Prof. Saifur Rahman
Director, Advanced Research Institute, Virginia Tech, USA
2022 IEEE President-elect

Plenary Panel

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

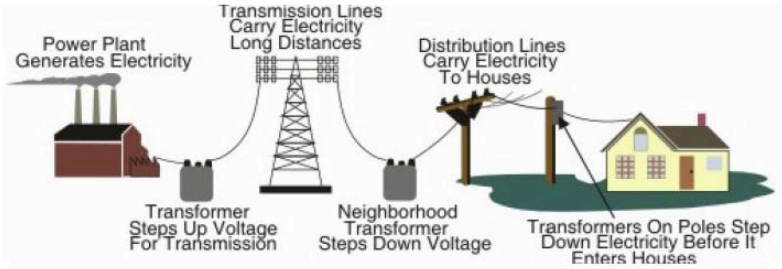
India Smart Utility Week
02 March 2022

Evolution of the Grid

Smart Grid

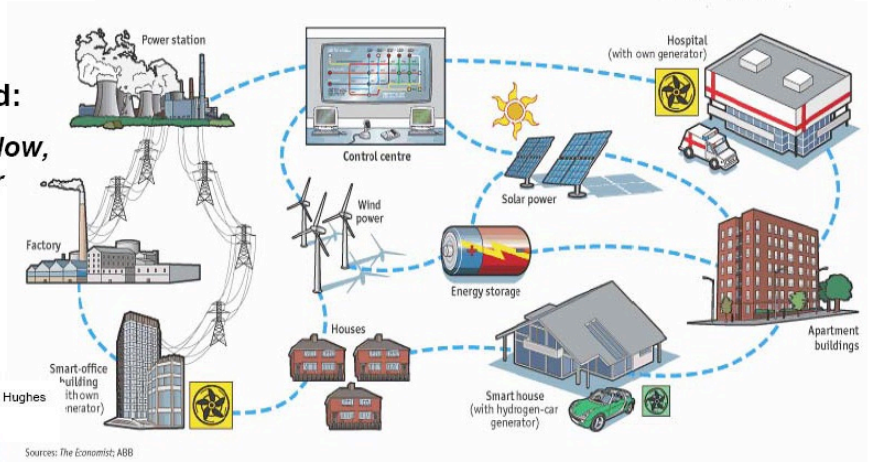
Before **Smart Grid:**

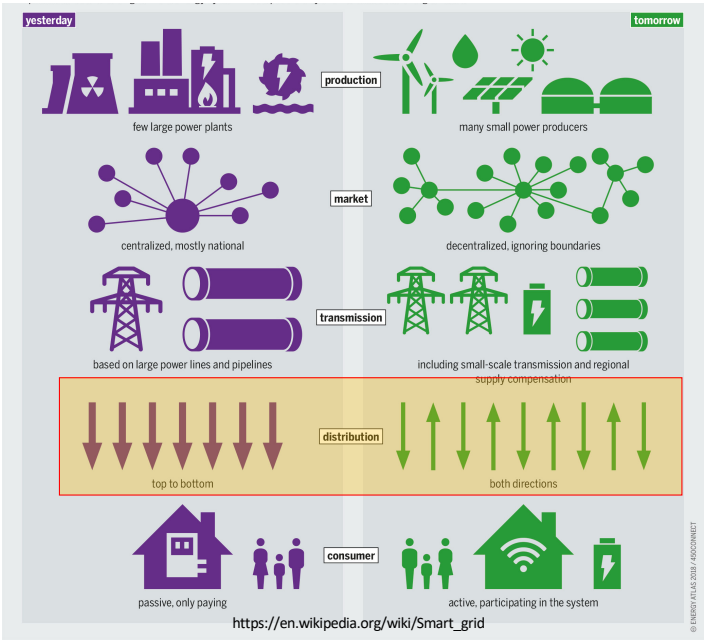
One-way power flow, simple interactions



After **Smart Grid:**

Two-way power flow, multi-stakeholder interactions

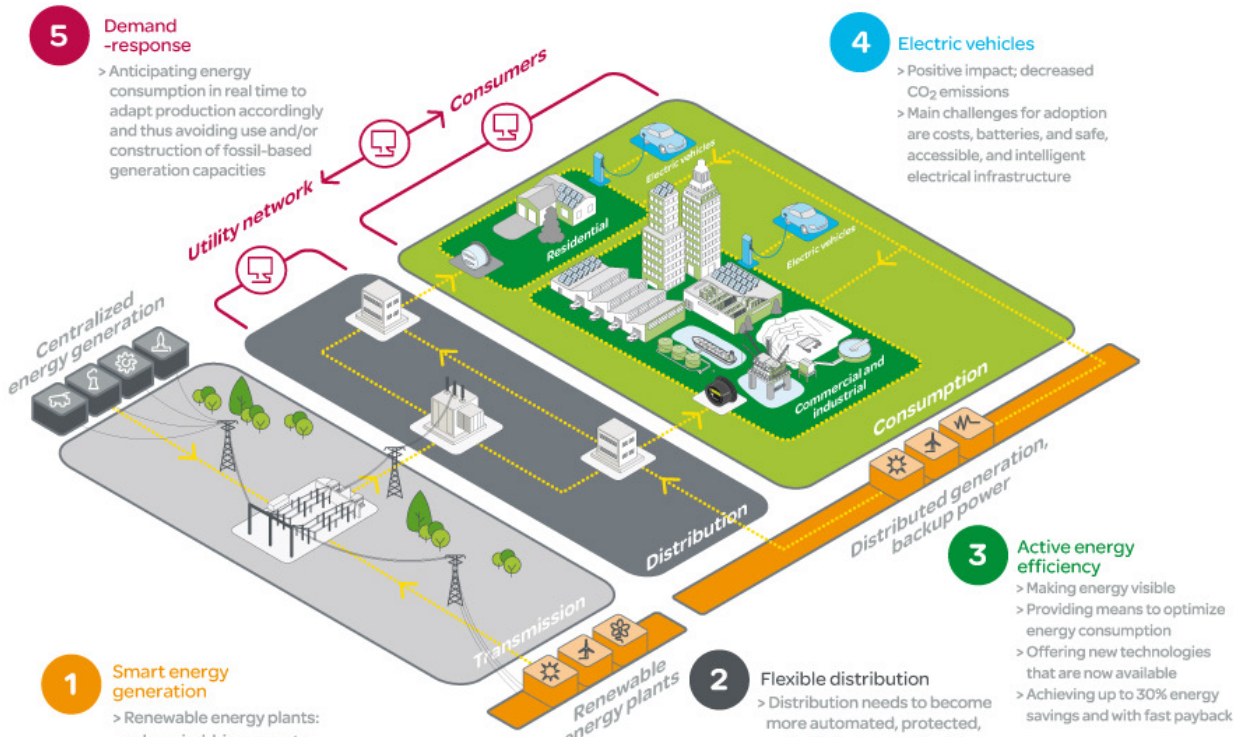




One-Way Vs. Two-Way Power Flows

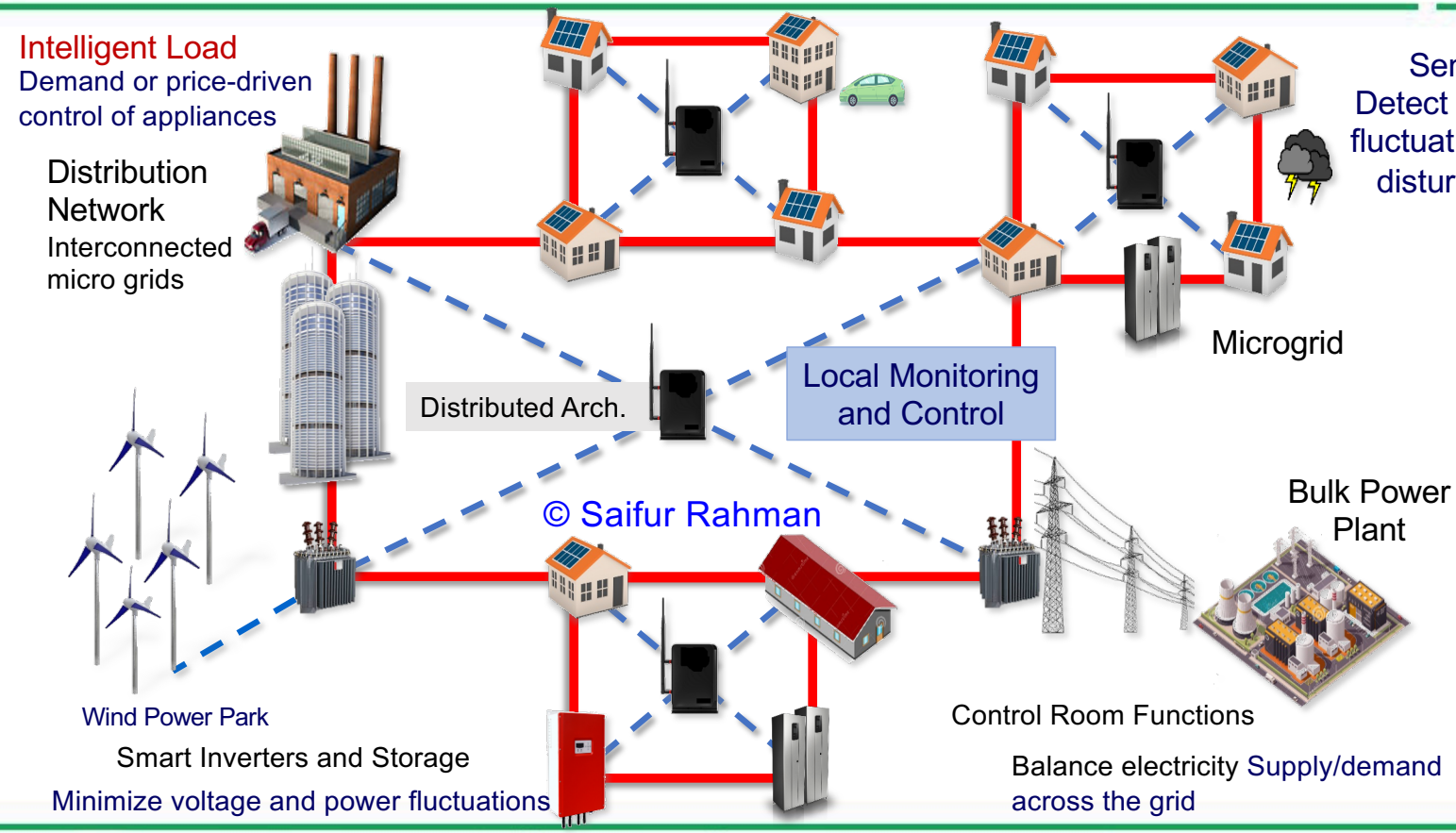
Source: Altalink, Alberta, Canada

Electricity Networks and Grid In Evolution



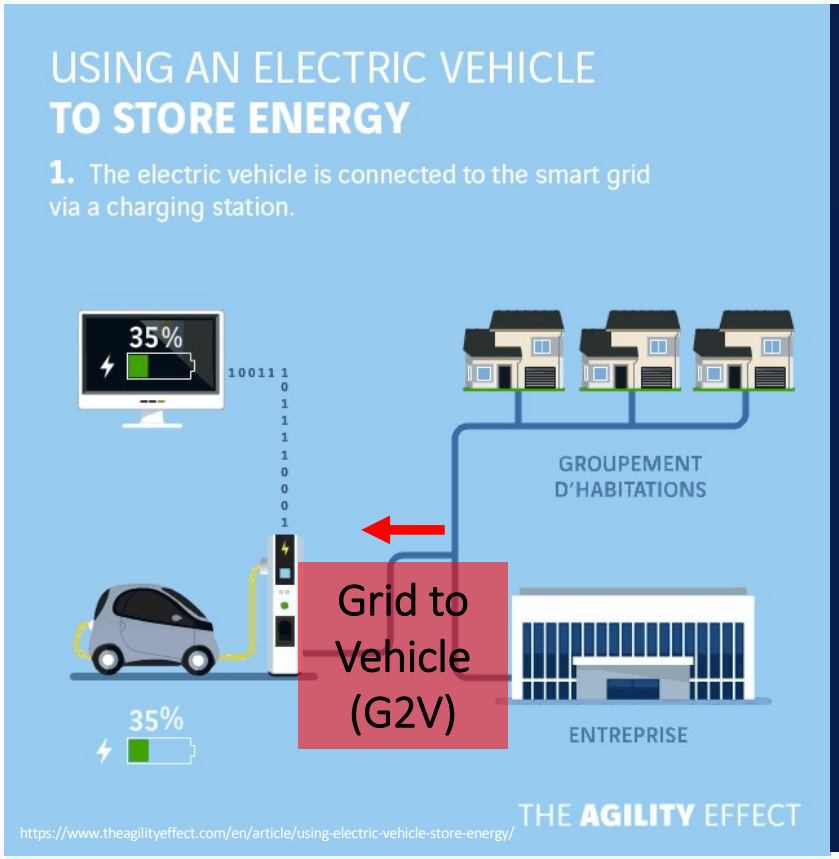
https://blog.se.com/building-management/2014/04/28/internet-things-next-step-smart-grid-evolution/

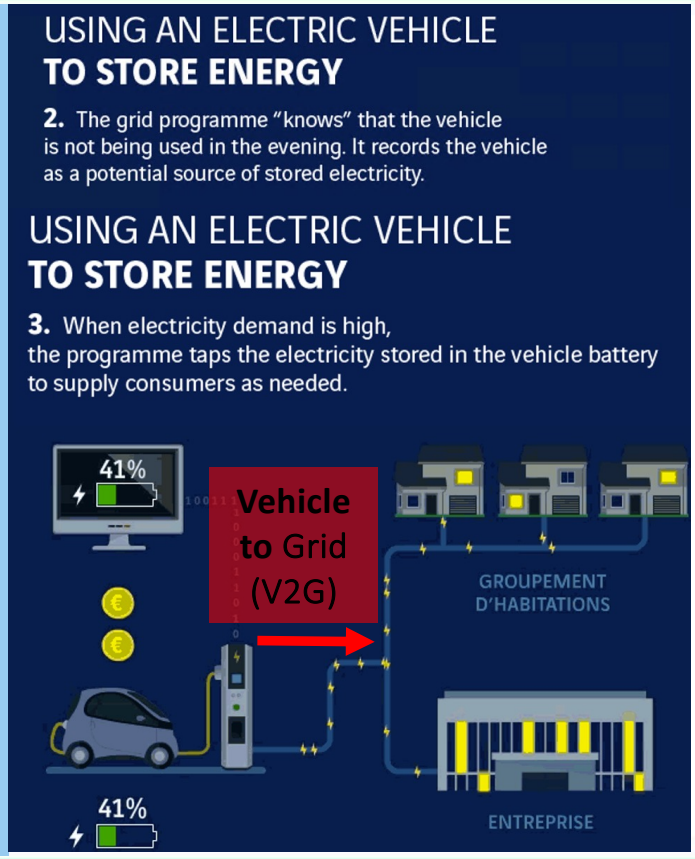
Intelligent Interconnected Microgrids



Changing Landscape for the Electric Utility

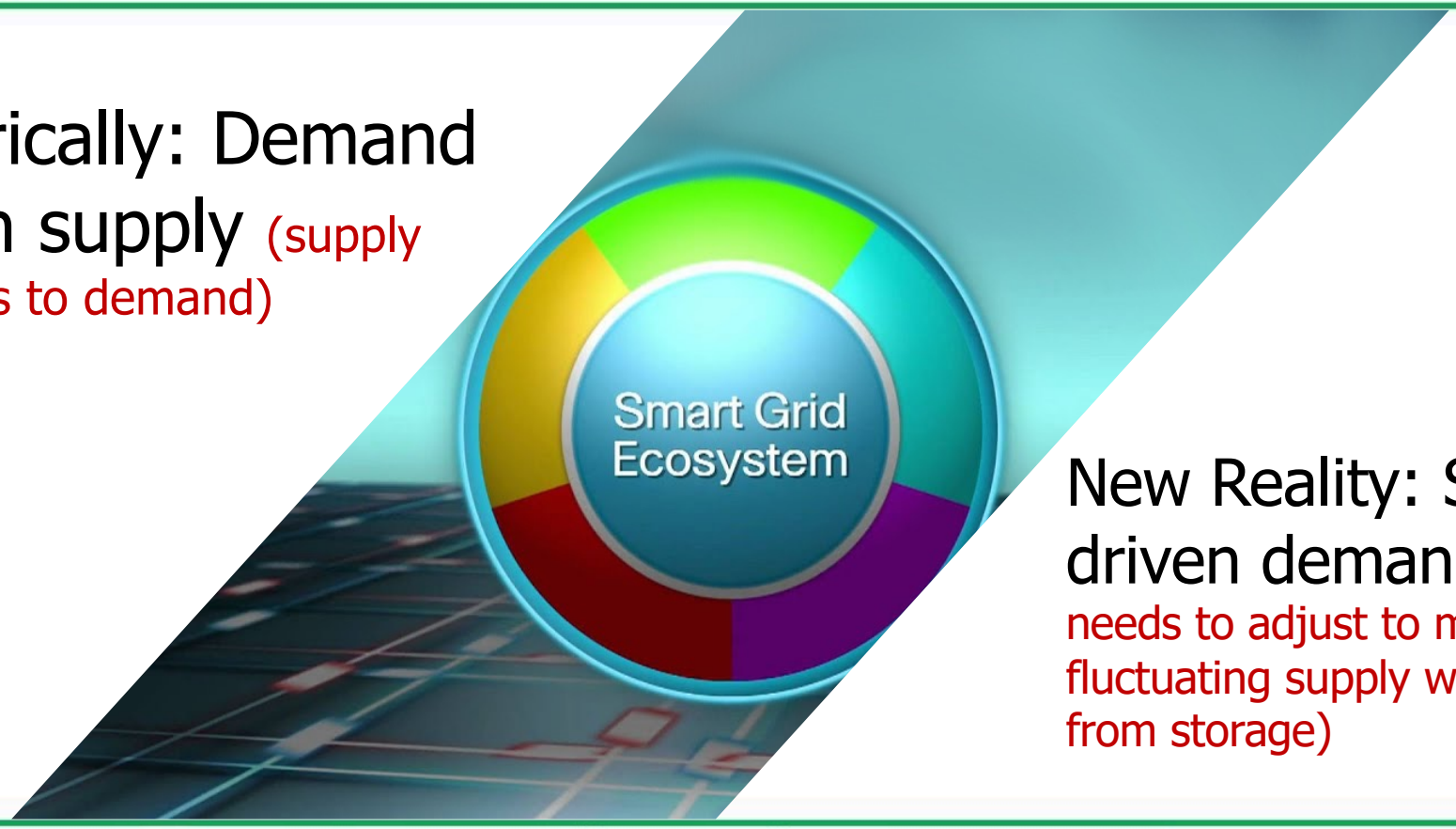
Grid to Vehicle (G2V)
Vehicle to Grid (V2G)





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)

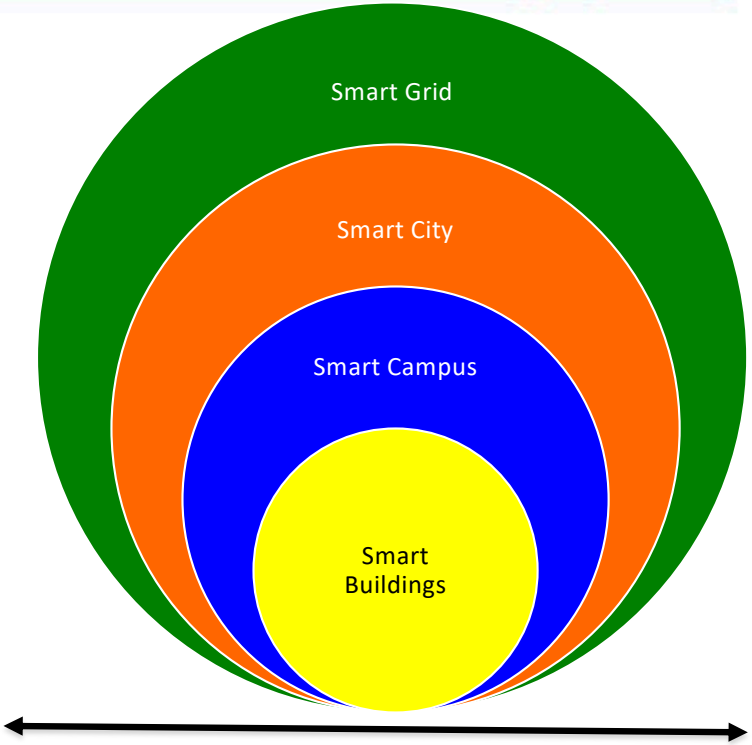
Smart Grid Ecosystem

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

Prof. Saifur Rahman

For discussions/suggestions/queries email:
www.indiasmartgrid.org
www.isgw.in
www.srahman.org

Thank You

India Smart Grid Forum
CBIP Building, Malcha Marg,
Chanakyapuri,
Delhi-110021
Website: www.indiasmartgrid.org