Evaluating Modular Microgrid Solutions for Remote Communities, Campuses & Critical Infrastructure

IDEA conference - Jun 11th, 2018

Alif Gilani

The energy systems are changing dramatically

From monopoly power …


… to deregulated markets.


From downstream power delivery …


… to smart distribution and bidirectional power flows.

From top-down topologies …


… to autonomous local structures.

From predictable long-term value streams …


… to versatile, value-based transactions.

Today's Energy Landscape

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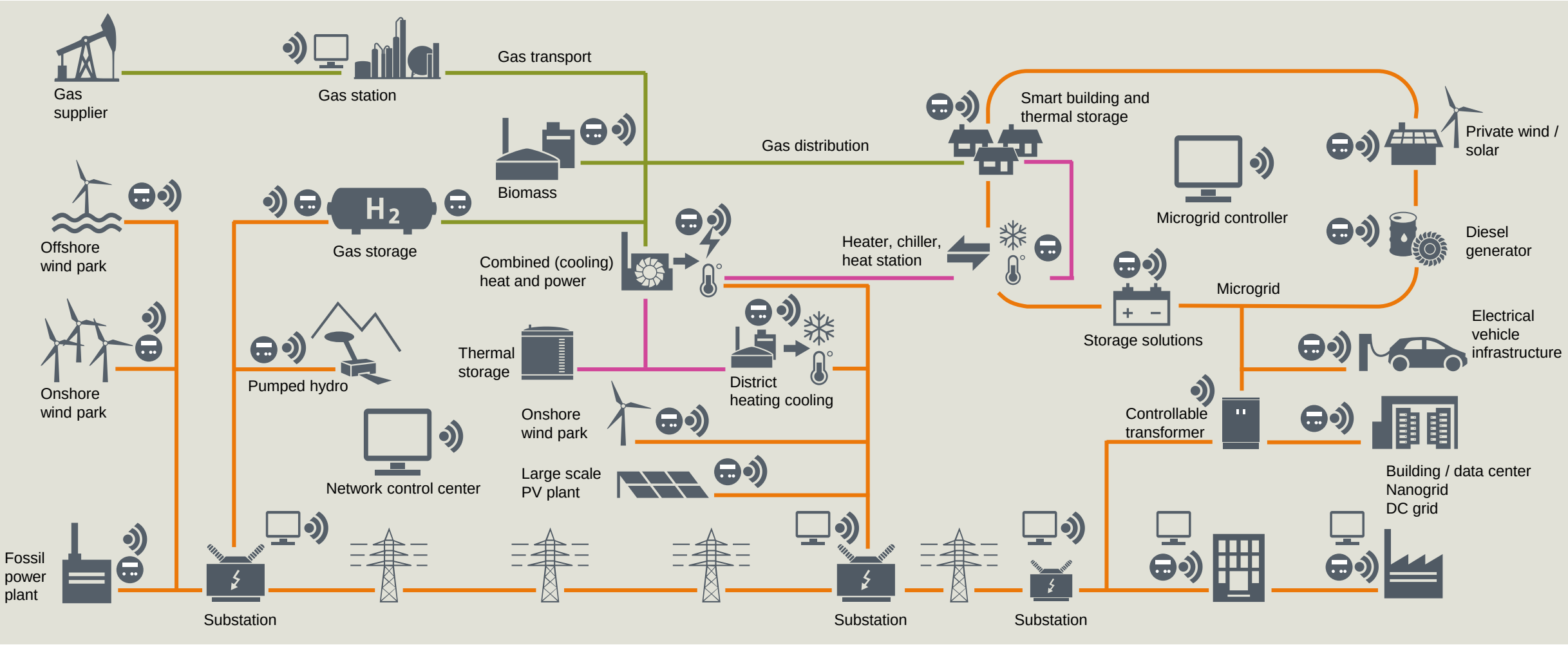

Increasing electrification in all sectors
Heading towards an all electric world

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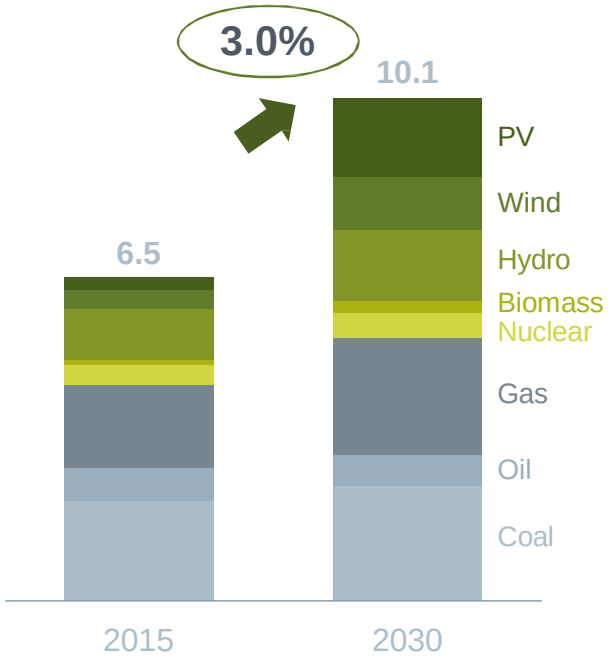
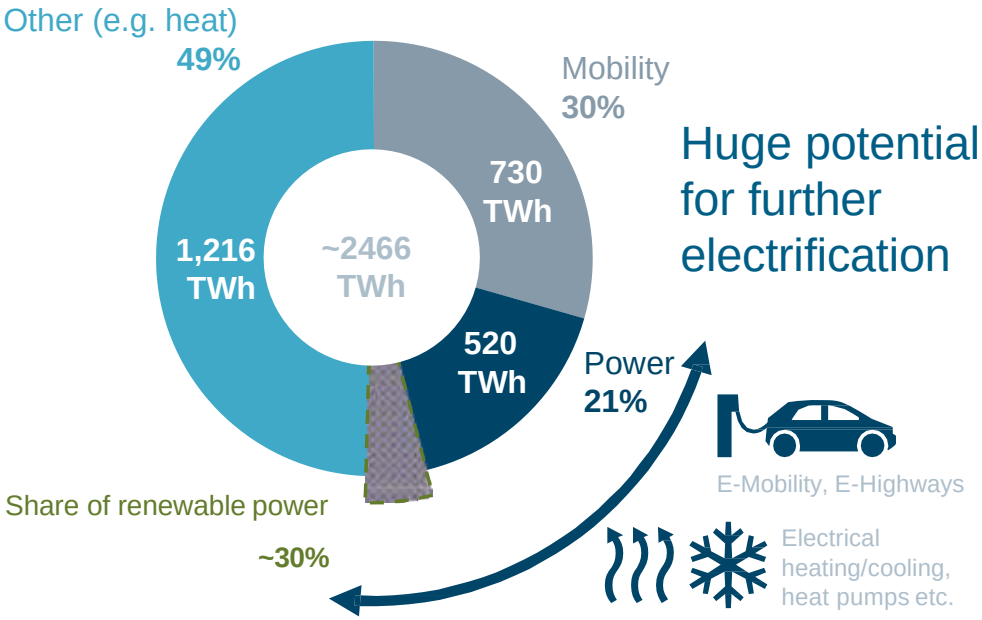
Global power generation capacity in TW



Renewables and distributed power gene-ration grow above average

Source: Siemens Energy 2020 Project 2014 – Base Case Scenario

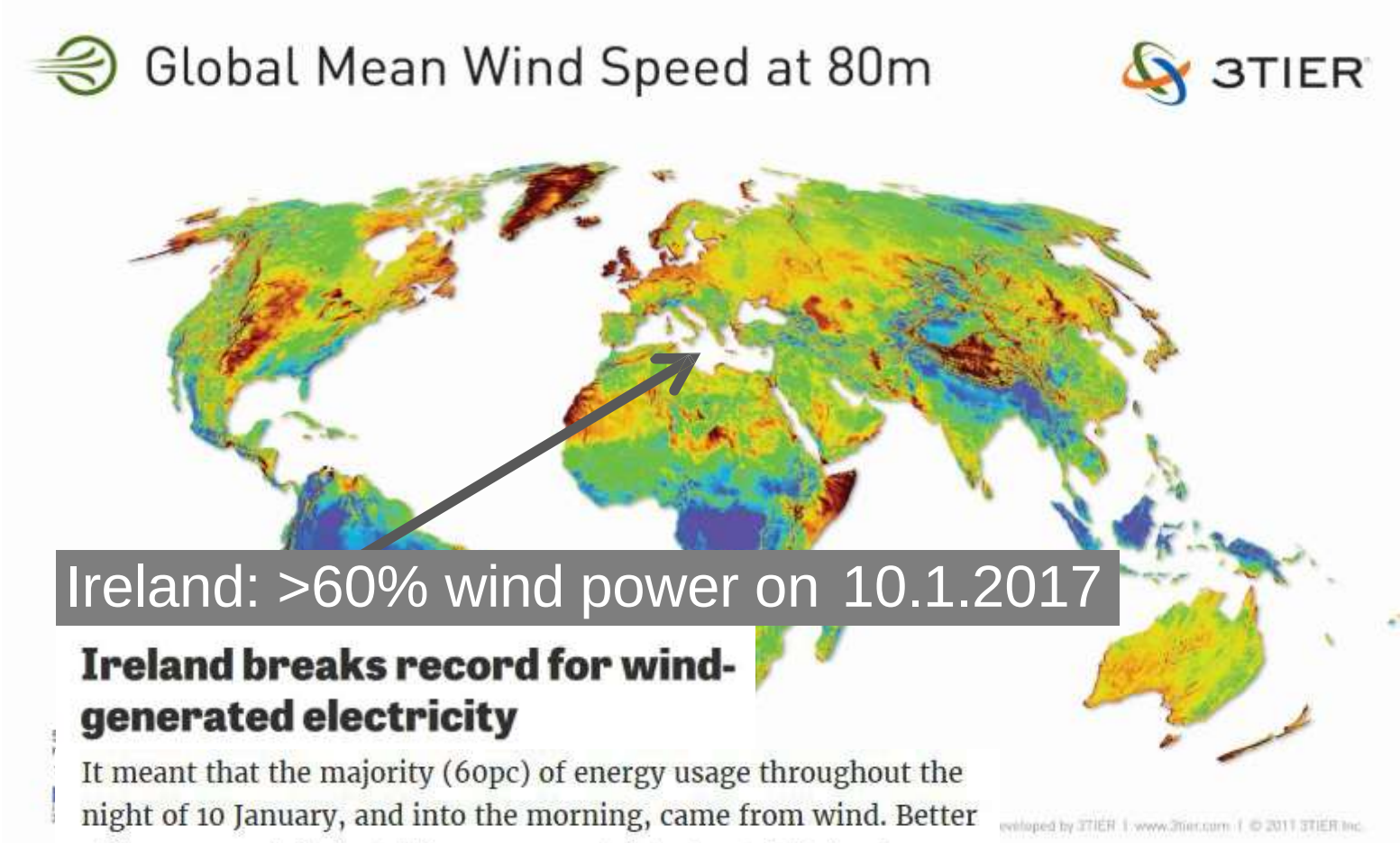
Example: Final energy consumption in Germany 2015



Huge potential for further electrification

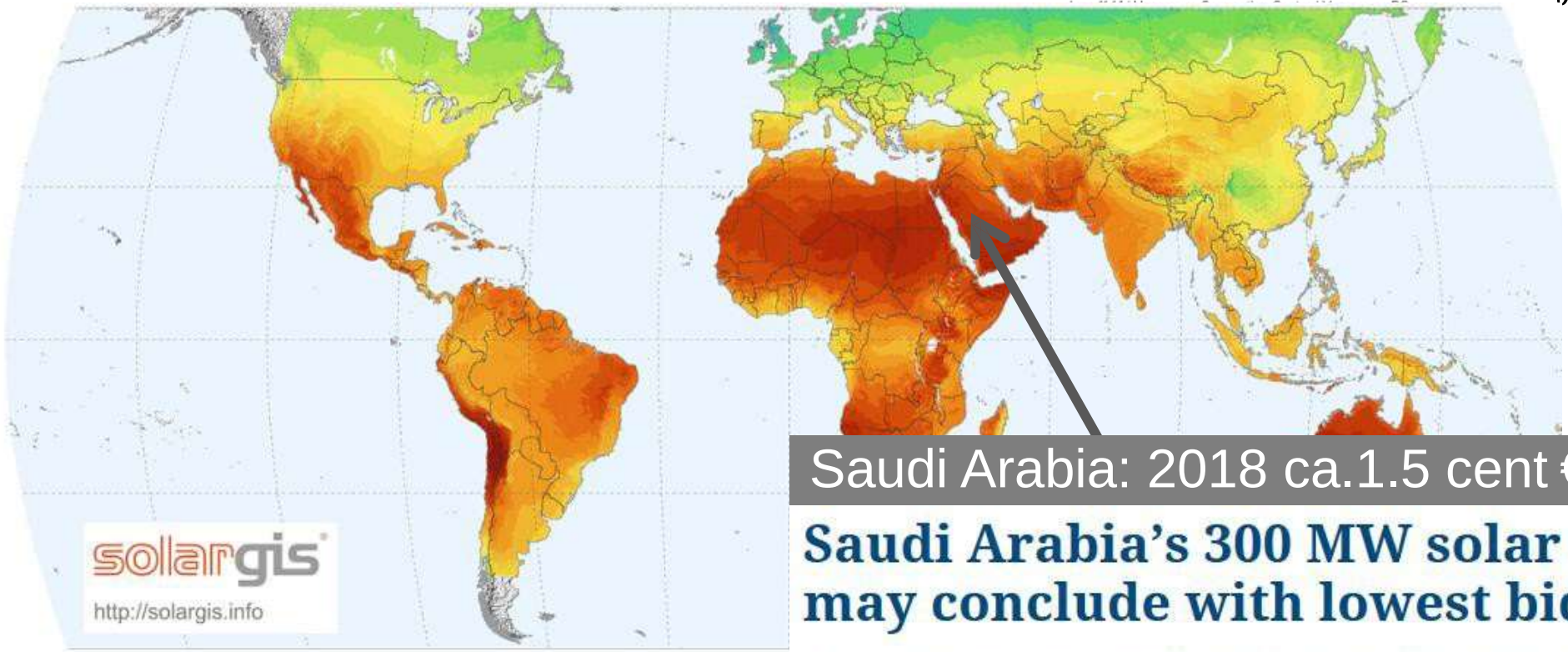
Source: umweltbundesamt.de/Arbeitsgemeinschaft Energiebilanzen, status 7/16; IHS

On Shore Wind Potential



https://dupontconsulting.files.wordpress.com/2012/01/3tier_5km_global_wind_speed.jpg

Solar Yield



Saudi Arabia: 2018 ca.1.5 cent €/kWh

Saudi Arabia's 300 MW solar tender may conclude with lowest bid ever

A consortium formed by UAE-based Masdar and French energy giant EDF has offered to deploy all the tendered capacity at a LCOE of 0.06697 SAR ($0.0178) per kWh. In addition, seven of the eight bids were under $0.03 per kWh. The tender's bidders will be announced by the end of January 2018.

https://en.wikipedia.org/wiki/Photovoltaic_system#/media/File:SolarGIS-Solar-map-W orld-map-en.png
https://www.pv-magazine.com/2017/10/04/saudi-arabias-300-mw-solar-tender-may-conclude-with-lowest-bid-ever/

Drivers for Microgrids

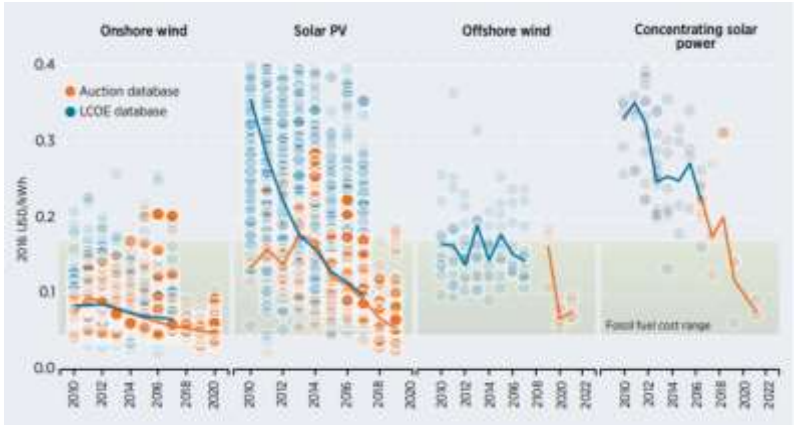
Economic & Energy efficiency

Reliability & Resilience

Sustainability

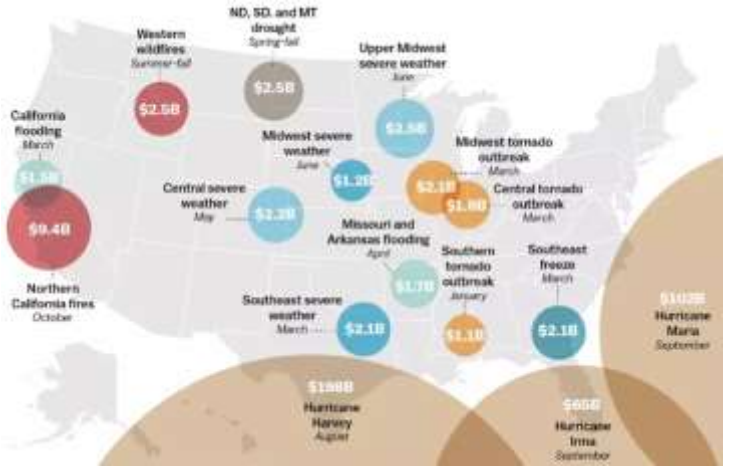
Economics, Reliability & Resilience, Sustainability Plays

Levelized cost of electricity for renewables is getting close to fossil fuel cost range



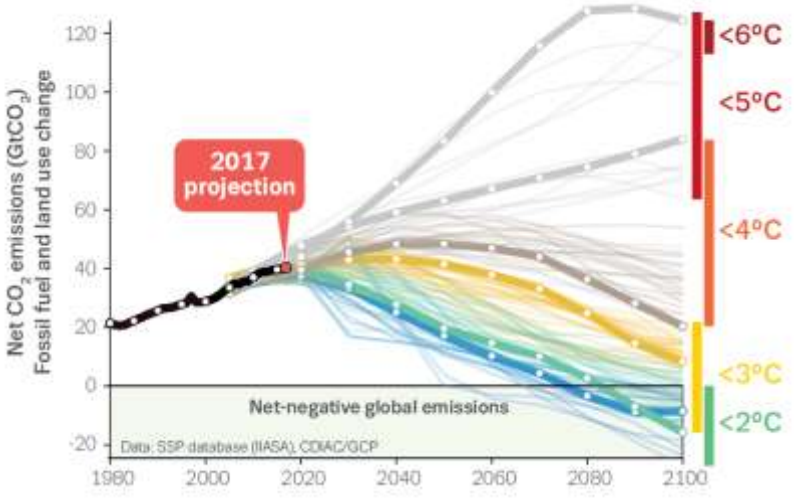
Source: IRENA Renewable Cost Database and Auctions Database
https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_2017_Power_Costs_2018.pdf

Billion-dollar disasters of 2017 in the US



Source: NOAA, Ball State University Center for Business and Economic Research, Vox
https://www.vox.com/energy-and-environment/2017/12/28/16795490/natural-disasters-2017-hurricanes-wildfires-heat-climate-change-cost-deaths

Net CO2 emissions projection and their possible impact on temperature



Source: Global Carbon Budget 2017
http://www.globalcarbonproject.org/carbonbudget/index.htm

Economics – LCoE approaching fossil fuel cost range

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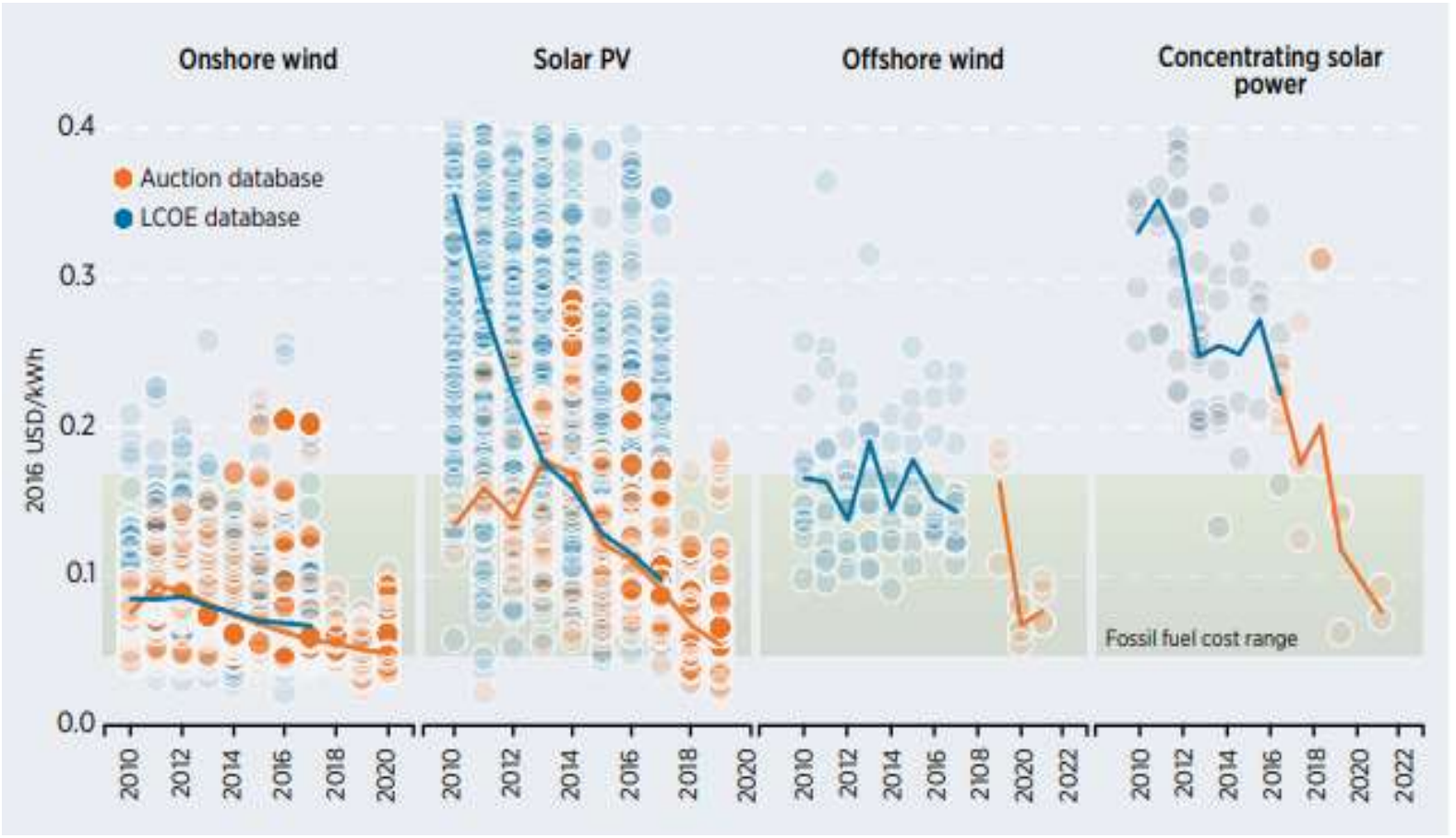
Economic & Energy Efficiency



Reliability & Resilience – Financial Impact of US Disasters 2017

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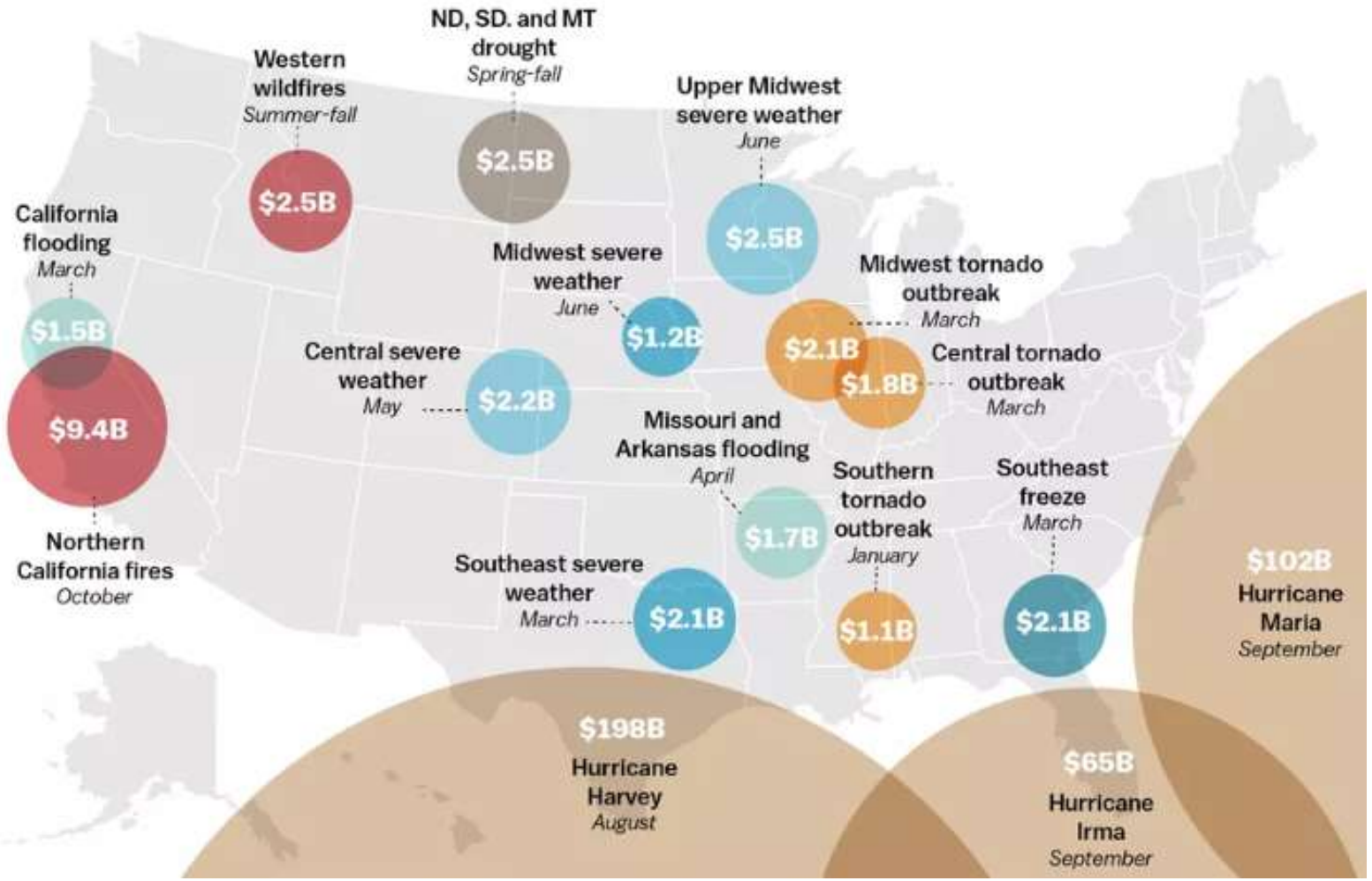

Reliability & Resilience

Sustainability –
Impact of GHG Emissions on Temperature

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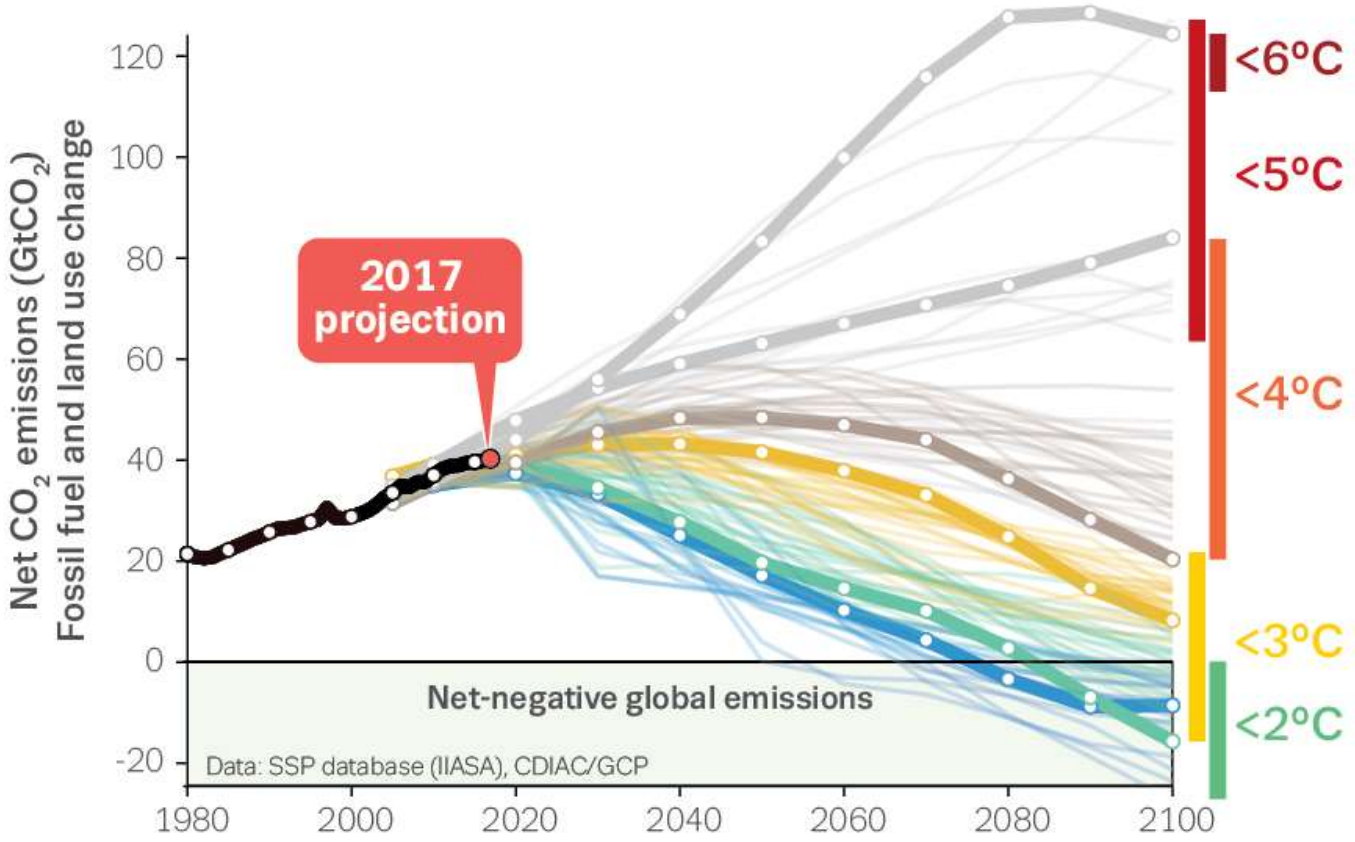
Sustainability



Use Cases – Silver Bullet Solutions!

Utilities Industry Customer Remotes

Use Cases – Silver Bullet Solutions!

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Grid Edge / Offgrid Load Feed

- Remote / Islanded Communities
- End of Line rural area feeds

Transmission & Distribution Capital Deferral

- Infrastructure for load extension is expensive
- End of Life Asset Replacement cost

Resiliency Play – Outage Management

- Critical Infrastructure – Military Bases, Hospitals, Emergency Services
- Force Majure – Natural Disasters: Floods, Lightning, Hurricanes, Snow Storm

Ancilliary Services

- In non islanded scenarios – using DERs for Volt / Var Optimization
- Frequency response
- Spinning reserve

Carbon Tax / Cap & Trade Solutions

- Utilizing microgrids with renewables to reduce carbon tax

Regulated Utility Business

- NPV Analysis – Recovering Against Rate Base
- Regulator Restrictions – owning DERs
- Revenue Erosion

Non-Regulated Utility Business

- New / Alternative Business Models
- Microgrid as a Service (MaaS) – PPA Agreements
- Own, Operate, Maintain (OOM) Model – DERs + Infrastructure

Demand Response

- Using DERs for grid peak demand shaving / shifting
- Energy price arbitrage
- Conservation Programs – e.g. Negawatts
- Gamification

C&I Play

- Using PPA agreements for resiliency solutions
- Islanded operations of power critical industries

Diesel Offset

- Reduction in Diesel Consumption

LEGEND Utilities Industry Remotes End Customer

Standardization & Modularization Pathway

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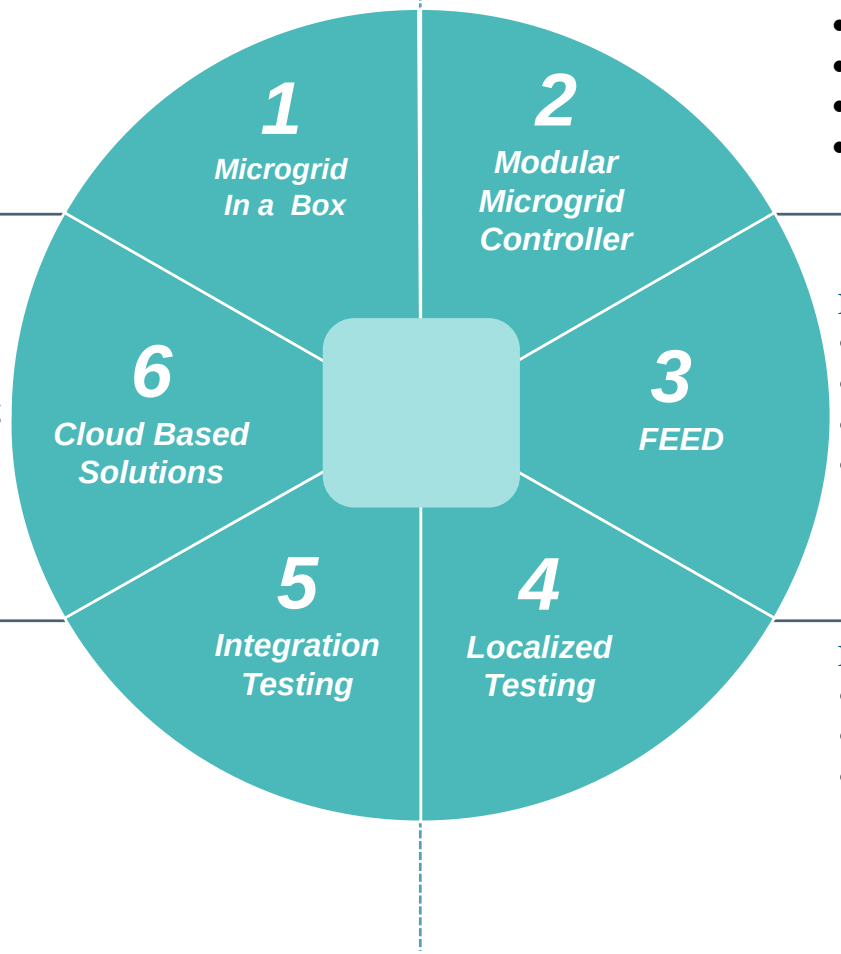
Microgrid in a Box
- Drop ship solution
- Includes BESS + MGC or
- Includes CHP + MGC
- Plug & Play Connectivity

Modular Microgrid Controller
- Microgrid Modules that are expandable
- MGC should have multiple communication protocol options
- Scalable Hardware
- Cyber Capable
- Full SCADA Capability
- Vendor Agnostic Solution



Cloud Based Solutions
- Local MGC connection to Cloud
- Remote Troubleshooting
- Aggregation of Data
- Artificial Intelligence - Autonomous Learning
- Optimization Capabilities

Front End Engineering & Design
- Requirement to carry out a Simulation Study
- Assess Technical Solution
- Assess Business Case from a Financial KPI perspective
- Examine Asset Capabilities

Integration Testing
- Full Functional Testing
- Complete Use Case Testing

Localized Asset Testing
- Individual Asset Testing – PV, Wind, BESS etc.
- Asset Testing to MGC
- Modular Use Case Testing

Microgrid in a Box Solution

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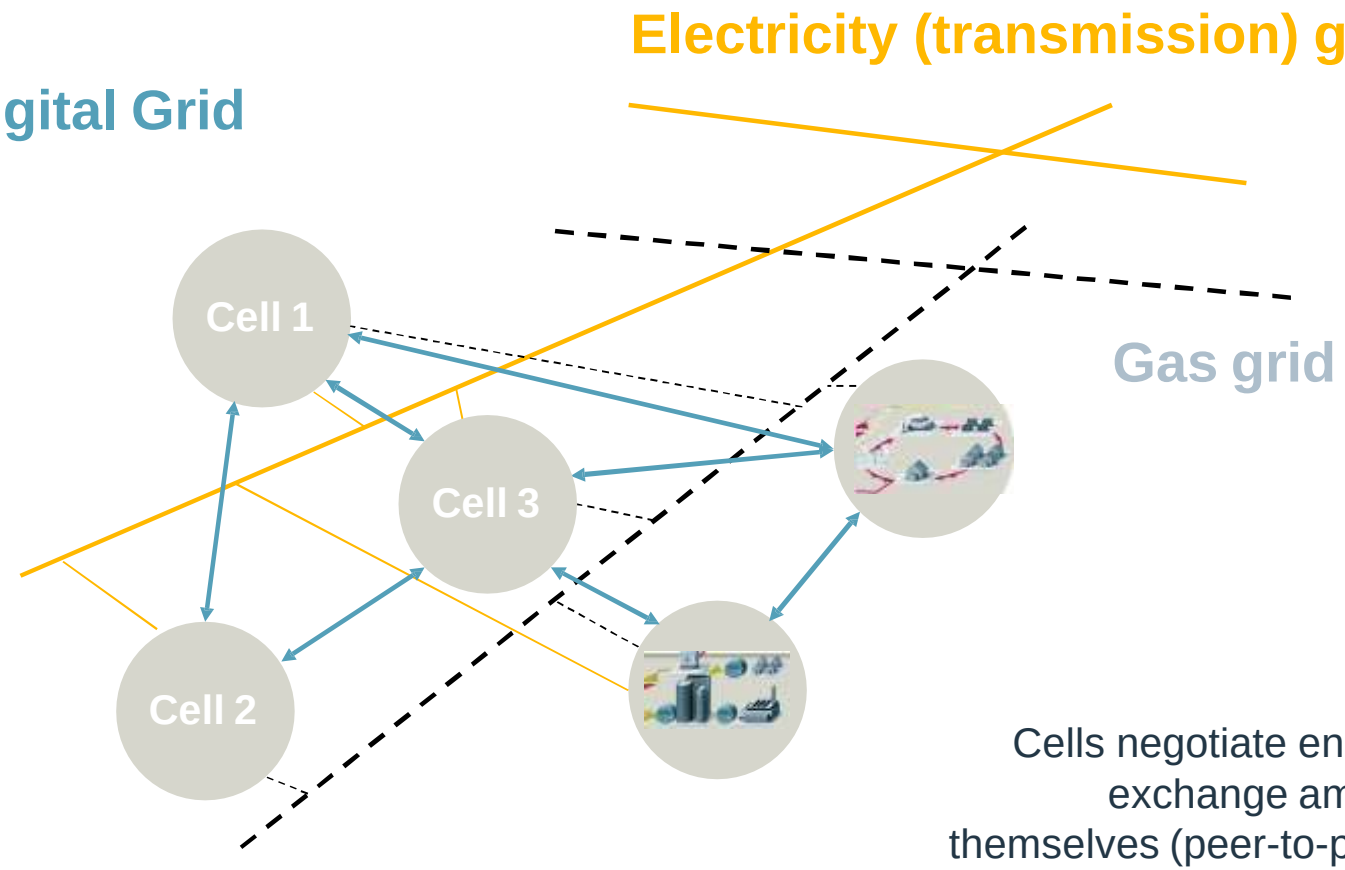
Future Outlook
3 Essential Grids in Context of an Energy Cell Concept

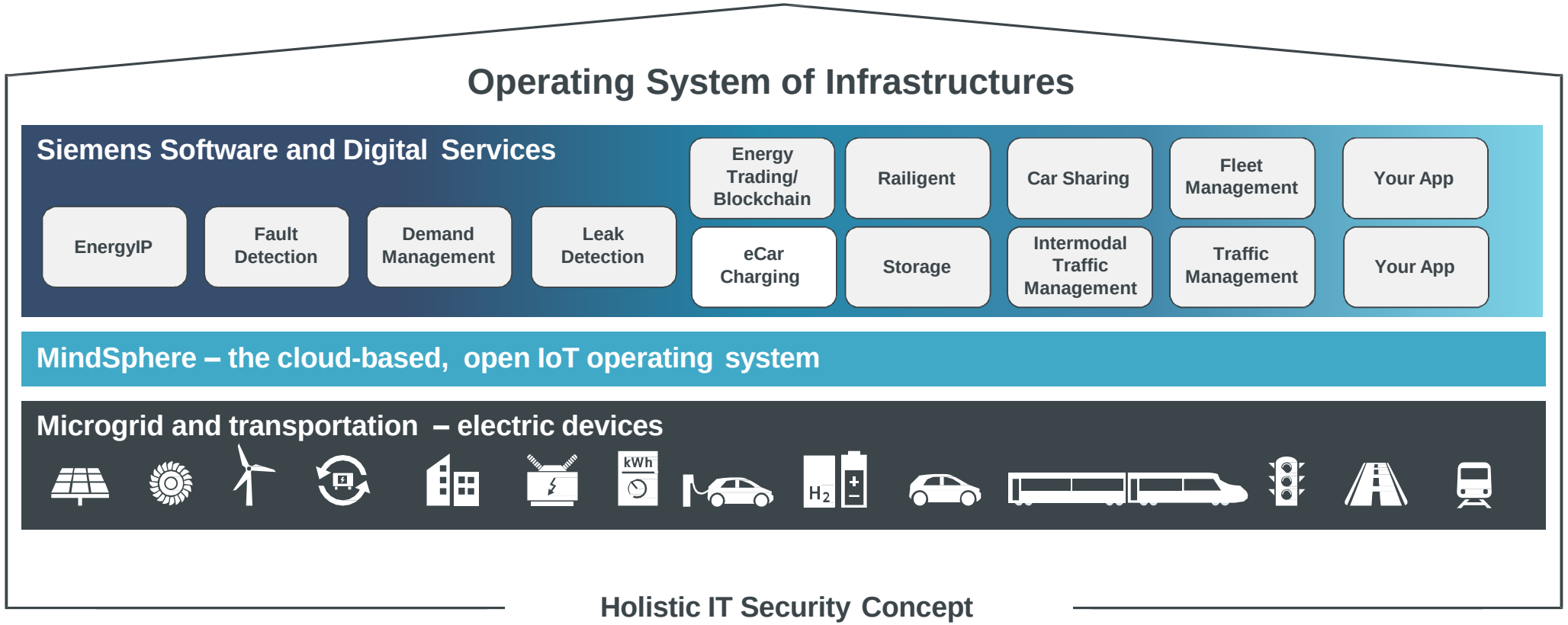


Cells negotiate energy exchange among themselves (peer-to-peer)

Energy cells can be
- Community
- Factory
- Power plant
- Dedicated storage facility

Energy cells contain
- Power generation
- Thermal and gas grids
- Energy storage
- Power-to-X (-value)
  - ƒ Dynamic load control
  - ƒ ICT, self-organizing, self-healing intelligence
- Resiliency
- …

IoT Operating Systems to manage Infrastructures
Example - Mindsphere



Outlook

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1. More Wind- and PV, Electrification, Distributed Energy Systems
2. Sector-couplings and Energy Storage increasingly relevant
3. Digitalization key enabler (simulation, operation, market integration)
4. Emerging Sharing Economy concepts for Prosumers
5. Artificial Intelligence gaining momentum

Contact Information

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