



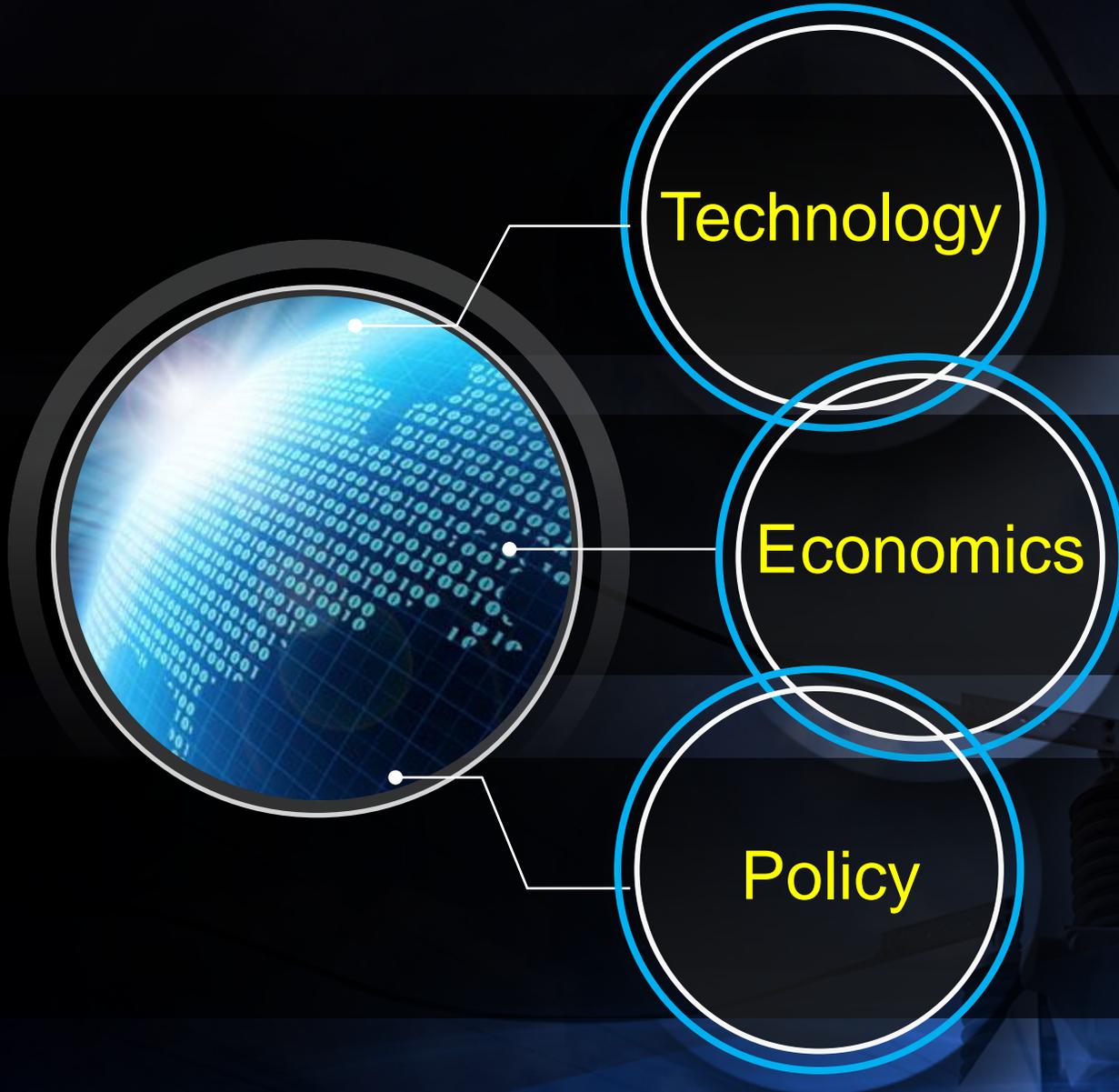
Gridonomics™

An Holistic Overview on the Interaction of Economics, Policy and Technology in the New Energy Ecosystem

Leonardo von Prellwitz

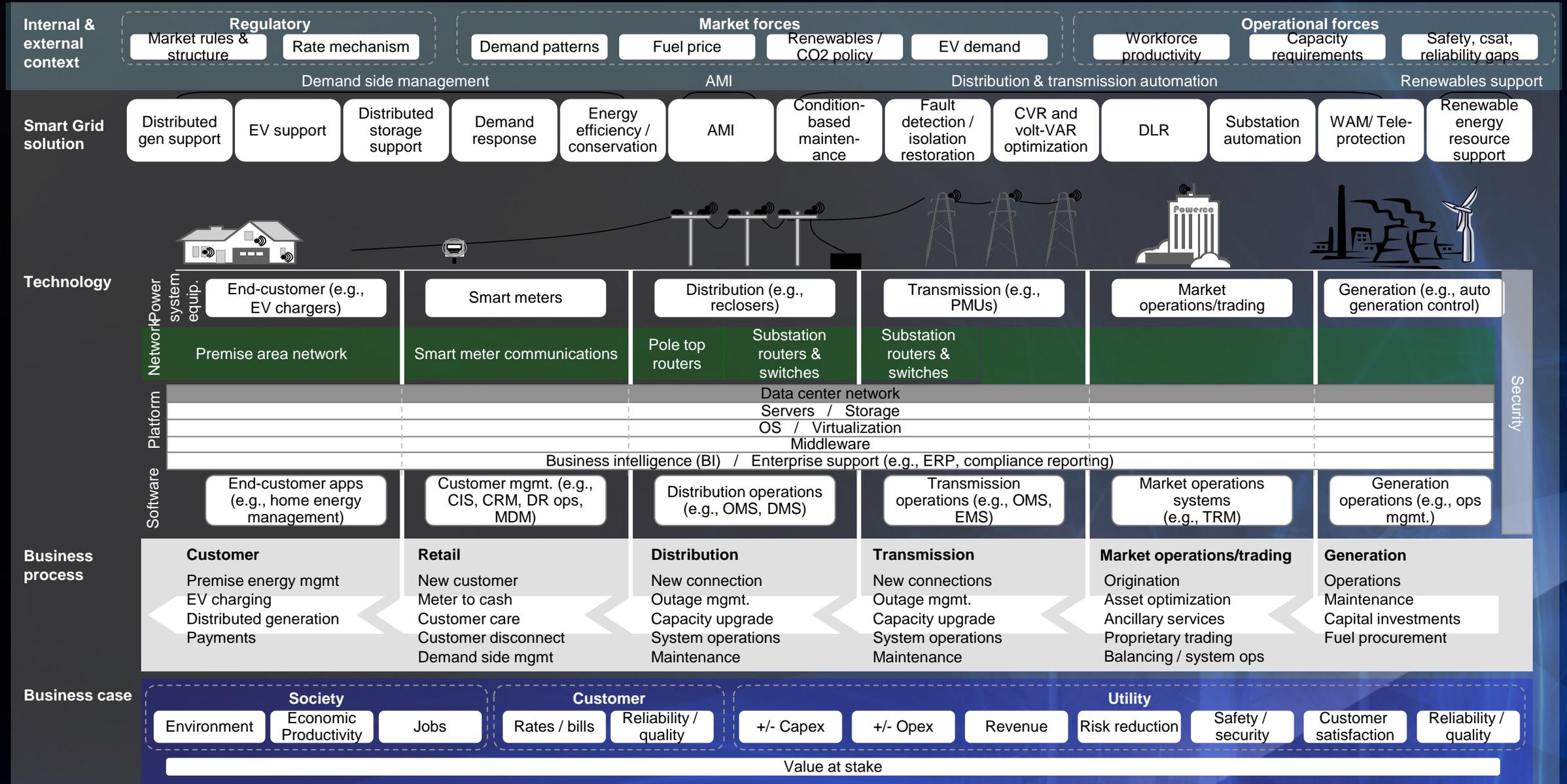
25 April 2012

Global Energy Megatrends



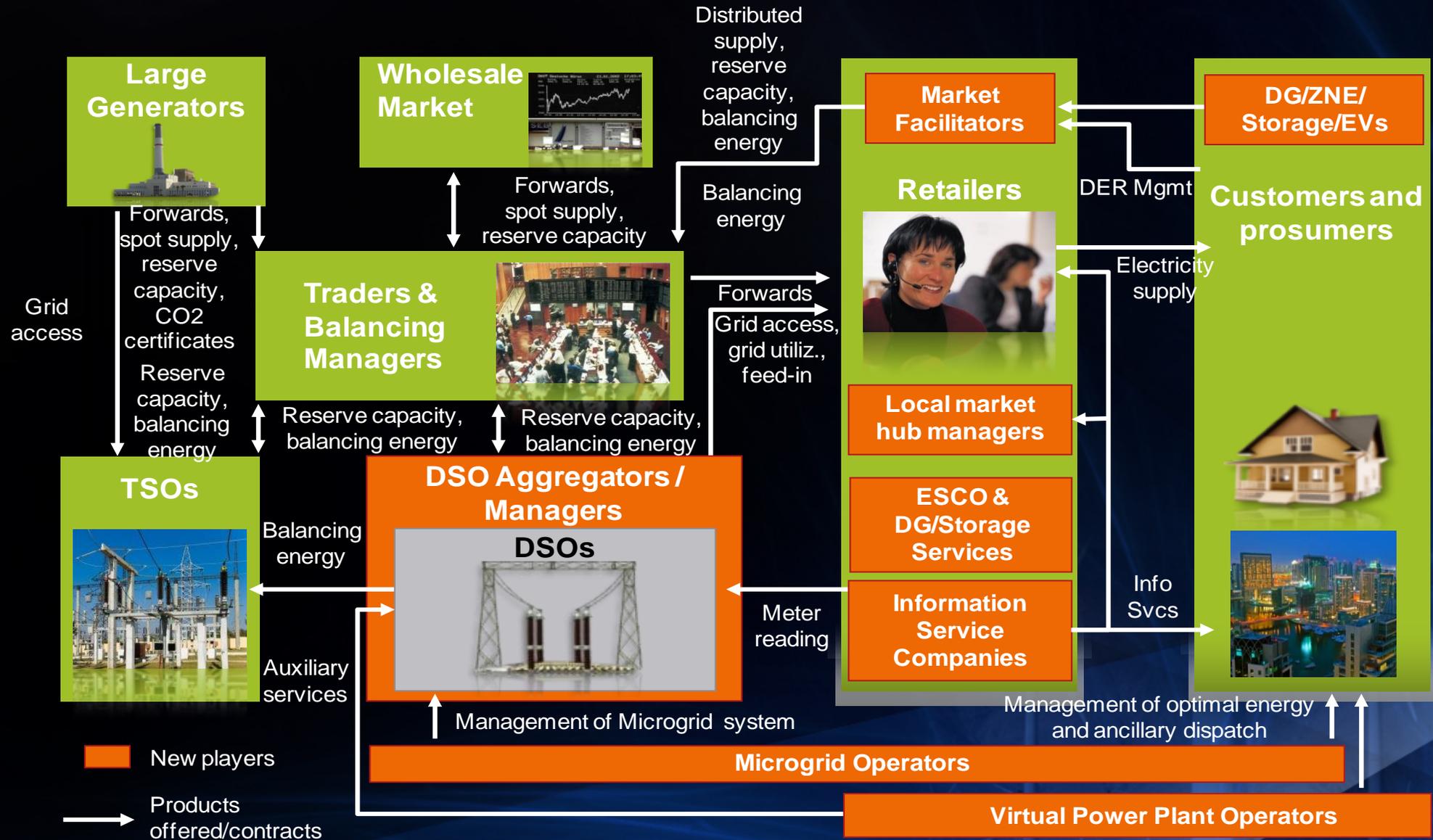
- Network Convergence to Internet Protocol based Platforms
- Increased Variable & Distributed Resources
- Electrification of Energy
- Aging Workforce, Infrastructure
- Consumer Affordability
- Evolving Industry Business Models
- Need for New Regulatory Framework
- Monetization of Value
- Energy Independence

The Gridonomics analysis framework



Economics: paradigm changes in the value chain

Business strategy will be defined by new convergence patterns



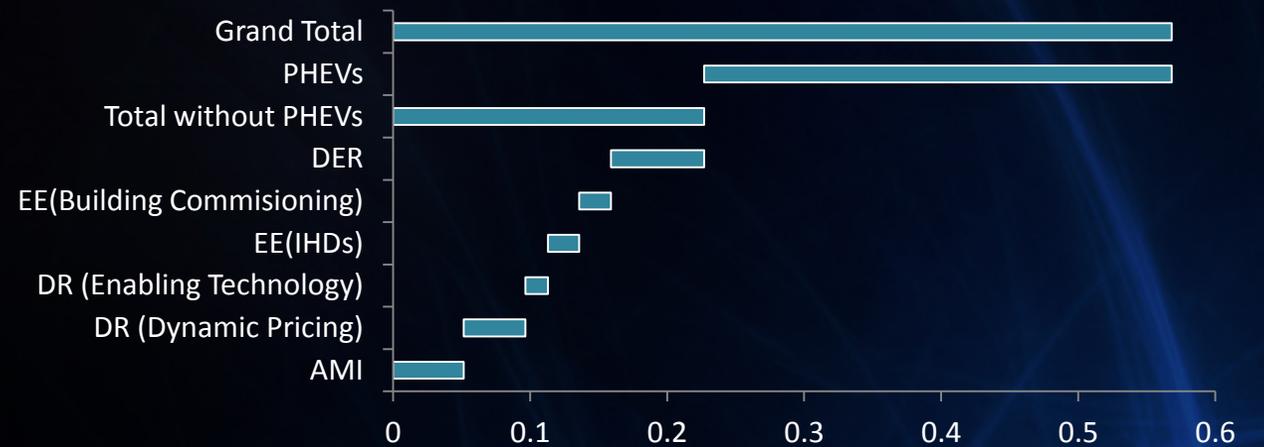
Smart Grid Return on Investment Analysis

Demonstrating and quantifying value creation to overcome existing barriers

SG value creation/capture across the value chain – USD 2bln
Results from Gridonomics 15 year NPV analysis on California



Smart grid value at stake by solution
Value created by different solutions over 2010-2050 (axis in USD trillions)



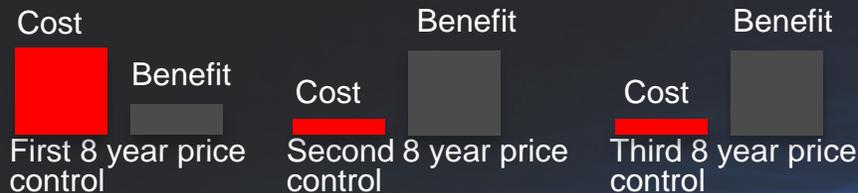
Source: Cisco

Source: Adapted from Brattle

But many mechanisms work against optimal investment choice

Temporal Mismatch between costs and benefits

Front-loaded cost and back-loaded benefits inhibit investments



- Friction in planning over periods longer than the price control periods
- Difficulty in justifying cross-solution investments
- Structural challenges to monetize the potential societal value into tangible customer and business value
- Incentive mechanisms
- Value chain cost-benefit mismatch

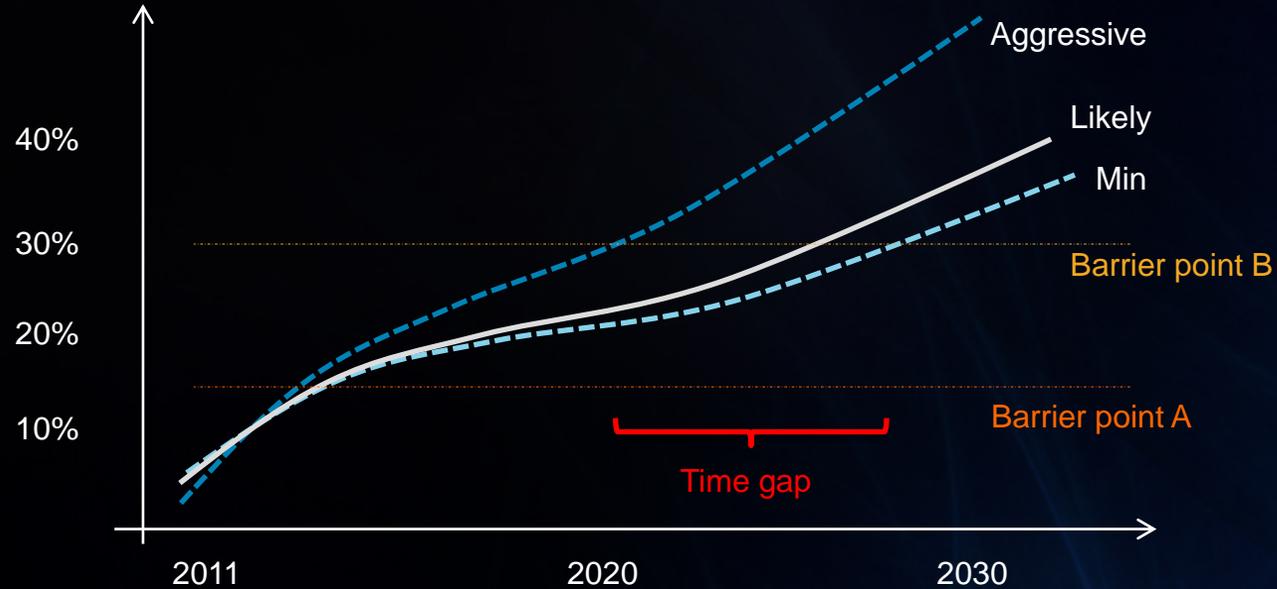
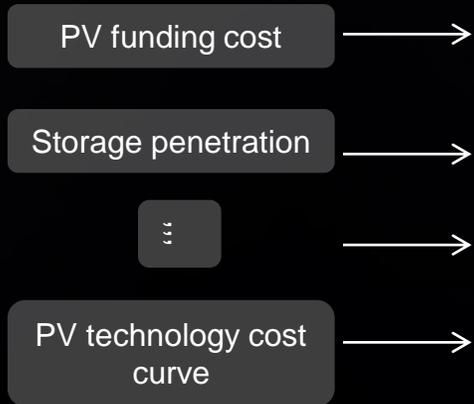
Source: Adapted from Ofgem

Integration of DERs – Implications of penetration

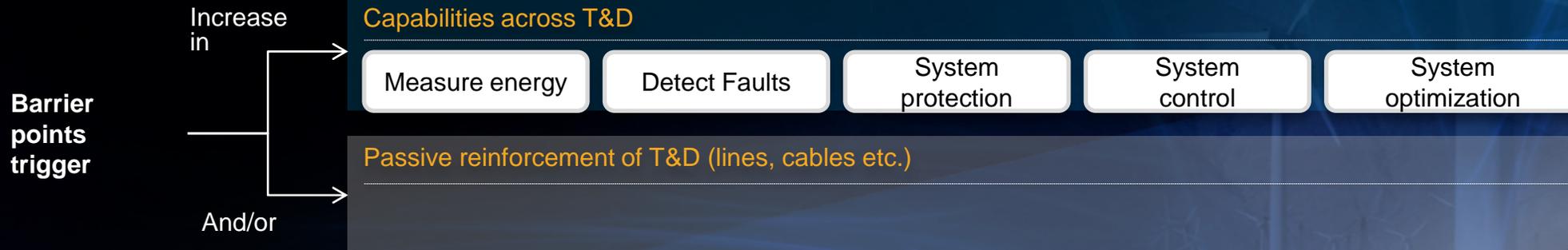
System planning and design should take into consideration uncertainties in their design

Influencing factors

Penetration of Distributed Energy Resources Percentage penetration on feeders (%)



Source: Illustrative example

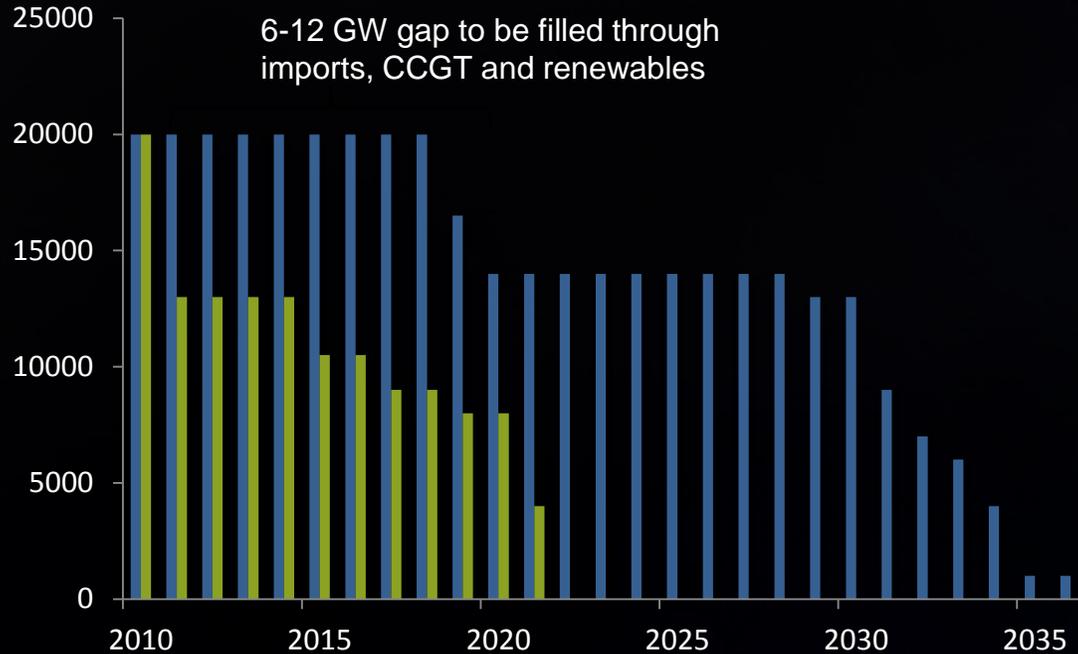


Example I: Regulatory driven fat tails

Nuclear decommissioning causing heavy strain on aging grid

Accelerated nuclear decommissioning in Germany

MW decommissioning old plan (blue) versus new 2011 plan (green)

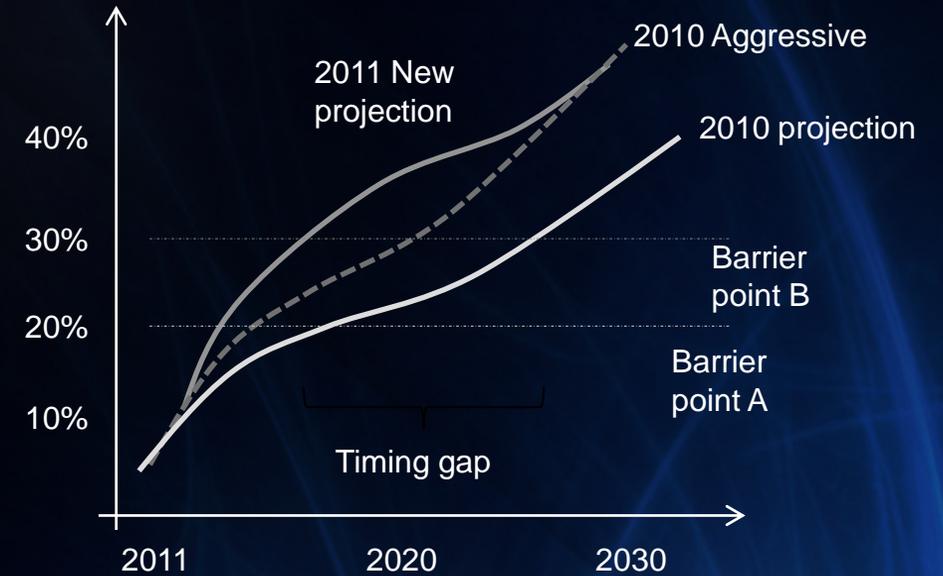


Source: EnBW

Effect of regulatory impact on VER rollout

Average VER penetration forecasts pre and post regulation

Average VER penetration



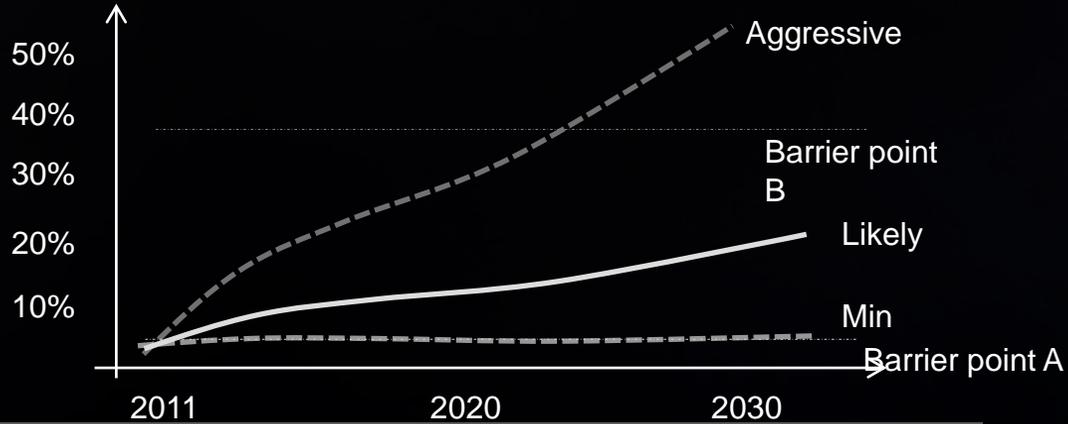
Source: Illustrative

- In 2011 Germany accelerated the long term decommissioning of its nuclear portfolio, that is causing many headaches on the grid companies that have to accommodate the new requirements posed by up to 7GW of solar PV and even more Wind coming online to fill that gap
- Given the long lead times needed in Transmission and Distribution construction will take years to fill the requirements gap: this highlights some of the problematics that arise when there is no flexibility to offset fat tail events
- In this case the option for flexibility could be equated to value from insurance

Other factors: Direct and indirect effects

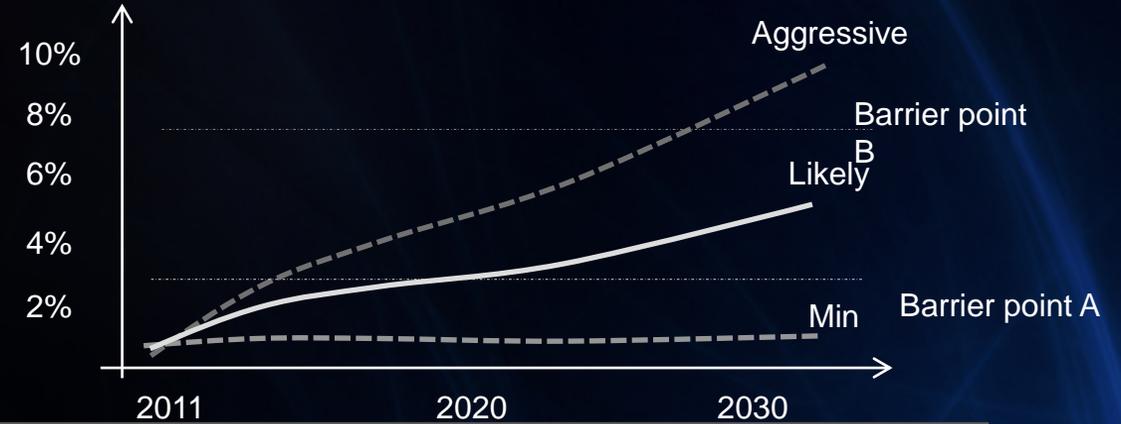
Looking beyond the direct drivers to hedge against derivative effects

Dynamic pricing participation rate
Percentage penetration by customers (%)



Source: Illustrative

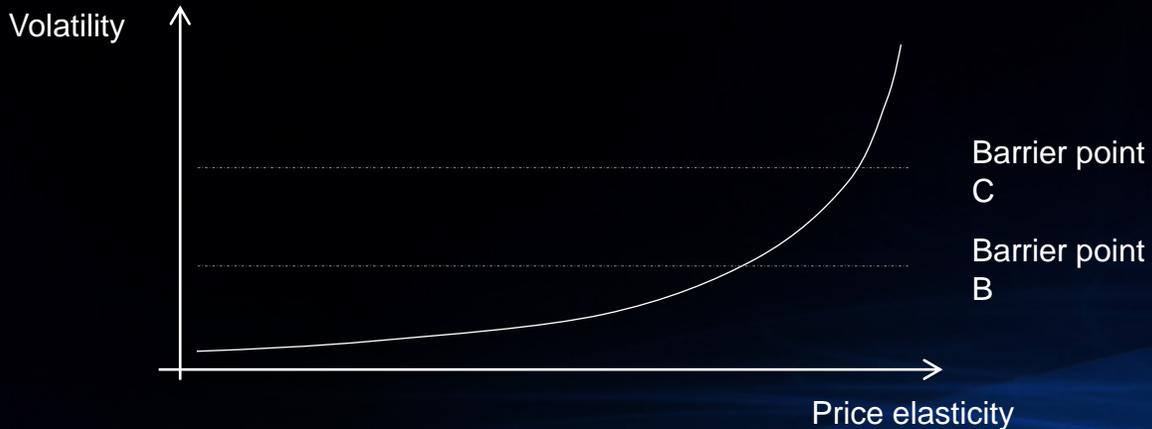
Storage penetration
Percentage penetration for blended customers (%)



Source: Illustrative

DIRECT IMPACT

Volatility versus real time pricing
Representation of volatility curve effects



Source: Adapted from (Roosbehani & Dahle 2011)

- Dynamic pricing, DSM, DR and storage help increase price elasticity and thus have derivative repercussions that might push the requirements on the underlying platform even further than the direct effects of these technologies
- An example of that is the system volatility that might increase exponentially through the elasticity effect of demand side technologies

INDIRECT IMPACT

Q&A





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Thank you.