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Plenary Panel

Evolving Architecture of the 21st Century Grid With Two-Way Power Flows



India Smart Utility Week
02 March 2022

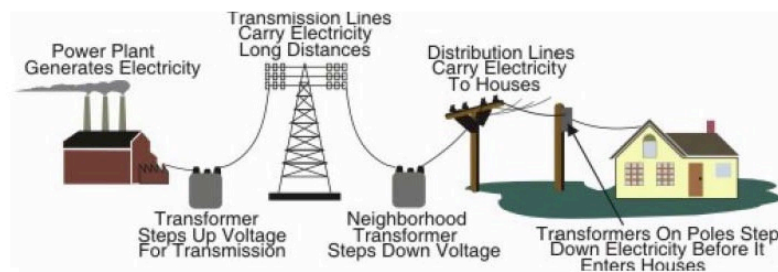


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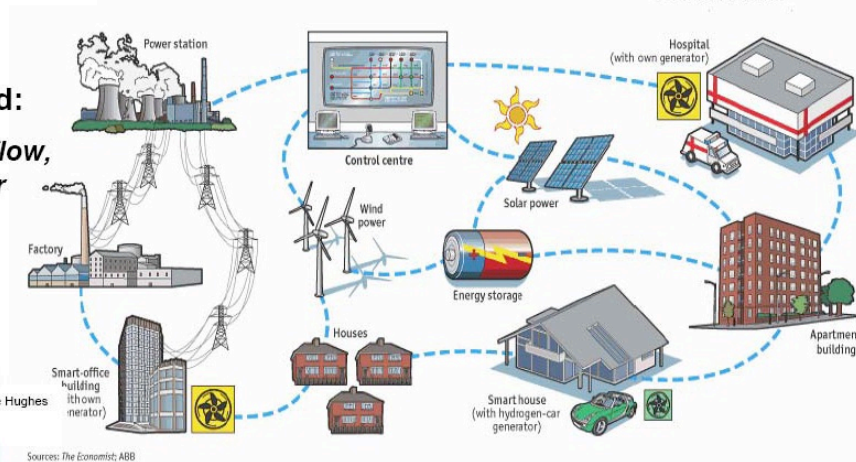
Evolution of the Grid

Smart Grid

Before Smart Grid:
One-way power flow,
simple interactions



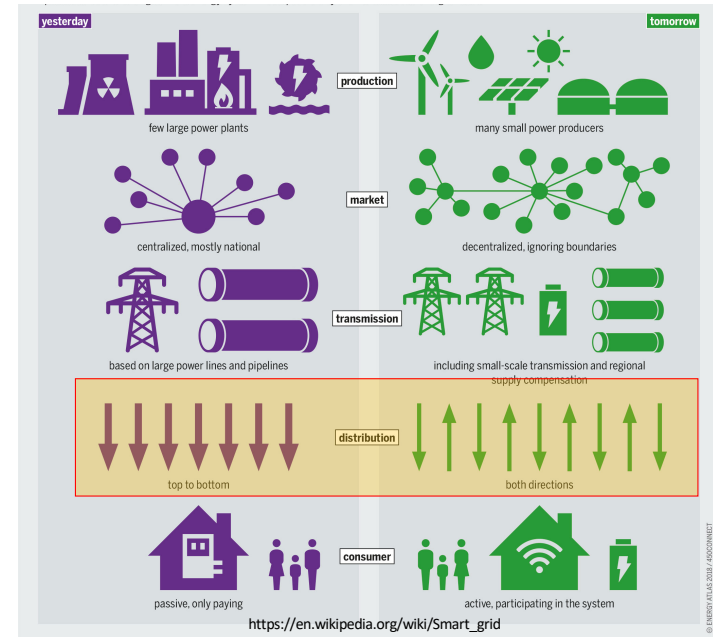
After Smart Grid:
Two-way power flow,
multi-stakeholder
interactions



Adapted from EPRI Presentation by Joe Hughes
NIST Standards Workshop
April 28, 2008

Sources: The Economist; ABB

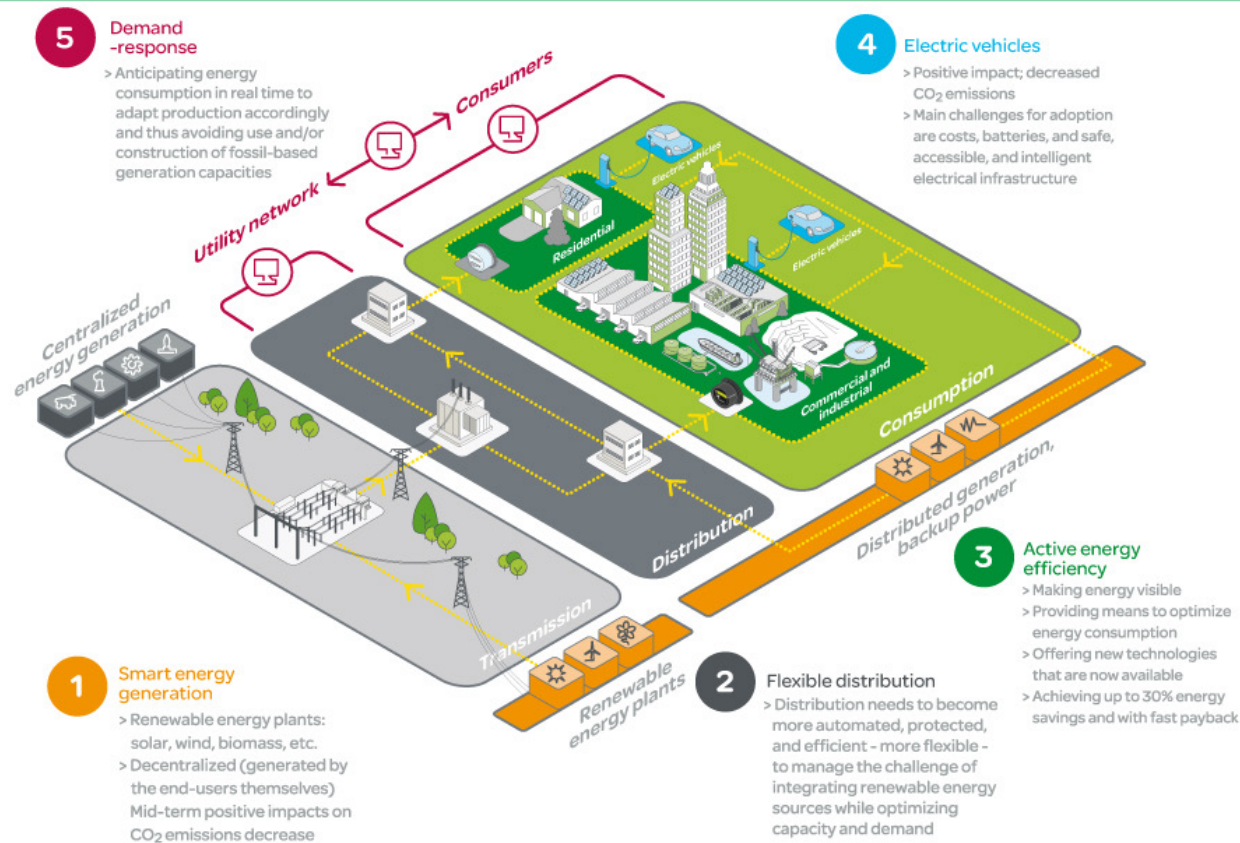
Source: Altalink, Alberta, Canada



One-Way Vs. Two-Way
Power Flows



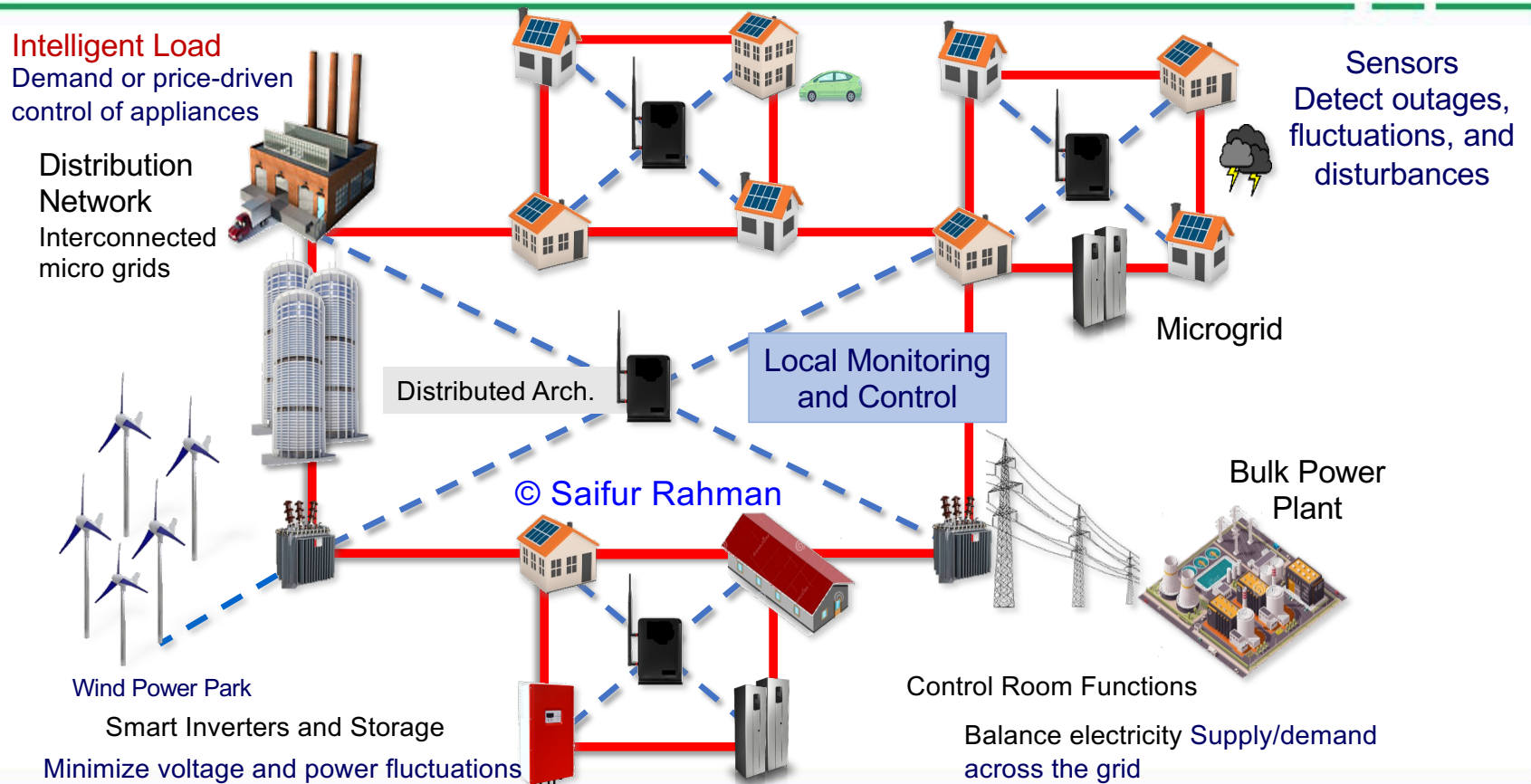
Electricity Networks and Grid In Evolution



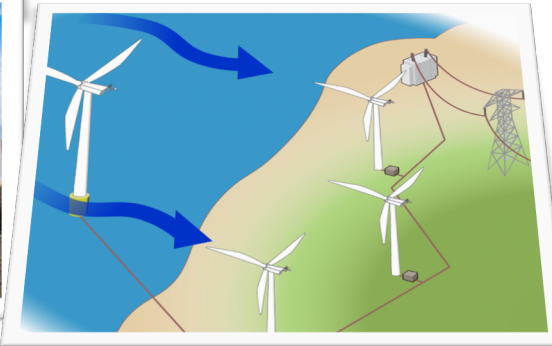
<https://blog.se.com/building-management/2014/04/28/internet-things-next-step-smart-grid-evolution/>



Intelligent Interconnected Microgrids



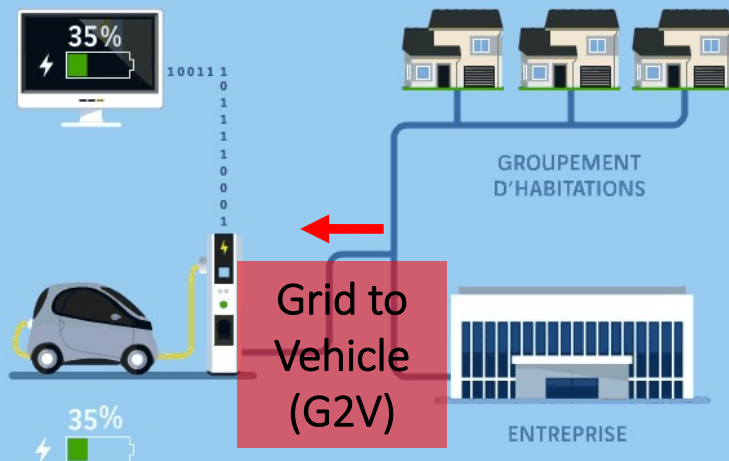
Changing Landscape for the Electric Utility



Grid to Vehicle (G2V) Vehicle to Grid (V2G)

USING AN ELECTRIC VEHICLE TO STORE ENERGY

1. The electric vehicle is connected to the smart grid via a charging station.



THE **AGILITY** EFFECT

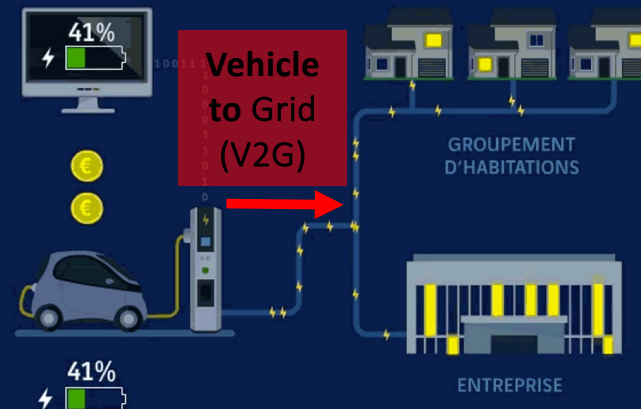
<https://www.theagilityeffect.com/en/article/using-electric-vehicle-store-energy/>

USING AN ELECTRIC VEHICLE TO STORE ENERGY

2. The grid programme "knows" that the vehicle is not being used in the evening. It records the vehicle as a potential source of stored electricity.

USING AN ELECTRIC VEHICLE TO STORE ENERGY

3. When electricity demand is high, the programme taps the electricity stored in the vehicle battery to supply consumers as needed.



Evolving Power Delivery System

Historically: Demand
driven supply (supply
responds to demand)



New Reality: Supply
driven demand (demand
needs to adjust to meet
fluctuating supply with help
from storage)



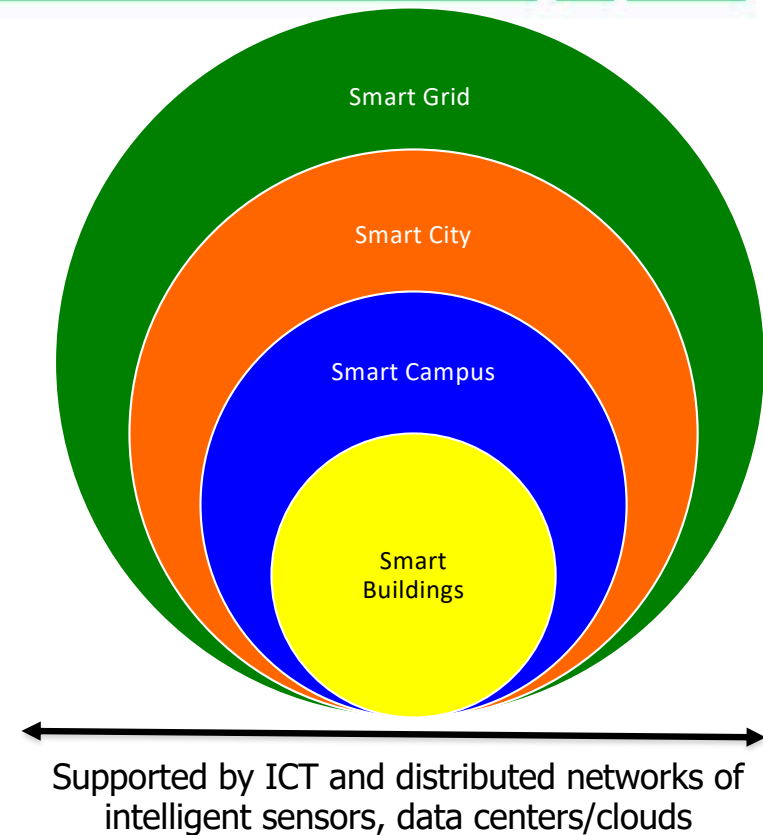
Smart Grid Ecosystem

Smart grid: Bi-directional flows of energy, remote control/automation of power, integrated distributed energy...

Smart city: Complex system of interconnected infrastructures and services...

Smart Campus: A collection of buildings managed by the same facility manager...

Smart buildings: Intelligent building automation systems, smart devices, productive users, grid integration...



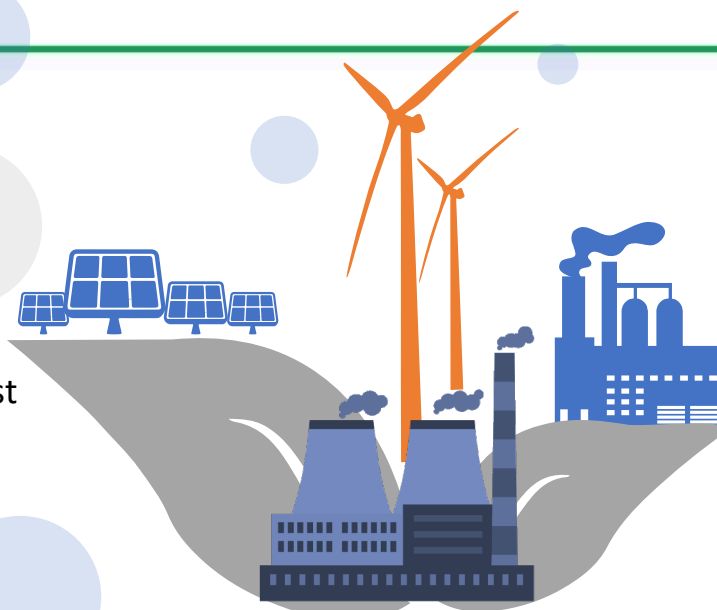
Key Takeaways/ Recommendations

- Relay capabilities and their coordination need to be studied.
- Utilities must update their equipment with reverse-power-flow logic.
- Employing Demand Response and PV can help to shave Peak Load.
- The Impact that PV/Wind might have on the grid side needs to be investigated.
- The Intermittent behaviour of PV/Wind should be considered in two-way power flows calculation.
- PV tends to bring voltage up at the point of interconnection. Also, when clouds decrease PV output, voltage drops. It results in voltage flickers and fluctuations at customer sides and should be taken into account for planning purposes.
- PV/Wind/Electric Vehicle **Positive Impact:** Decrease Co2 Emission (Decarbonization)
- In Grid to Vehicle (G2V) and Vehicle to Grid (V2G) modes, the stochastic behaviour of both vehicle location and its consumption/generation should be taken into account for two-way power flows calculations.



Evolving Architecture of the 21st
Century Grid With Two-Way
Power Flows

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For discussions/suggestions/queries email:

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Thank You

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