SYSTEMIQ

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The macro challenge: electrification and decarbonisation

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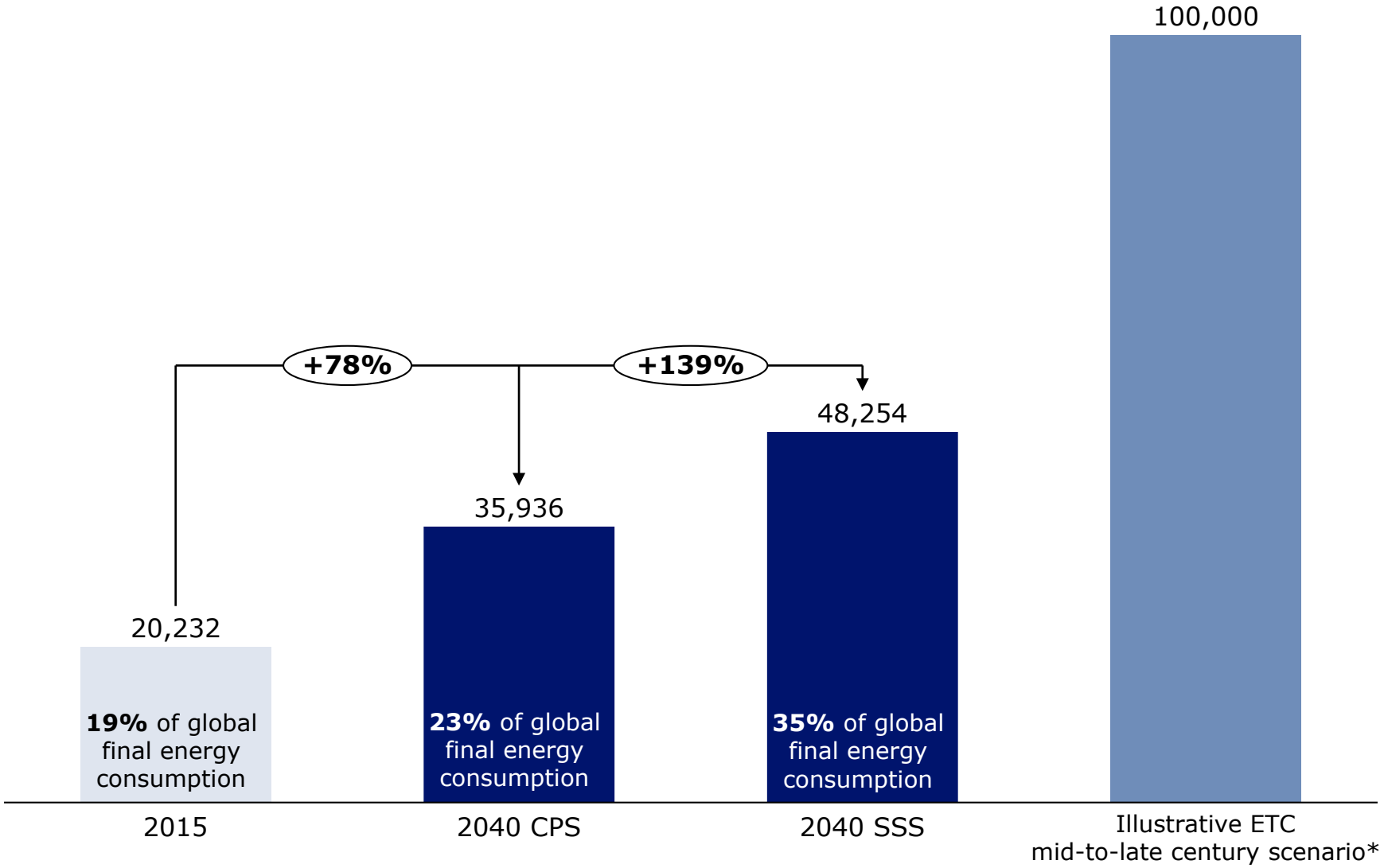
Economic growth combined with the electrification of new economic sectors will trigger significant increases in power demand globally by 2040 and beyond

Global power demand in 2040 according to different scenarios (TWh/year)



Note on scenarios

IEA's Current Policies Scenario (CPS) constitutes a conservative base case, assuming a continuation of current policies and no step change in climate action.

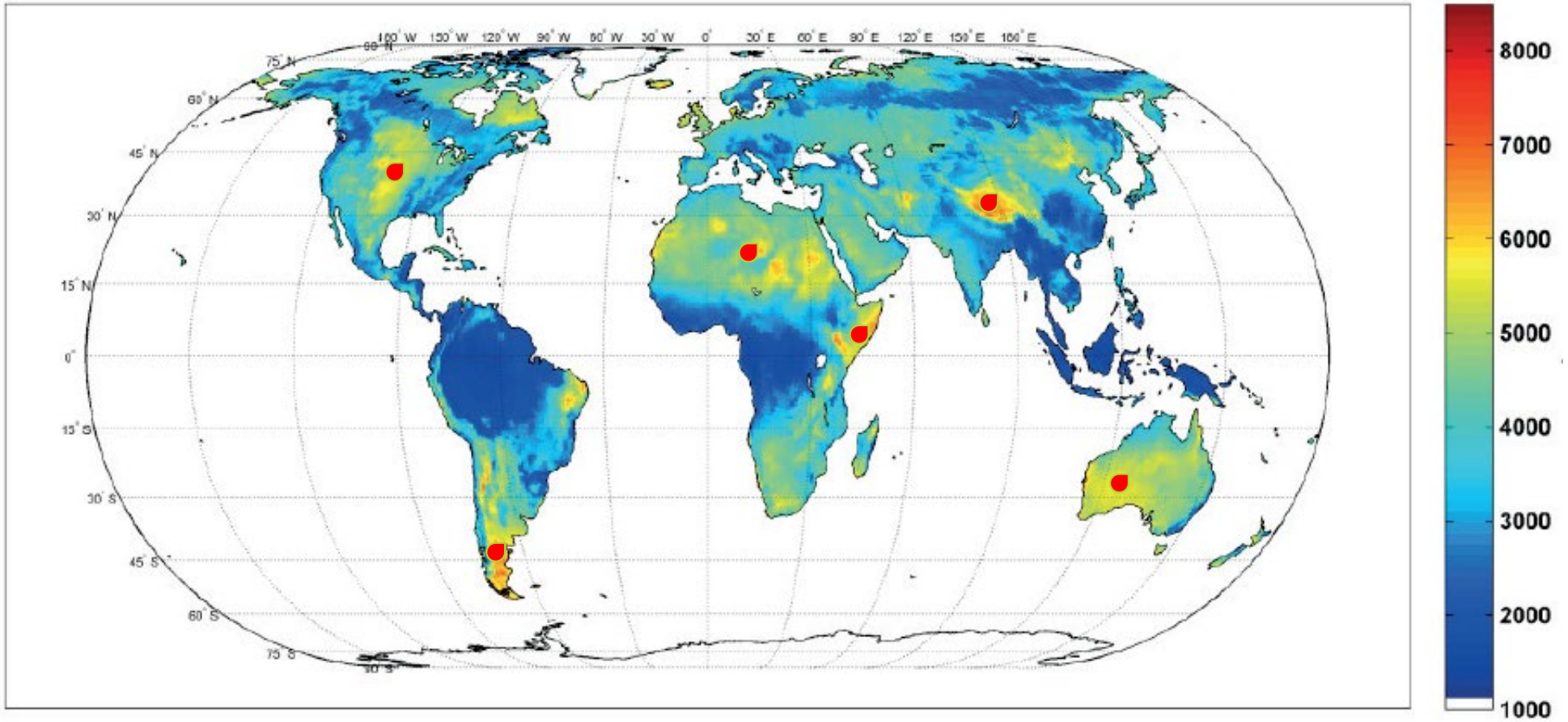
Shell's Sky Scenario (SSS) constitutes an aggressive energy transition scenario, combining step changes in energy productivity, renewables expansion and electrification of the world economy.

Source: CPS = IEA's Current Policies Scenario from World Energy Outlook (2017) / SSS = Shell Sky Scenario (2018) / *Preliminary results

Only a limited number of regions will benefit from a good combination of wind and solar, and long-term storage is too expensive to get to 100% renewables in other locations

Hybrid solar and wind full load hours adjusted by critical overlap in 2005

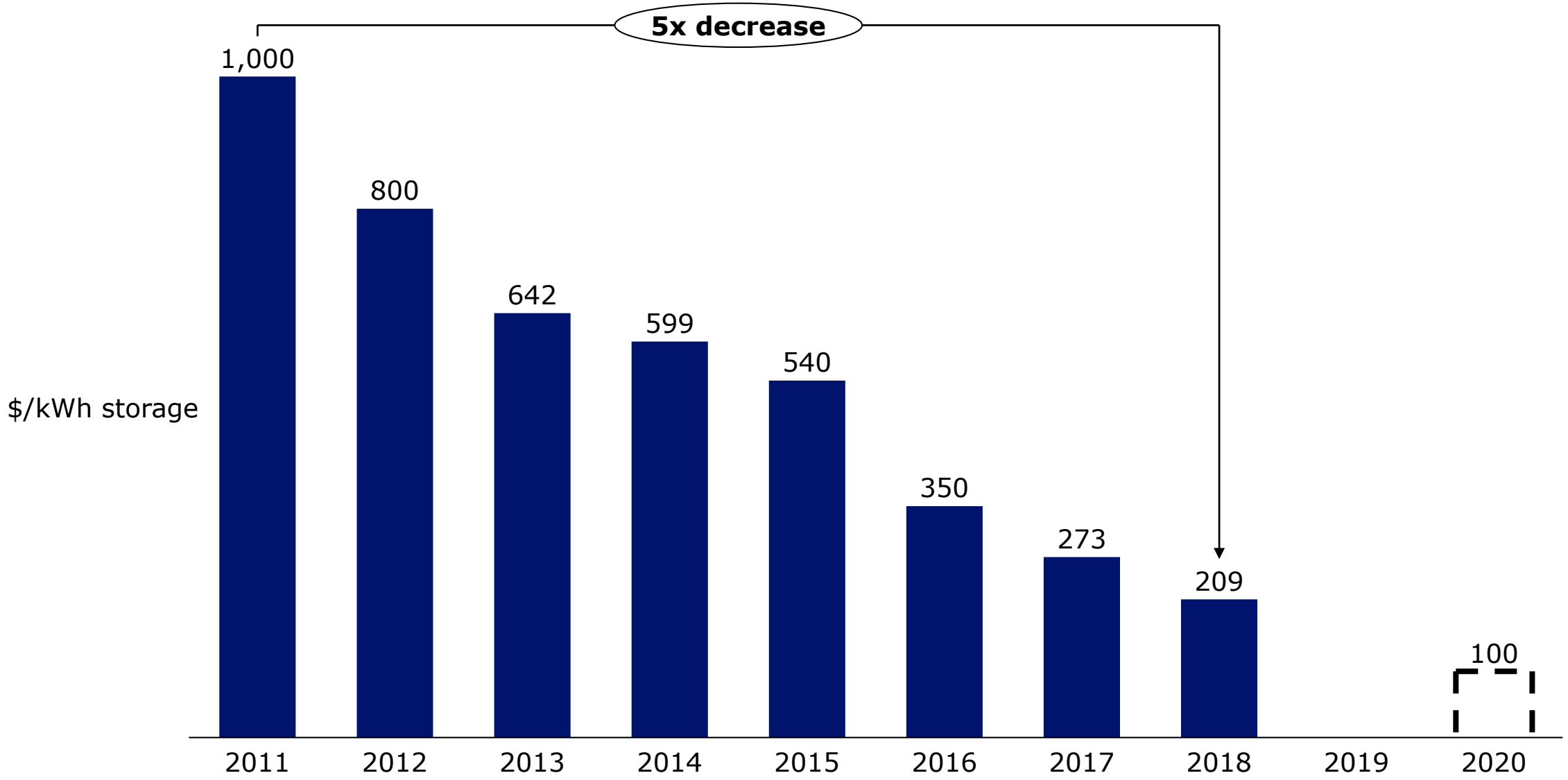
Full load hours per annum



Source: IEA (2017), Renewable energy for industry.

… but the cost of batteries, used to bridge daily flexibility needs, is plummeting…

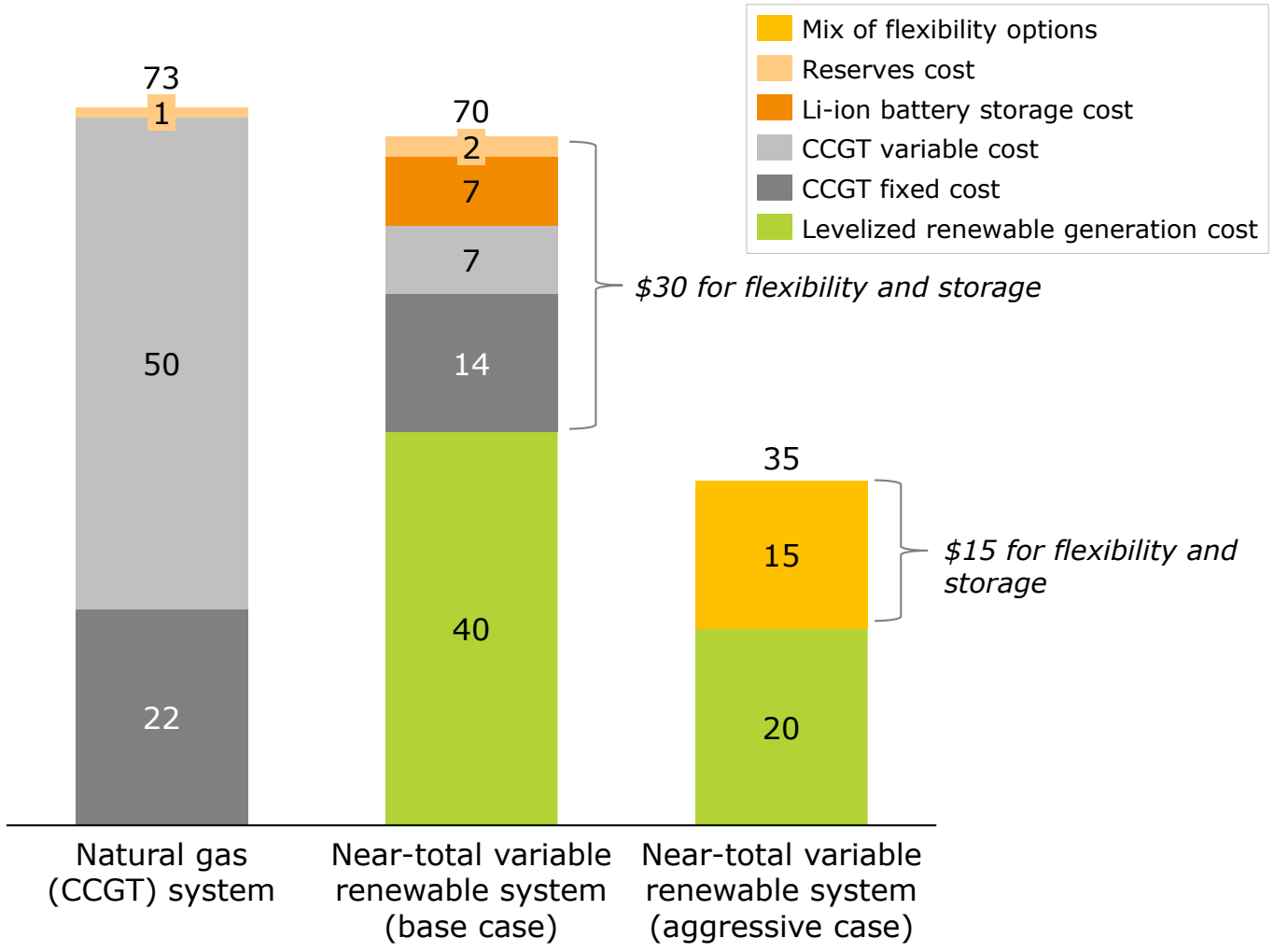
Lithium ion battery prices ($/kWh of storage)



Source: Bloomberg New Energy Finance, 2018

… making baseload renewable-based power systems increasingly cost-competitive

All-in cost of power generation by 2035 ($/MWh)



$70/MWh Maximum in most geographies

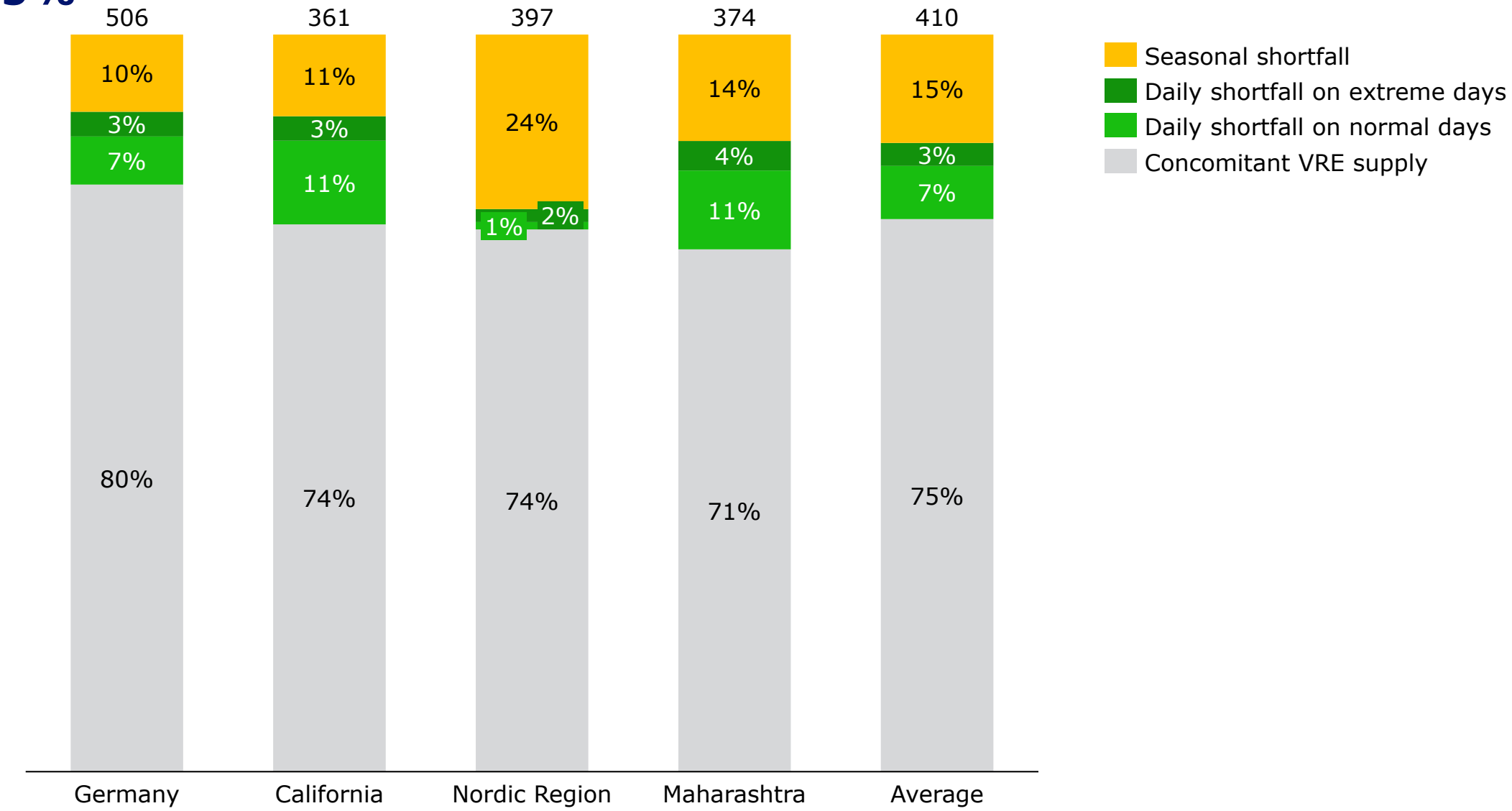
$55/MWh In most geographies when using other sources of flexibility (e.g. dispatchable hydro, demand management, industrial production timing, hydrogen production timing…)

<$35/MWh In favorable locations for cheap renewables generation

NOTE: Based on Germany resource and load profile. / Base case considers only 2 flexibility technologies: CCGT & Li-ion batteries / Levelized renewable energy generation cost includes all energy potentially produced, including amount curtailed or stored/shifted.

Source: Climate Policy Initiative & ETC, 2017, *Low-cost, low-carbon power systems*. & SYSTEMIQ analysis

In near total variable renewable power systems, regions with different climates show daily flexibility needs of 10% on average and seasonal flexibility needs from 10 to 25%

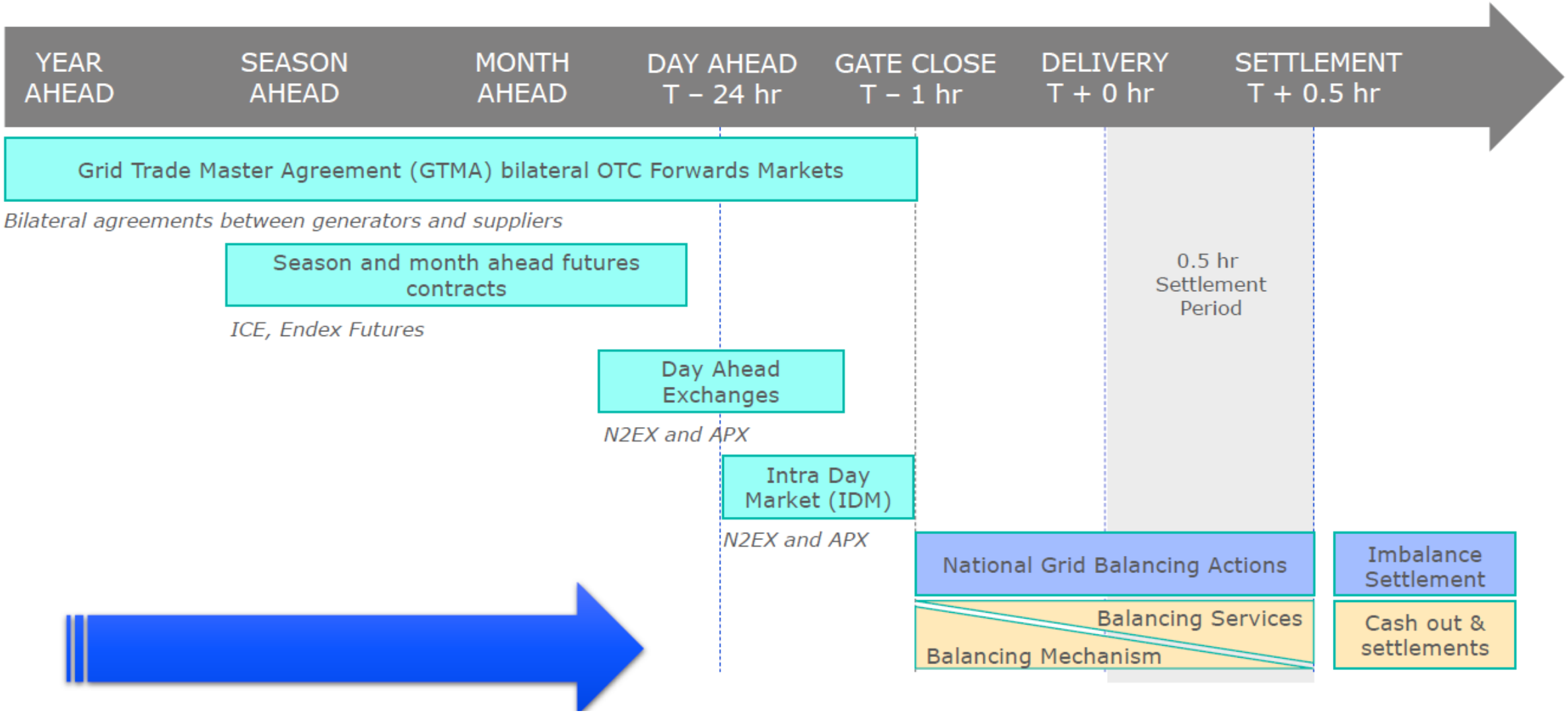


Source: Climate Policy Initiative & ETC, 2017, *Low-cost, low-carbon power systems*.

The micro challenge: flexibility and fast interconnection

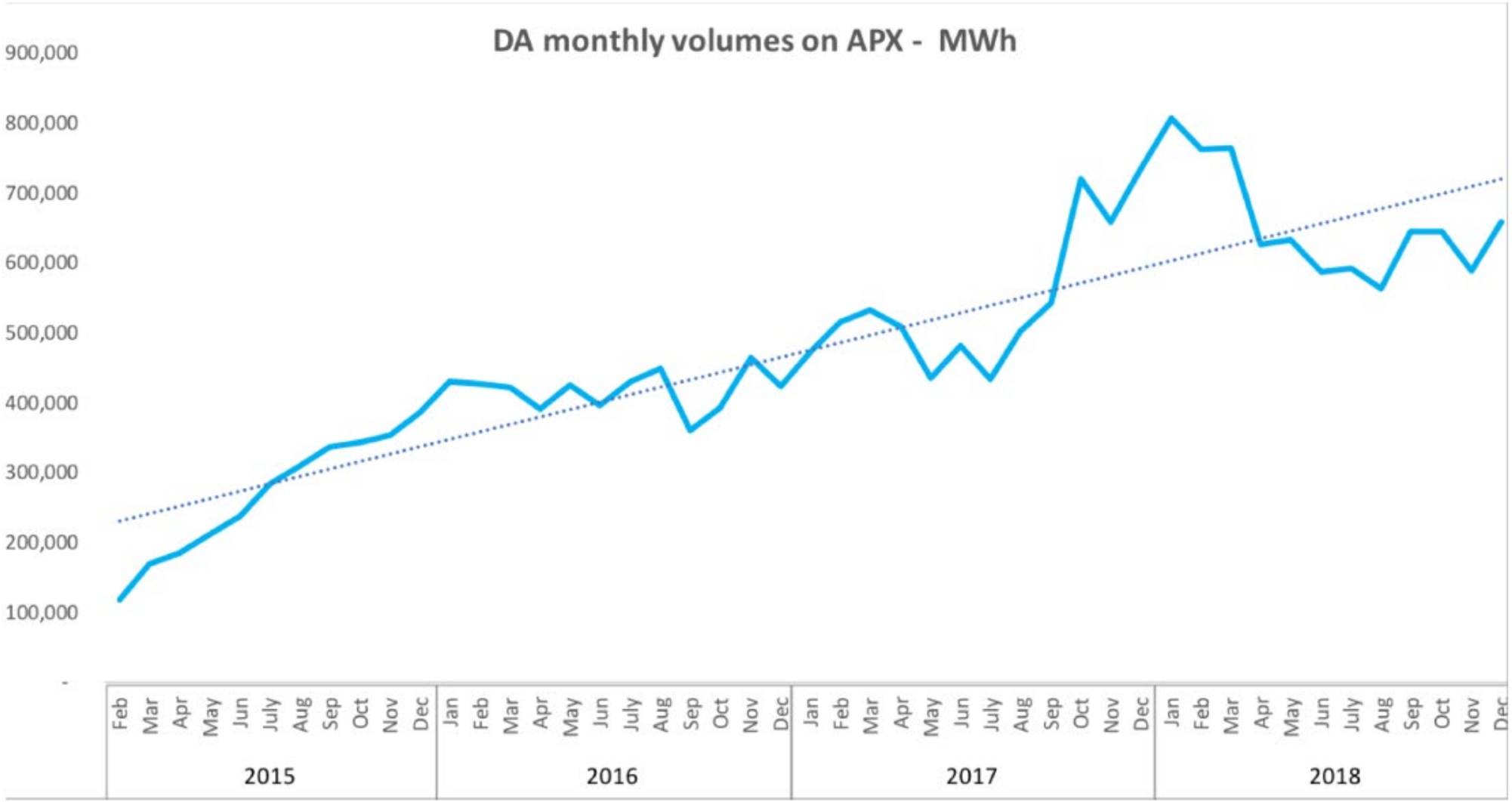
The balancing of electric systems is moving closer to real time

UK Example



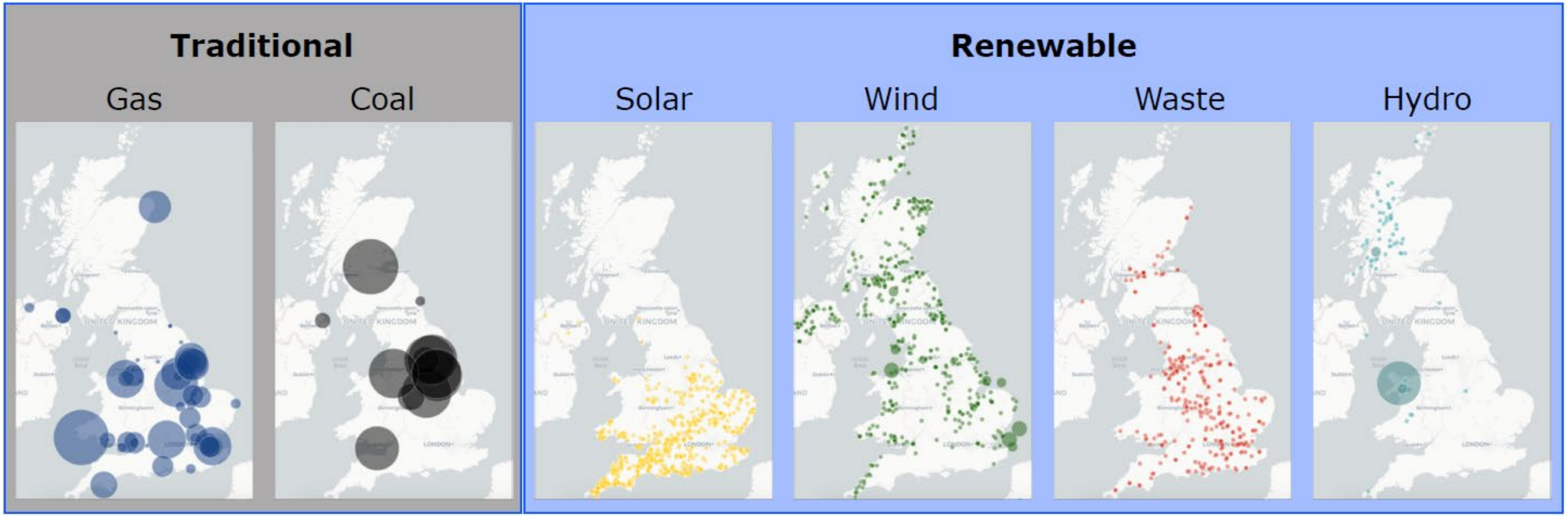
Source: Upside Energy

Day-ahead volumes in the UK have increased by 640% in the last 3 years (53% CAGR)



Source: APX

At the same time, the increase of renewable generation is becoming highly distributed



Source Carbon Brief – "Mapped: How UK generates its electricity"

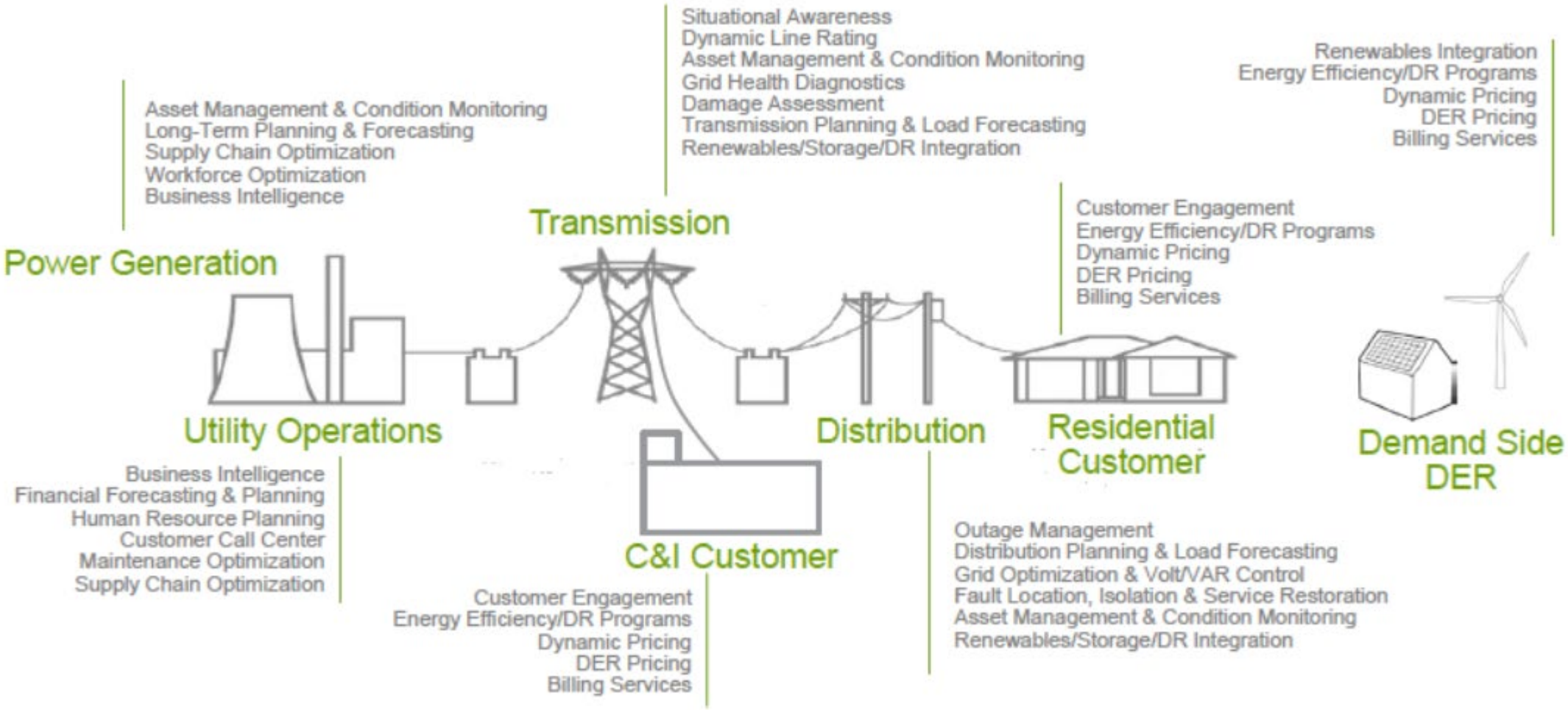
To manage this transformation the utilities will need adapt both their operations and IT systems

Velocity	Operate in real time and deploy assets rapidly
Intelligence	Control assets in real time and volume with the ability to forecast, optimize and analyse
Volume	Manage large numbers of highly distributed assets
Integrated	Integrated with own and third party systems and markets
Diversity	Manage diverse energy resources

Source: Upside Energy

Flexibility adaptation will require change across the utility value chain

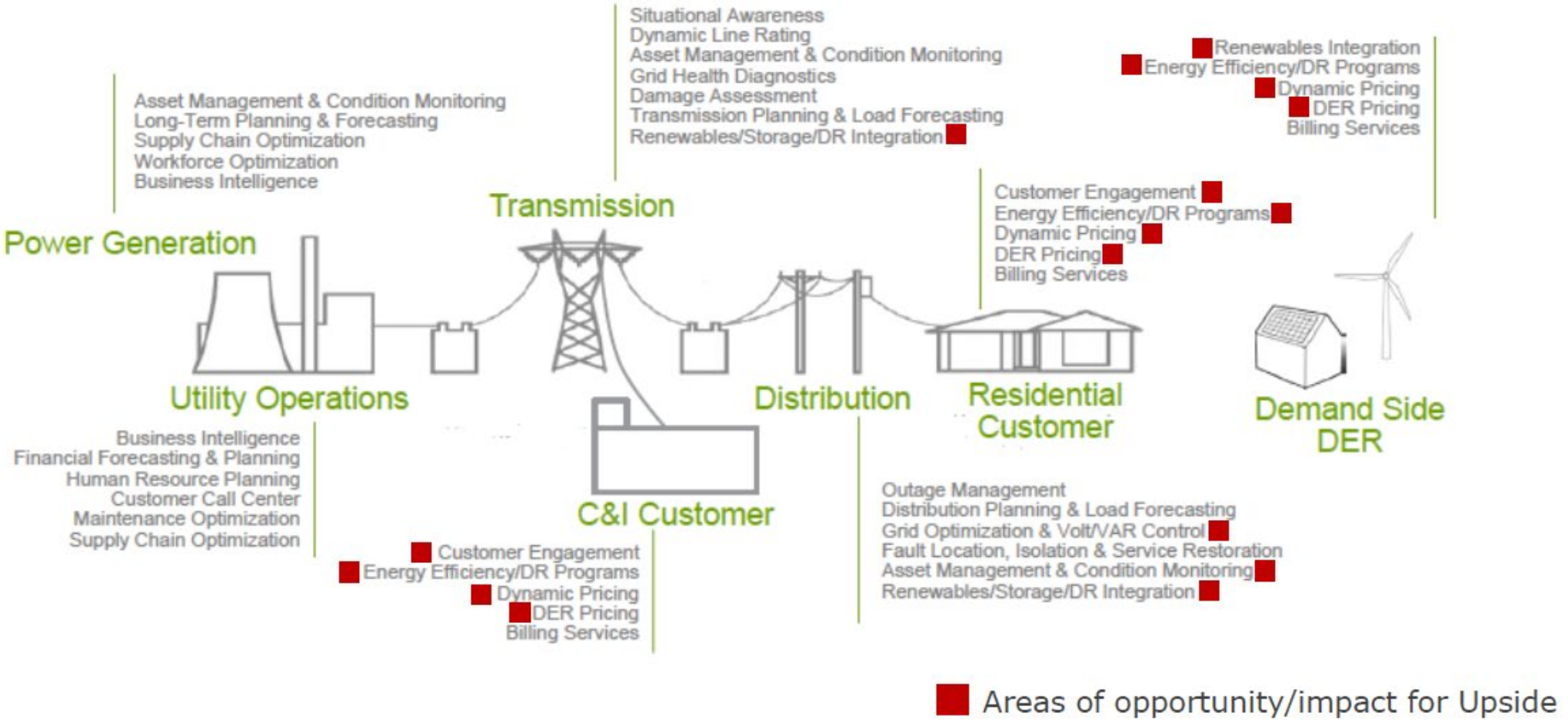
Utilities increasingly require advanced software solutions to adjust to the fundamental shift from centralized generation toward a mix of distributed energy resources (DER) and smart grid solutions. Dozens of grid emerging applications are currently being explored and deployed by utilities.



Source: Upside Energy

… creating significant opportunities for software companies like Upside Energy

The energy system efficiency could significantly increase with the application of machine learning to analyse home and business energy demand, aggregate energy storage provision to provide flexible capacity and offer demand response solutions. Regulation needs to evolve towards a new power market design.



Source: Upside Energy