

Zero – One : Building a Smarter, Flexible and Resource Agnostic Grid"

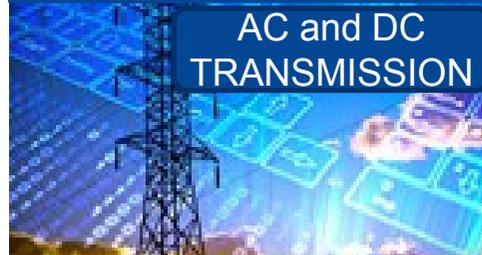
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World Bank
Washington, DC
April 17, 2015

ALSTOM
Shaping the future

Alstom Group Overview

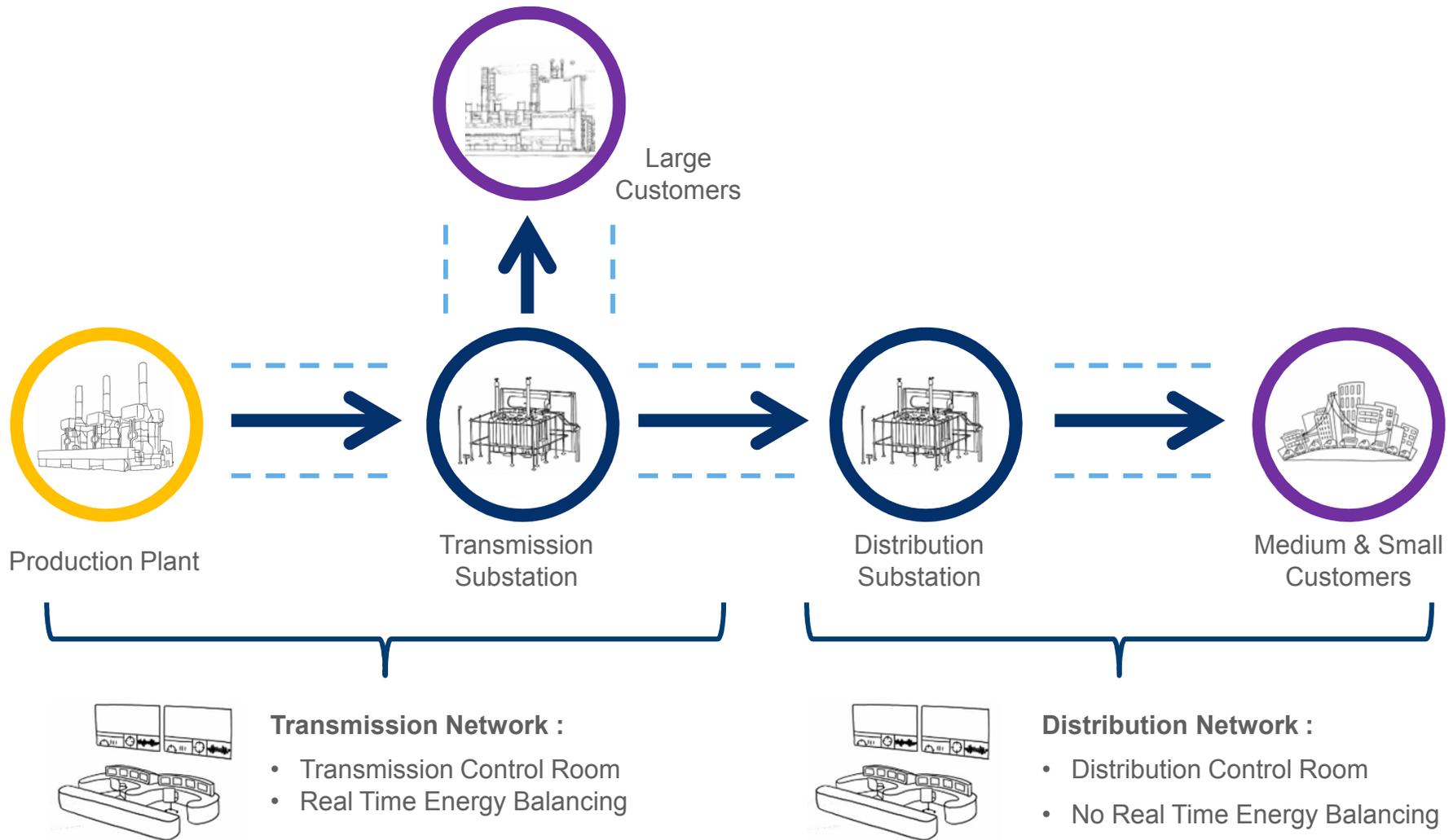
Critical Infrastructure for Power and Transport

Power Generation		Grid	Transport
Thermal	Renewable		
COAL 	HYDRO 	AC and DC TRANSMISSION 	STREET CARS AND TRAMS 
GAS 	GEOTHERMAL 	SMART GRID 	METROS 
NUCLEAR 	SOLAR 	STORAGE 	HIGH SPEED 
	WIND On- and Off-shore 		

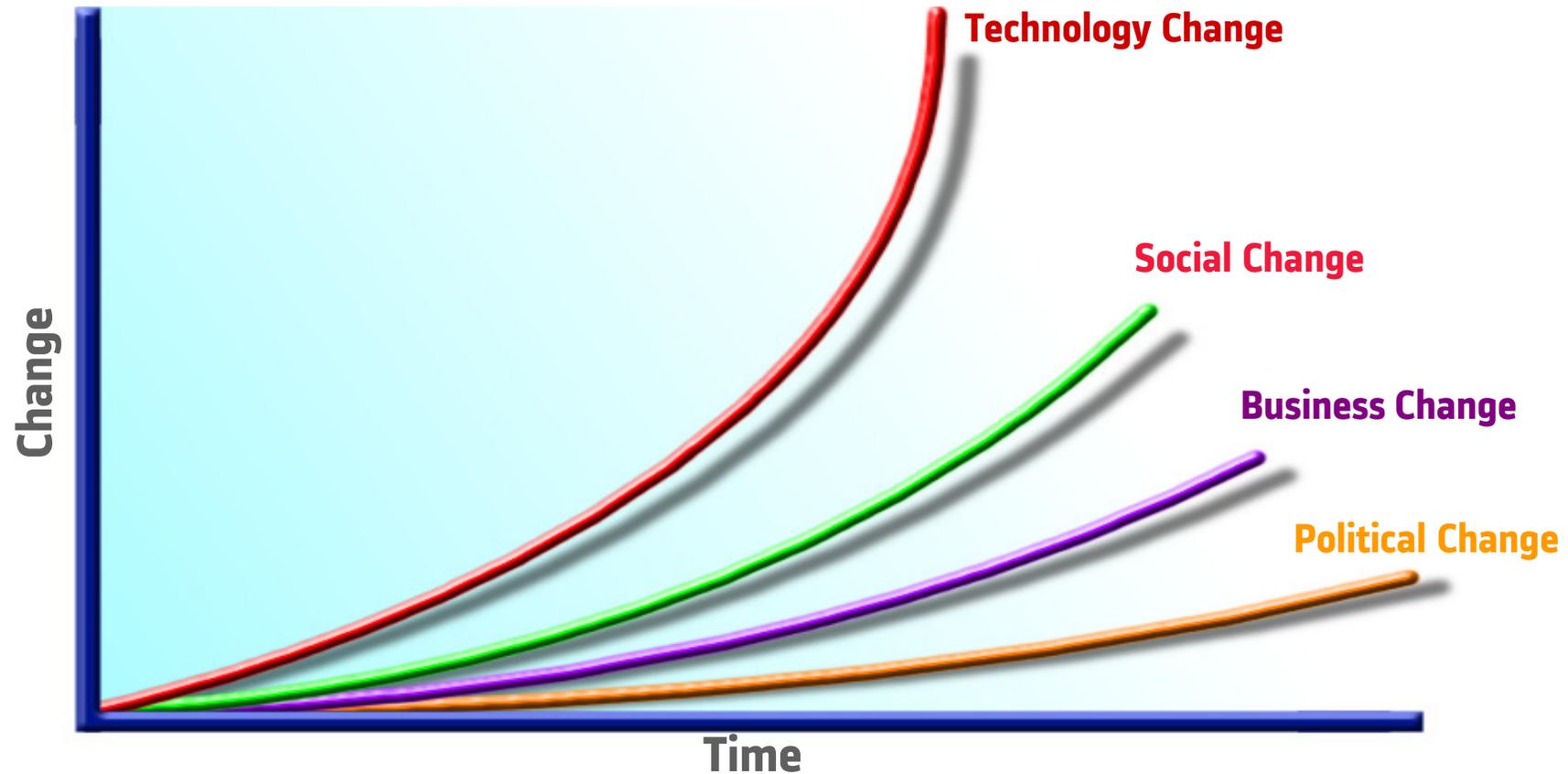
92'800 employees; present in ~100 countries

*Source: Annual Results 2013/2014
Fiscal year ended 31 Mar 2014

Electricity Grid Today – Typically a One Way Road



Drivers of the Global Power Industry Transformation



The Transformation is Multifaceted, Multidimensional and Complex

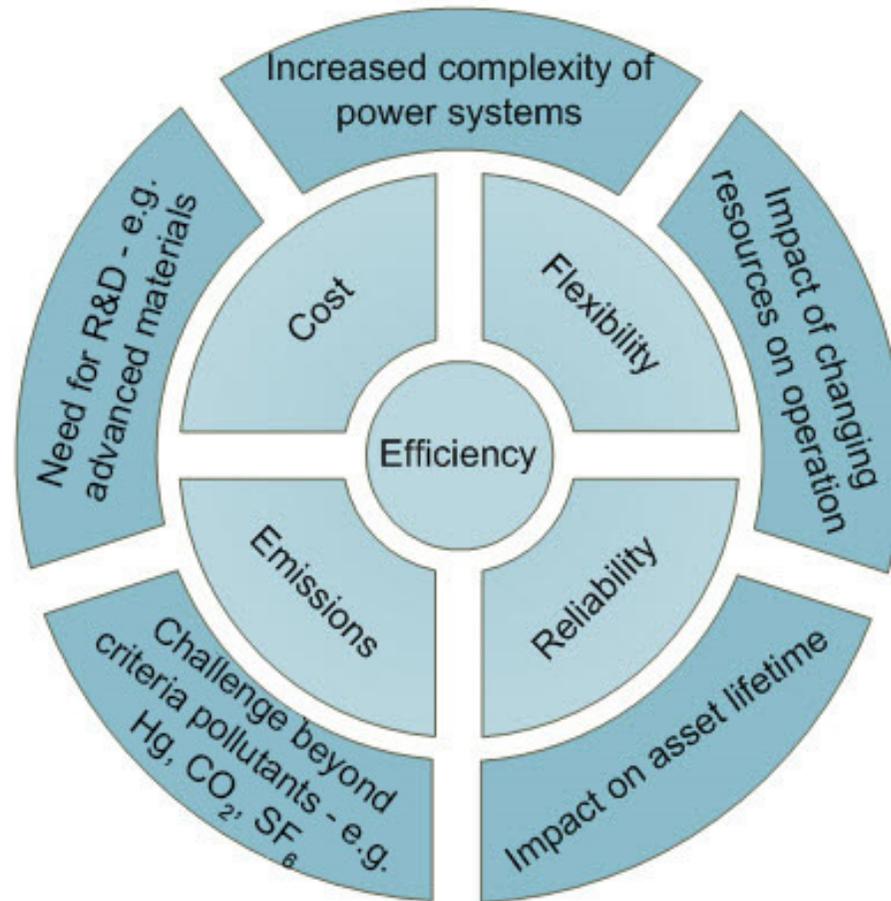
Transformation of Value Chains

- Evolutionary, Revolutionary, Exponential -

**“Converging technologies offer new options for customers
but challenge the business assumptions of established companies”**

Larry Downes, The Laws of Disruption

Power Industry Policy Transformation



Making Trade Offs While Managing Risks and Uncertainty

Disruptive forces are driving change

- Increasing renewable energy investments
- Price of natural gas
- Focus on Greenhouse gases
- Weather related outages
- Cyber Threats
- Distributed Energy Resources
 - Declining PV costs
 - DR-enabled thermostats, smart appliances
 - Residential scale storage
 - Microturbines
- Microgrids
- Big Data technologies
- Cloud Computing
- Your example here

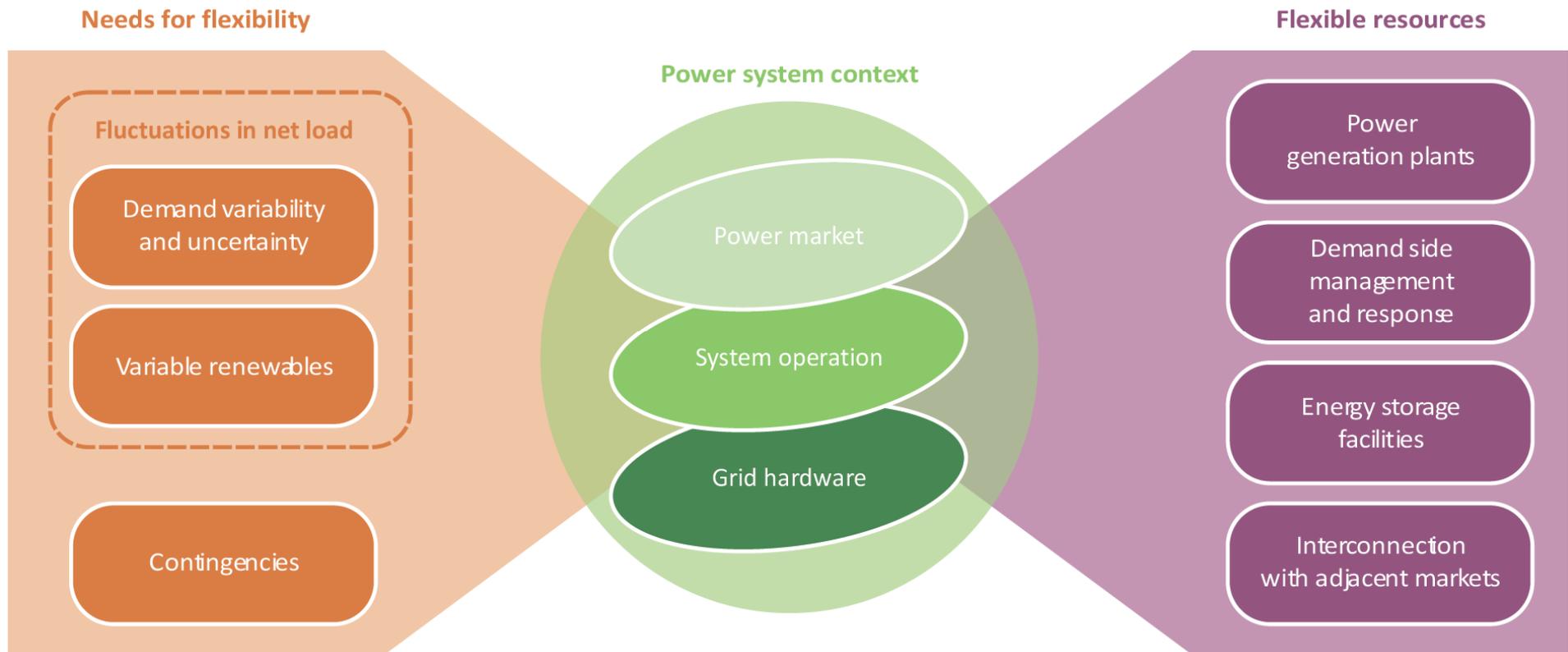


Smart Grid technology – the brain and the nervous system

Smart grid : a three-level architecture



Flexibility and the Resource “Agnostic” Grid



Existing and new flexibility needs can be met by a range of resources in the electricity system – facilitated by power system markets, operation and hardware.

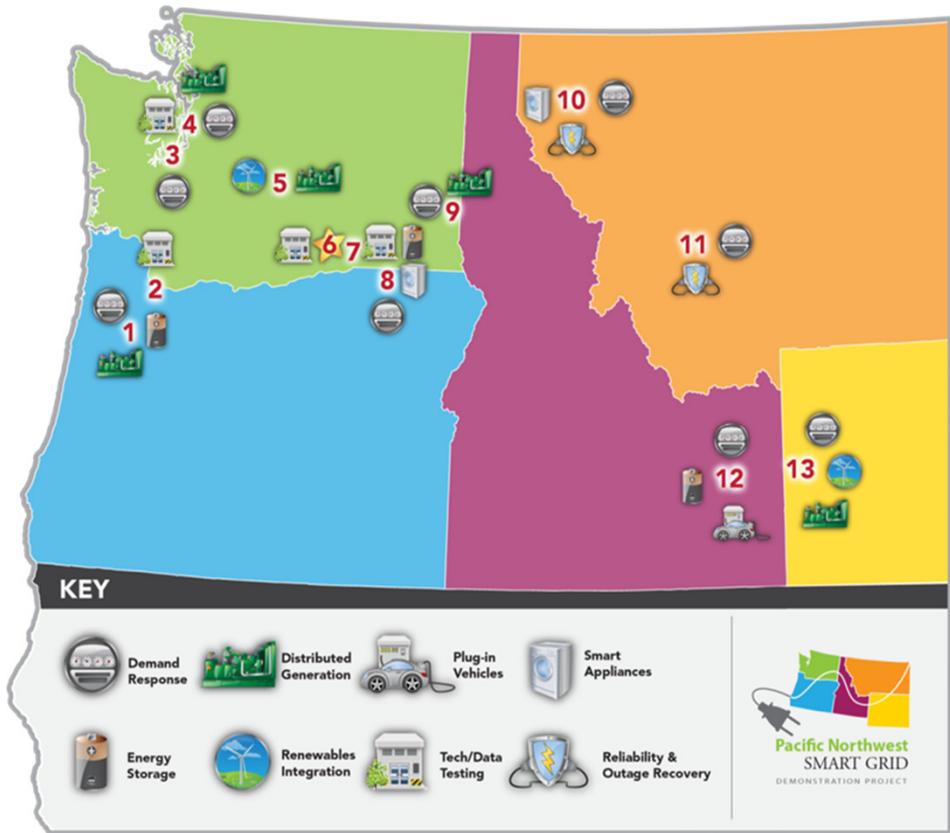
Source: Adapted from Harnessing Variable Renewables, International Energy Agency

Pacific Gas & Electric (PG&E) demonstration to advance Synchrophasor Grid Monitoring

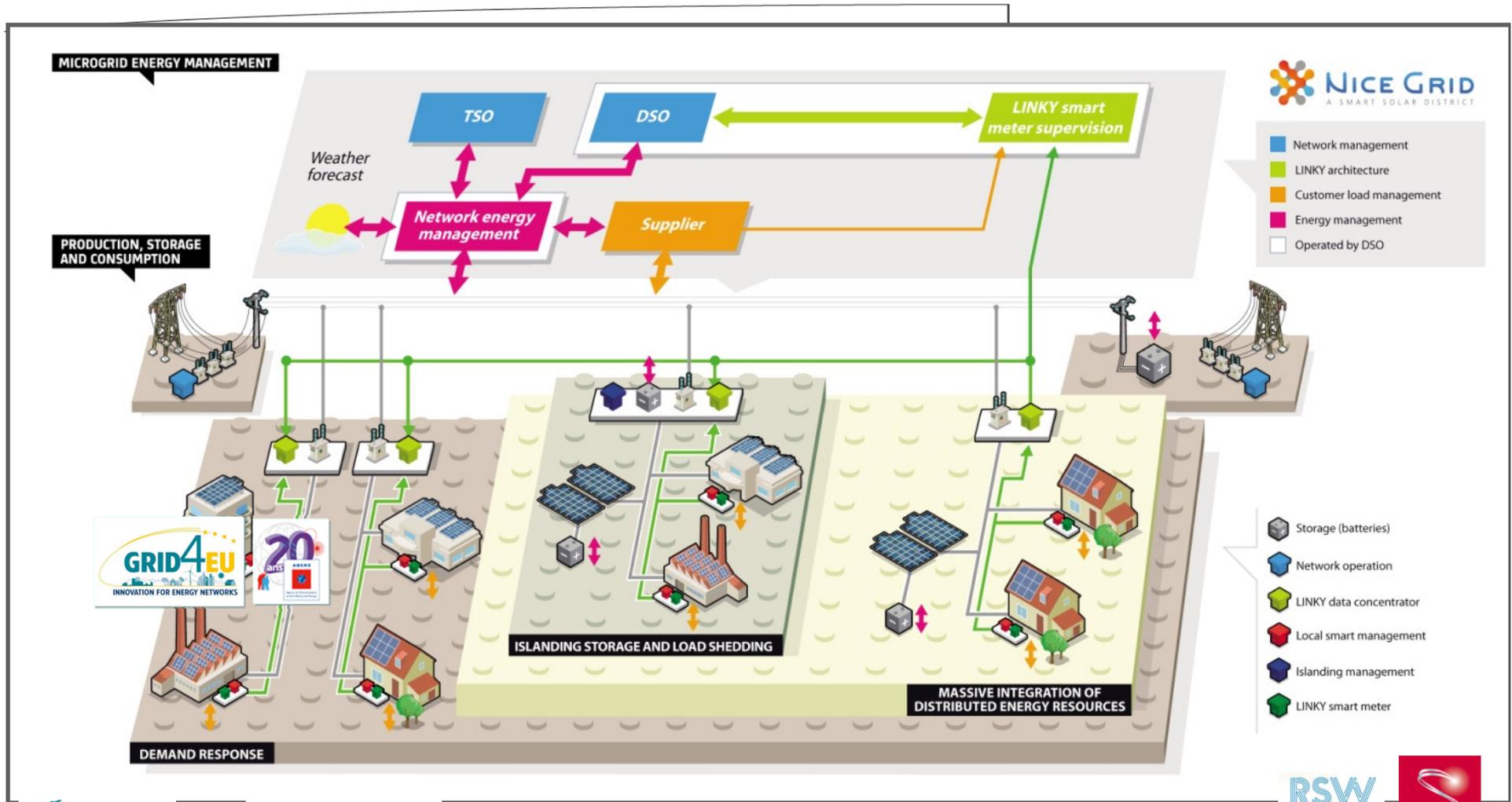
Adding intelligence with Synchrophasors



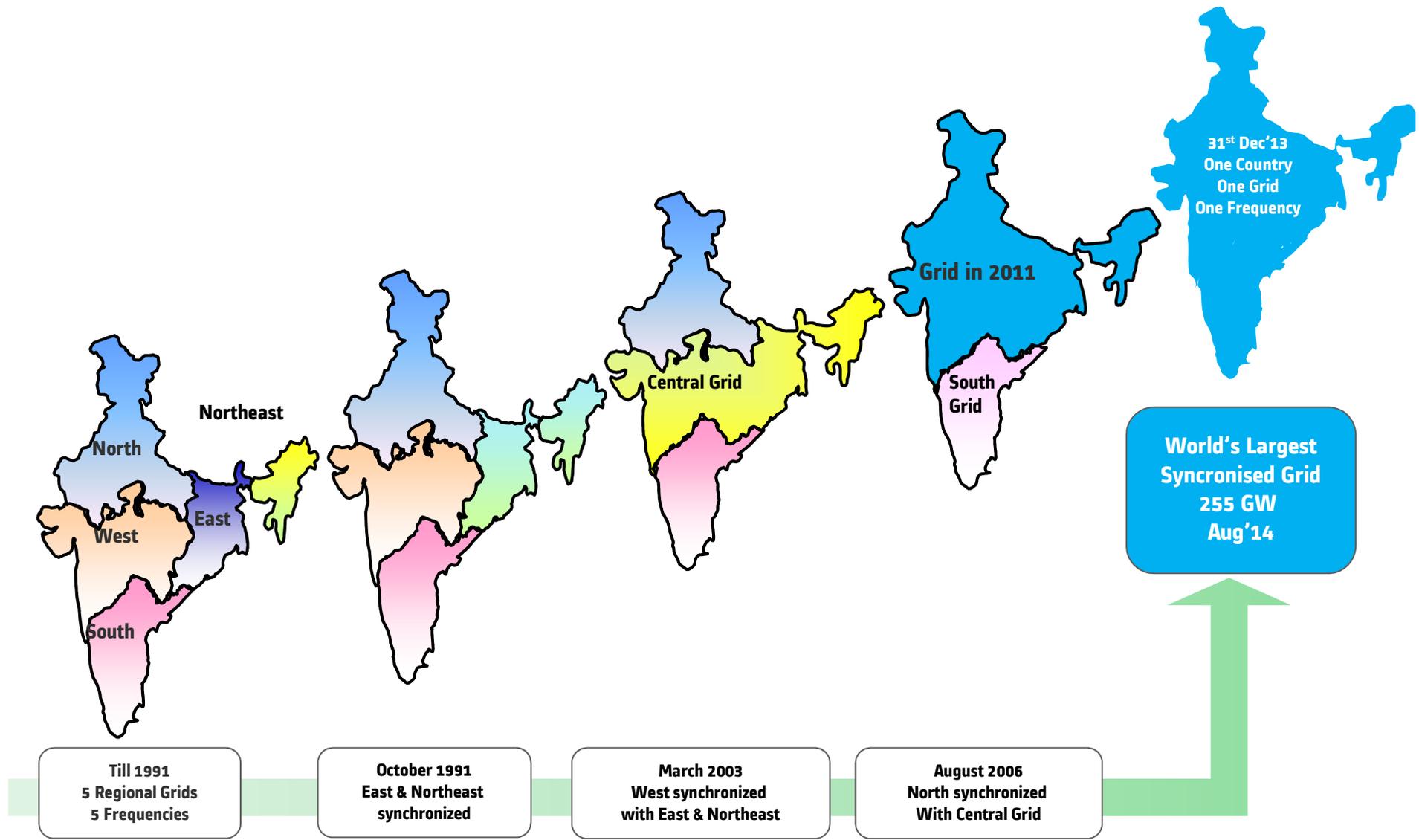
Pacific Northwest Demonstration Project / USA



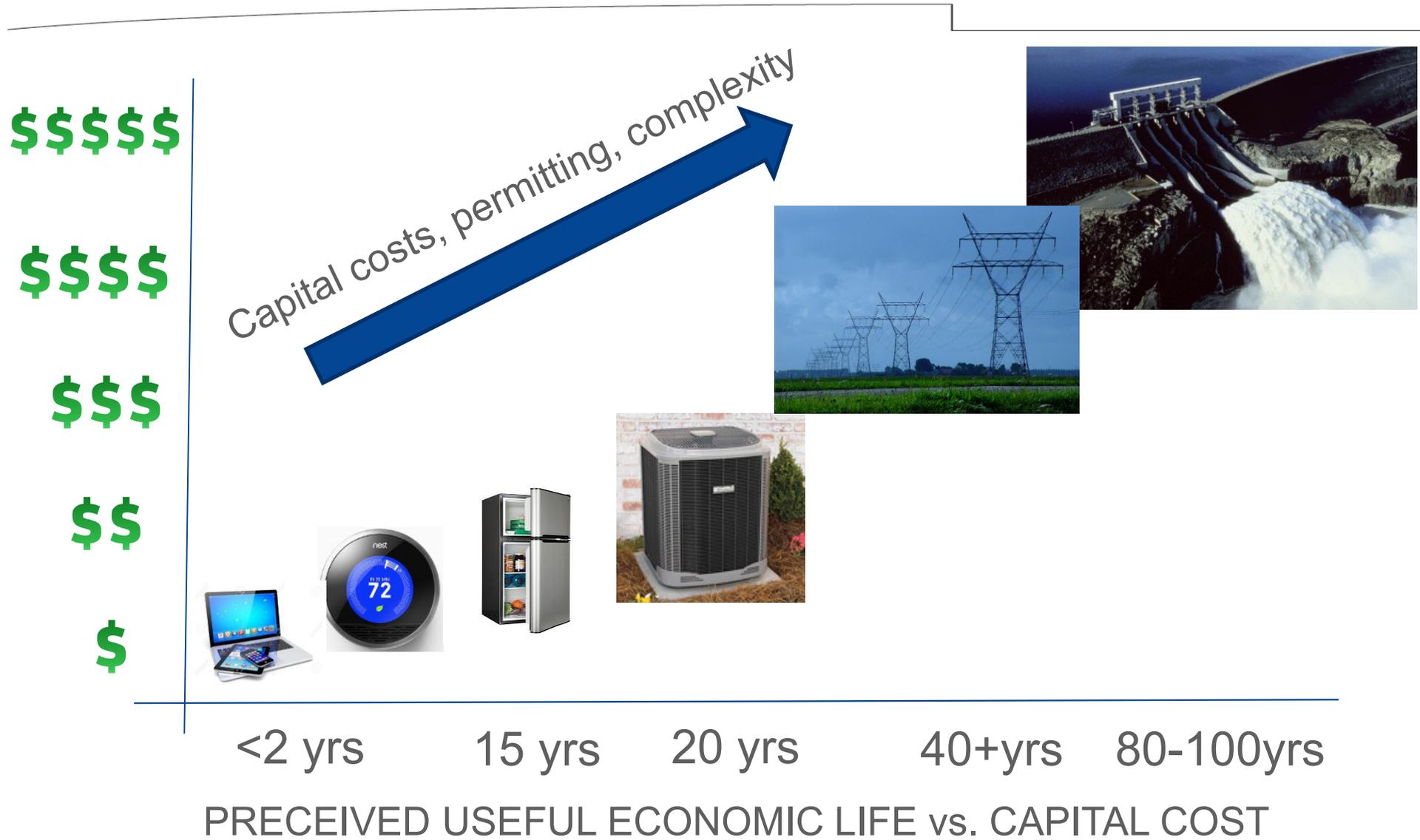
Nicegrid – Europe’s First Smart Solar District

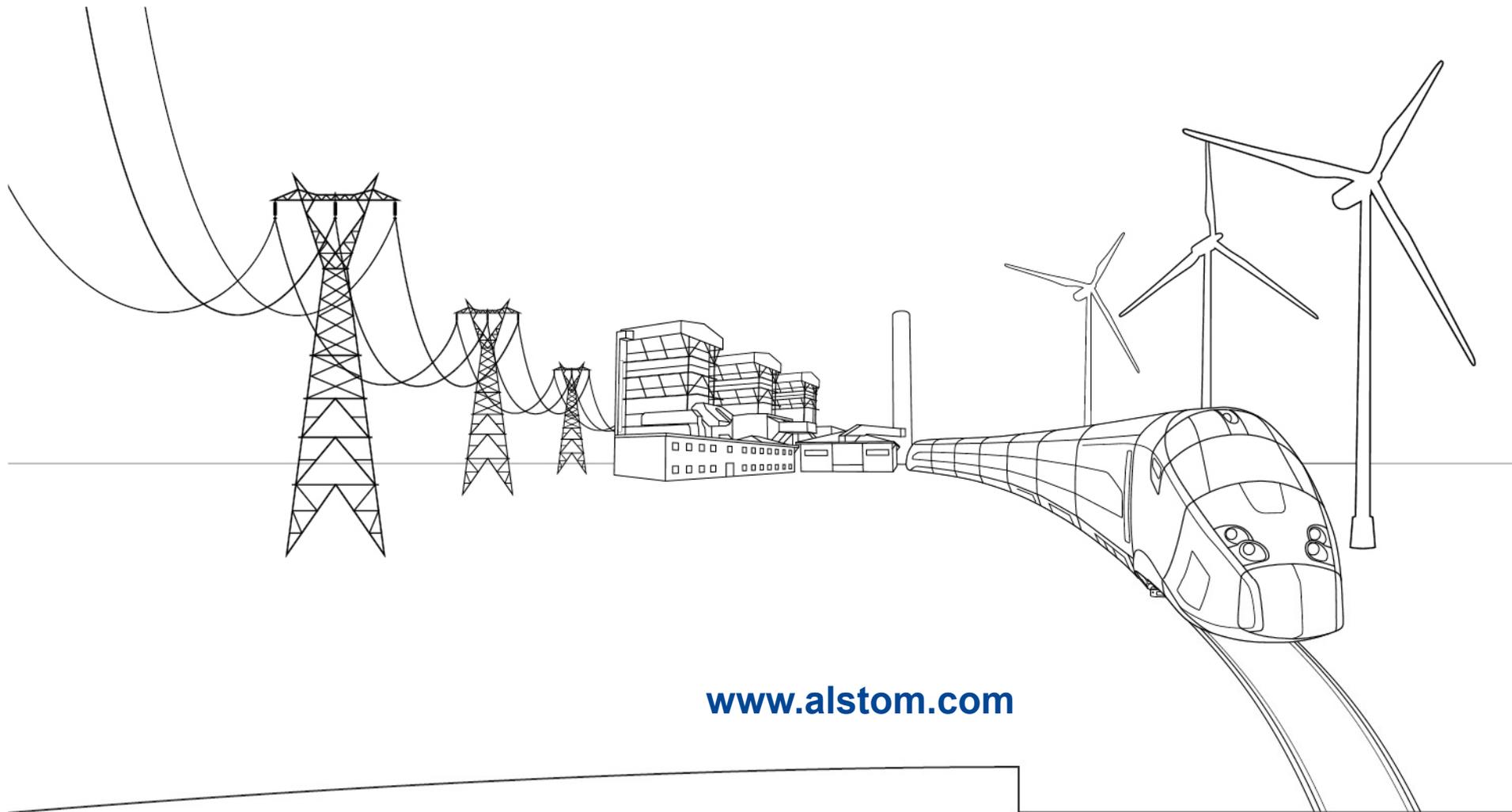


India's Evolution to a Single Synchronized Grid



Cost of Resource Agnostic Grids in the Age of Hybridity?





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