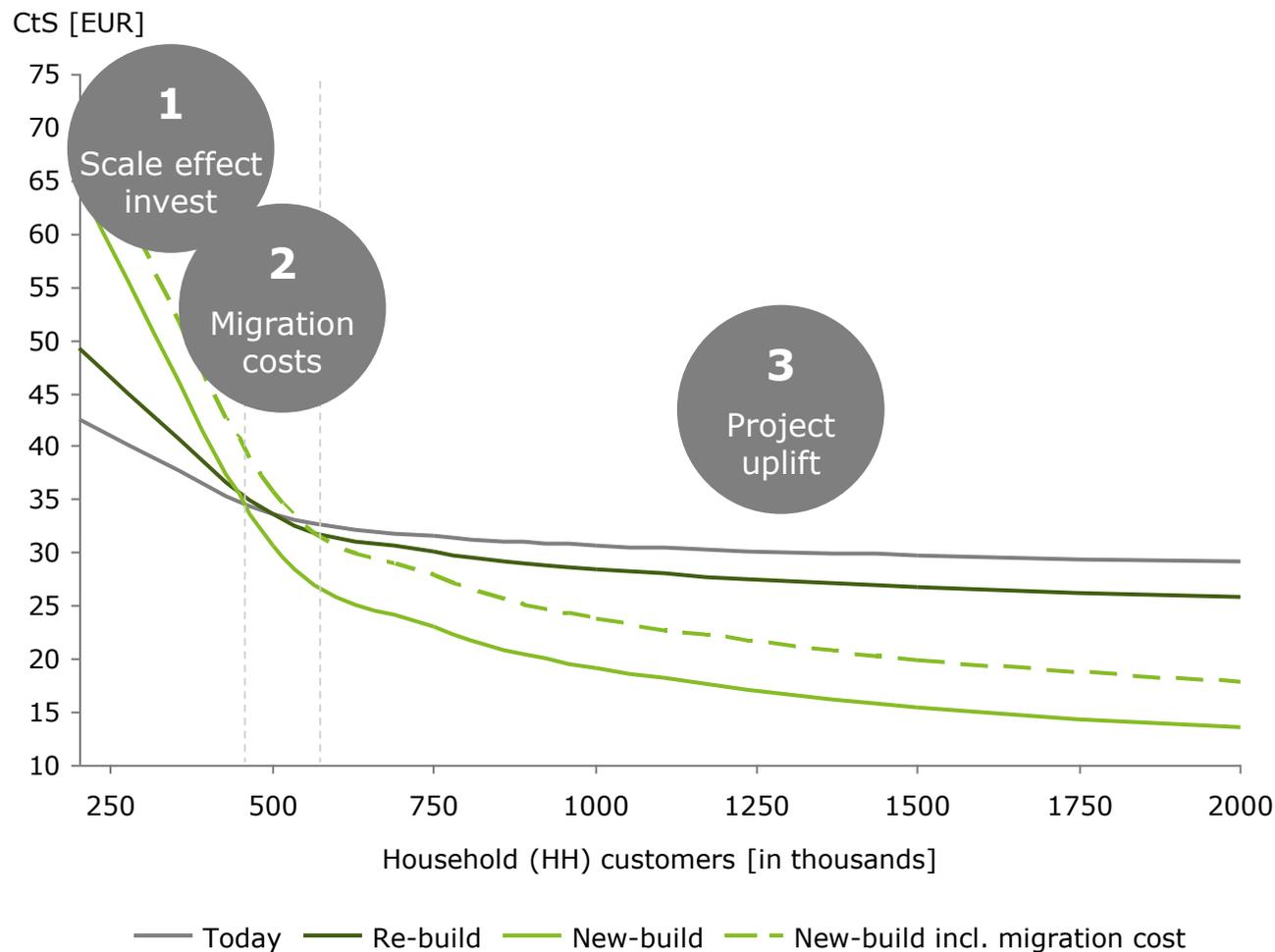
- High cost-of-change and operating expenditure (mainly personal and IT licenses)
- ... but limited investment while enabling more customer friendly and analytic-based frontend



Consumption | Cost implications

New-build results in significantly lower costs – even though these are only becoming effective as of larger customers numbers

Cost-to-Serve analysis



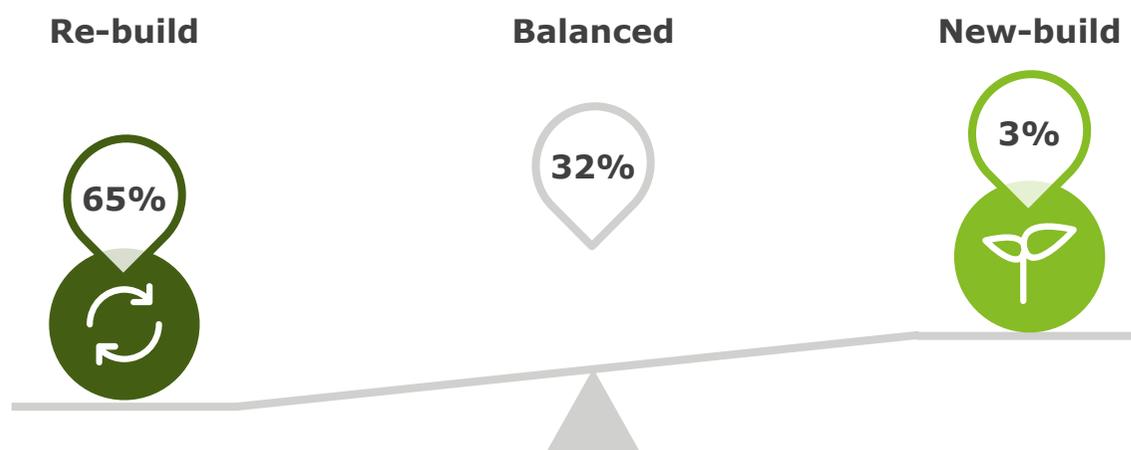
Considerations

- German **utilities below 400,000 household customers are lacking scale** for own new-build initiatives
- Therefore small utilities **should cooperate** and **bundle** their digital back- and frontends to also achieve competitive CtS (Cost-to-Serve) levels in the near future
- Depending on migration costs to shift existing customer groups towards a digital only operating model, utilities with **over half a million** household customers might **benefit from new technologies and processes** outside existing structures
- For large utilities with **over a million** household customers it is prudent to **pursue a digital pure play model** to achieve all-in CtS of 10 EUR per household and lower

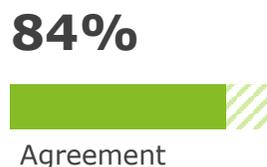
Consumption | Market reality

However, re-build currently seems to be the preferred option amongst German utilities

Dominance of re-build



Insights:



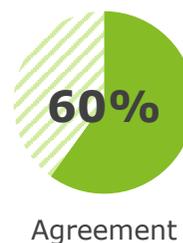
Funding for planned transformation available



Time frame of planned transformation within next 1-4 years



Transformation will lead to scale and synergies effects



Capabilities and resources for planned transformation are available

Considerations

- **Only 3%** of German utilities currently **prefer new-build** for single system stacks (e.g. smart meter data systems)
- 32% are uncertain with regard to re- or new-build and might try to use existing systems to cope with new customer demands
- **84%** of German utilities ensured **sufficient funding** for upcoming re- and new-build initiatives, of which **71%** will take place **within the next four years**
- Around **two thirds** of respondents see the planned transformation as a **means for scale and synergy effects**, where a joint digital backend or platform unlocks the full potential
- 40% of German utilities lack required capabilities and/or resources and demand for **external expertise**



Consumption | Outlook: Energy-as-a-service

New capabilities, though, are needed to unlock value and higher margins of the increasingly growing field of Energy-as-a-service

Energy-as-a-service – outlook

Application	Service	Technology	Players (%)
Security of Supply	Ancillary Services	Platform	16
	Energy Storing	Batteries P2X	23
Enabler Energy Transition	Energy Steering	Smart Meter	18
	Self-generation of RE (by Leasing)	PV	7
Energy Cost Optimization	Energy Saving	App Frontend Algorithm	21
	External Supply Optimization	Database	15

Considerations

- “Service”: **Absence of pure hardware or commodity sales**
- Countermovement to commoditization of recent times: **Conscious generation of non-transparency** by offering abstract, new or combined services (example: batteries can be better sold in combination with other services as they are often not profitable stand-alone)
- Main advantages of new players: **Increased customer loyalty** due to offering of mid-term contracts and opportunity to realize **high margins** (due to lack of comparability)
- Nevertheless, we expect to see also **industry consolidation in this growing field**, given the large numbers of new players



1

Customers, independent of age, demand leading experience and channel consistency, and utilities now need to deliver a cost effective digital channel landscape

2

Competitive cost-to-serve in the digital-only scenario becomes a matter of scale and small utilities require joint digital platforms to cope with new customer demands

3

Currently, German utilities focus on re-build – but disruption might come from within the industry through new standards being set by “First Movers”, followed by concentration and cooperation

What does this mean for utilities?

Implications | Strategic implications

The changing market realities result in different strategic implications per value chain segment

Implications per value chain segment



Generation

- Build long-term scale by combining conventional and renewable assets as entire portfolio is exposed merchant marketing



Distribution

- Unlocking innovation investment to propel end-customer solutions, while adapting investor base to improve capital efficiency



Consumption

- Integrating commodity and energy-as-a-services businesses into single solution competence for end-customers

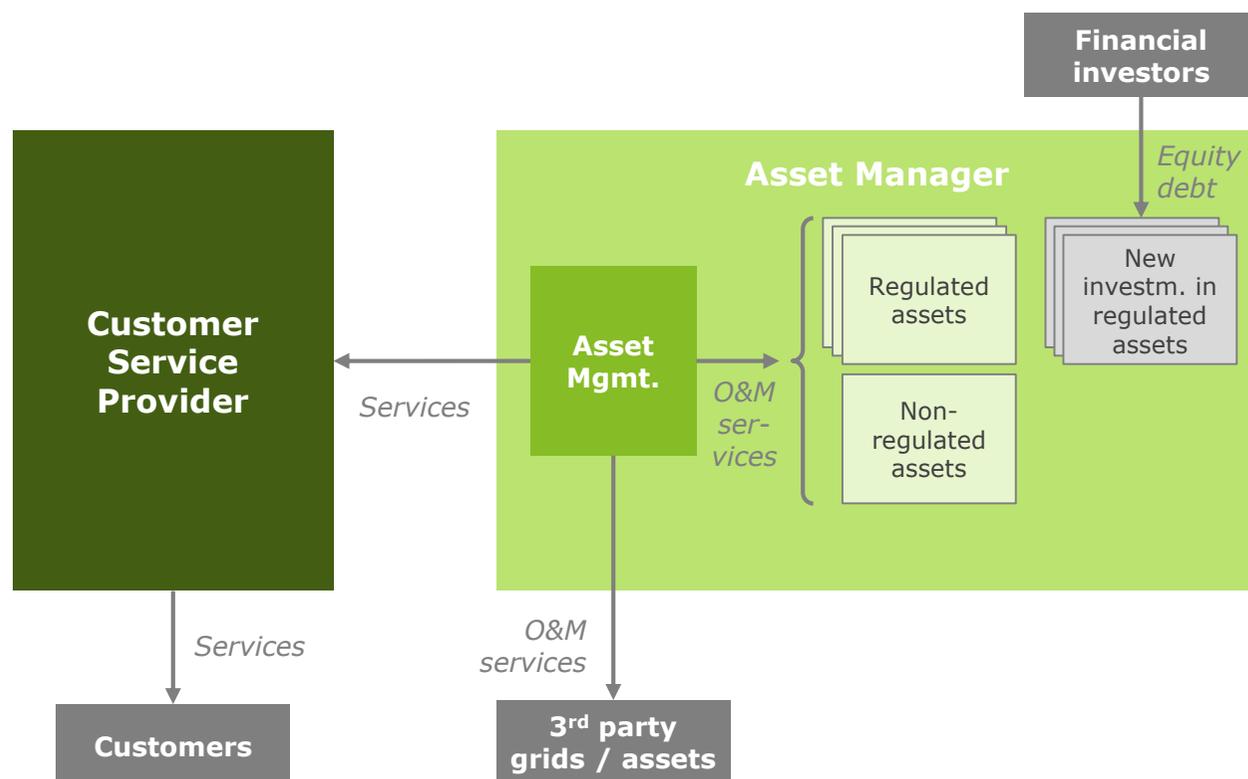
Considerations

- Strive to **even cleaner business models** around different market roles
 - Asset-intensive generation with system responsibility
 - Customer-centric solution business to deliver energy
- Customer-centric business model around a combination of Distribution and Consumption may require **new interpretation of unbundling**
- Regardless, utilities at all levels will have to cope with **stretch between continued cost discipline and agile**, quick-to-market decision making

Implications | Structural implications

In the future, utilities may pursue an asset-light strategy and position themselves as operational and financial asset managers

Potential structure for further development



Considerations

Operational benefits:

- Clear structure and focus on new roles: split between customer service provision and asset management
- Integrated operation: control over grid with grid asset management as basic foundations for build-up of customer solution businesses
- Asset management as separate business unit can focus on acquisition of 3rd party customers for Operation & Maintenance (O&M) services

Financial benefits:

- Wide range of options for asset-light financing to acquire and invest in further assets via partnership with institutional investors
- Additional cash flow from operational asset management services to 3rd parties and from financial asset management services to institutional investors (set-up of own fund)

Implications | Organizational implications

As a result of strategic and structural adjustments, organizational structures and capability requirements will change as well

Organizational implications



Considerations

- With **increasing automation** and **new technologies**, organizational structures will change and require
 - **New talent** with new skill sets (e.g. data miners, service designers, performance marketers and analysts)
 - **Agile approaches** (e.g. to speed up product development to respond quickly to changing customer needs)
- This also implies **changes in leadership / governance** as well as in **recruiting processes**

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