

Smart Grid as an Intelligent CPS Its Impact on Climate Change Mitigation

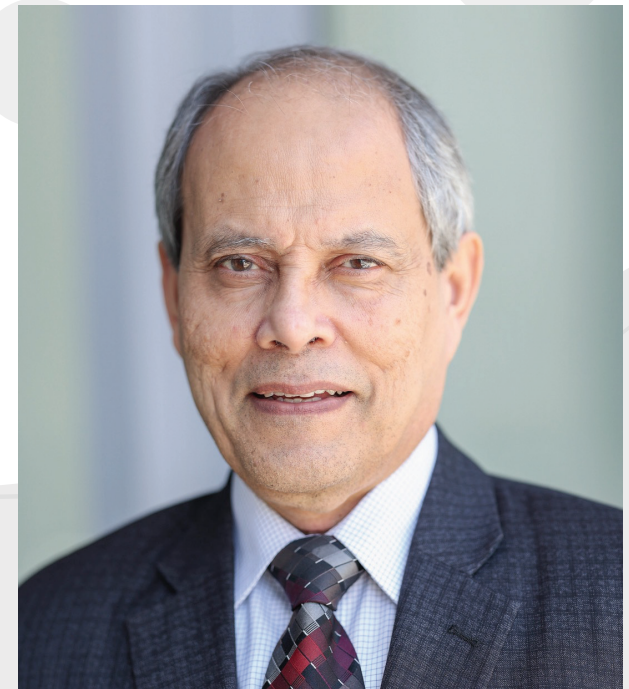
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2023 IEEE President & CEO

www.srahman.org

IEEE CONECCT 2023

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Plenary Keynote Speech

Why is Climate Sustainability a Challenge?

Unprecedented Natural Disasters

Africa, China and Florida, USA



Droughts in 2022



<https://idsb.tmgrup.com.tr/ly/uploads/images/2022/07/08/217454.jpg>

The Jialing Riverbed at the confluence with the Yangtze River is exposed due to drought on 18 August 2022, in Chongqing, **China**

Dry riverbed in **Italy** (Po River) due to worst drought in 70 years, June 2022



<https://image.cnbcfm.com/>

Wildfires in the US



July 2021: The Dixie fire burned close to a million acres in **California's** Lassen county over three months and became the first fire to cross the Sierra Nevada. Photograph: Noah Berger/AP

Peaks glowing with thousands of spot fires on
13 June 2022, in Flagstaff, **Arizona**.

Rob Schumacher/The Republic



How Do We Address This Problem?

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Climate
Change

climate-change.ieee.org



IEEE: Enabling Innovation and Technology Solutions

Mitigation

Slow down the impact

Adaptation

Take action to live with it

Climate Resilience

Prepare to recover quickly

Mitigation will allow time to adapt by developing new technologies, best practices and policy formulation

What is the Role of the Technologist?

Develop and Promote Universally
Applicable Cleantech Solutions
for Climate Sustainability?

Changing Landscape for the Electric Utility





Issues with Distributed Generation

- Wind and solar are intermittent
- Hydro is space limited
- Resource is free but not always usable

Historically: Demand driven supply (supply responds to demand)

New Paradigm for the Electric Power System



Smart Grid Ecosystem

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

THE SMART GRID ECOSYSTEM

How Can the Smart Grid Help?

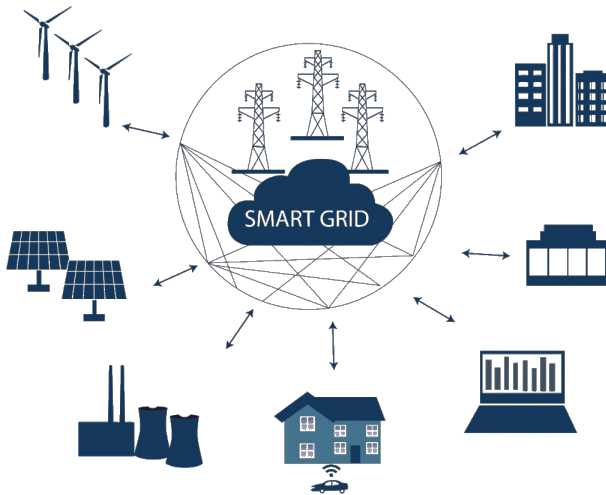
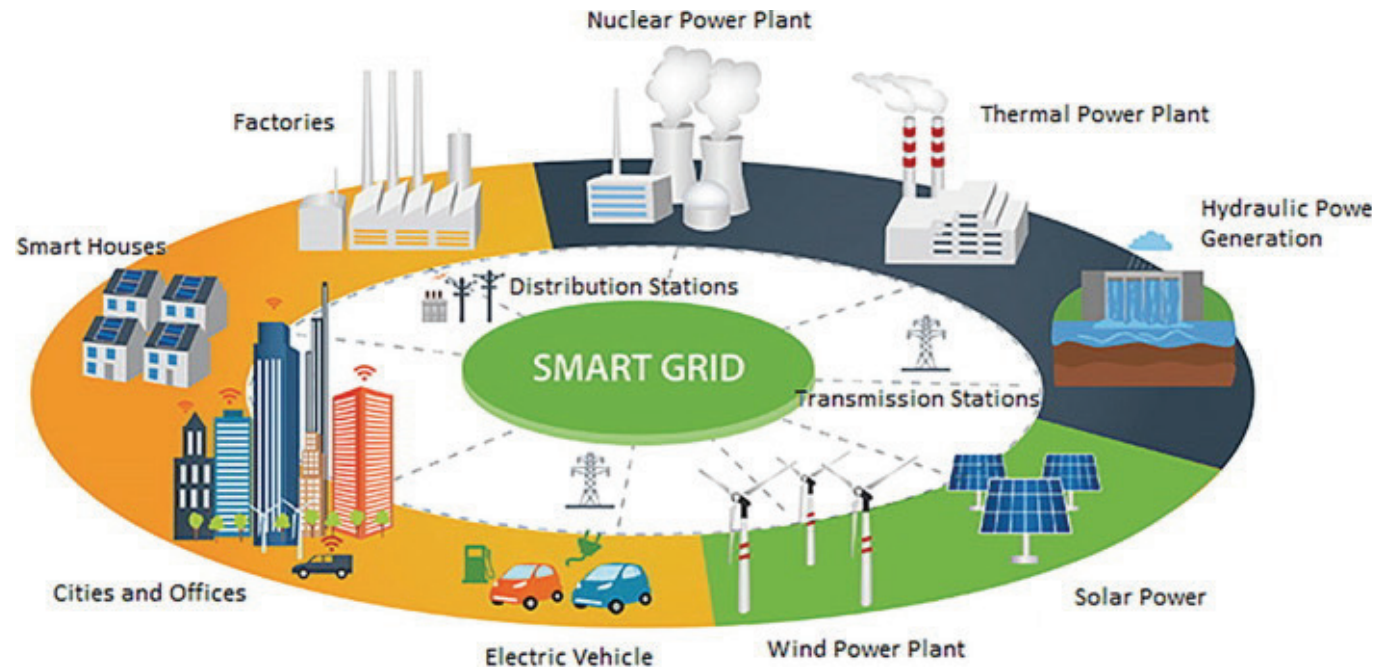
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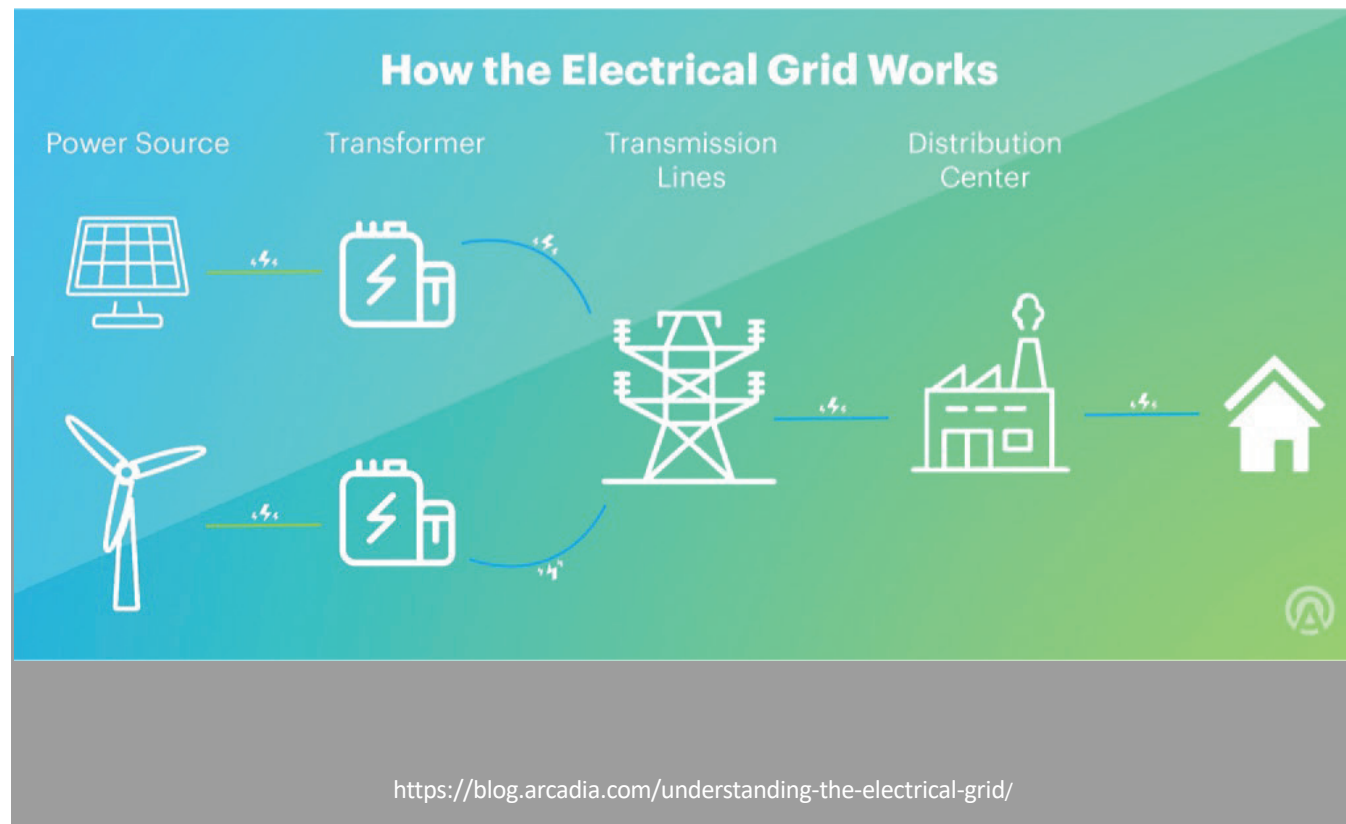


What is a Smart Grid

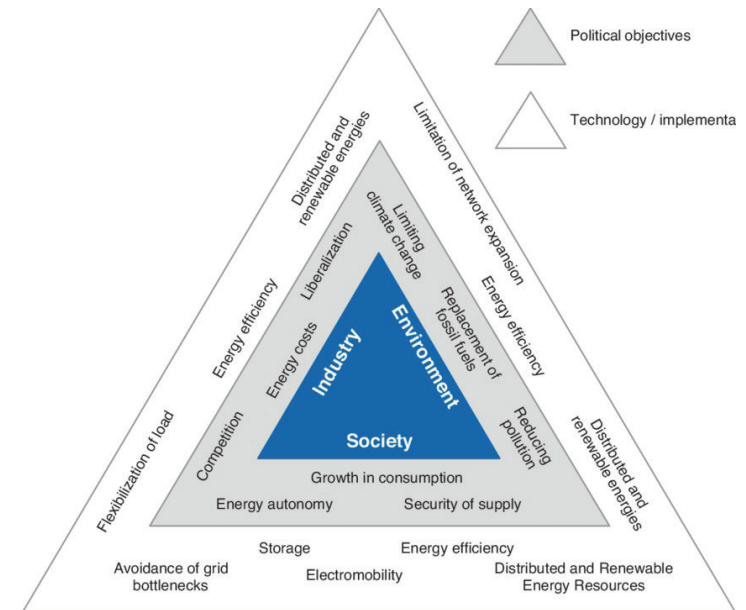
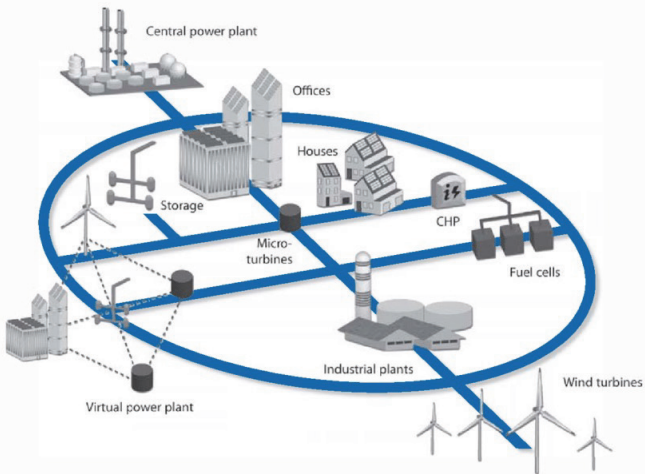


"Smart grid" is a concept with many elements where monitoring and control of each element in the chain of **generation, transmission, distribution and end-use** allow the electricity delivery and use to be more efficient.

Electric Power Grid



Motivation for a Smart Grid



https://www.researchgate.net/figure/Motivation-for-a-Smart-Grid-on-the-basis-of-the-energy-management-triangle-political_fig1_263264024

Desire to make the grid smarter, safer, reliable and more cost-effective using advanced sensors, communication technologies and distributed computing.

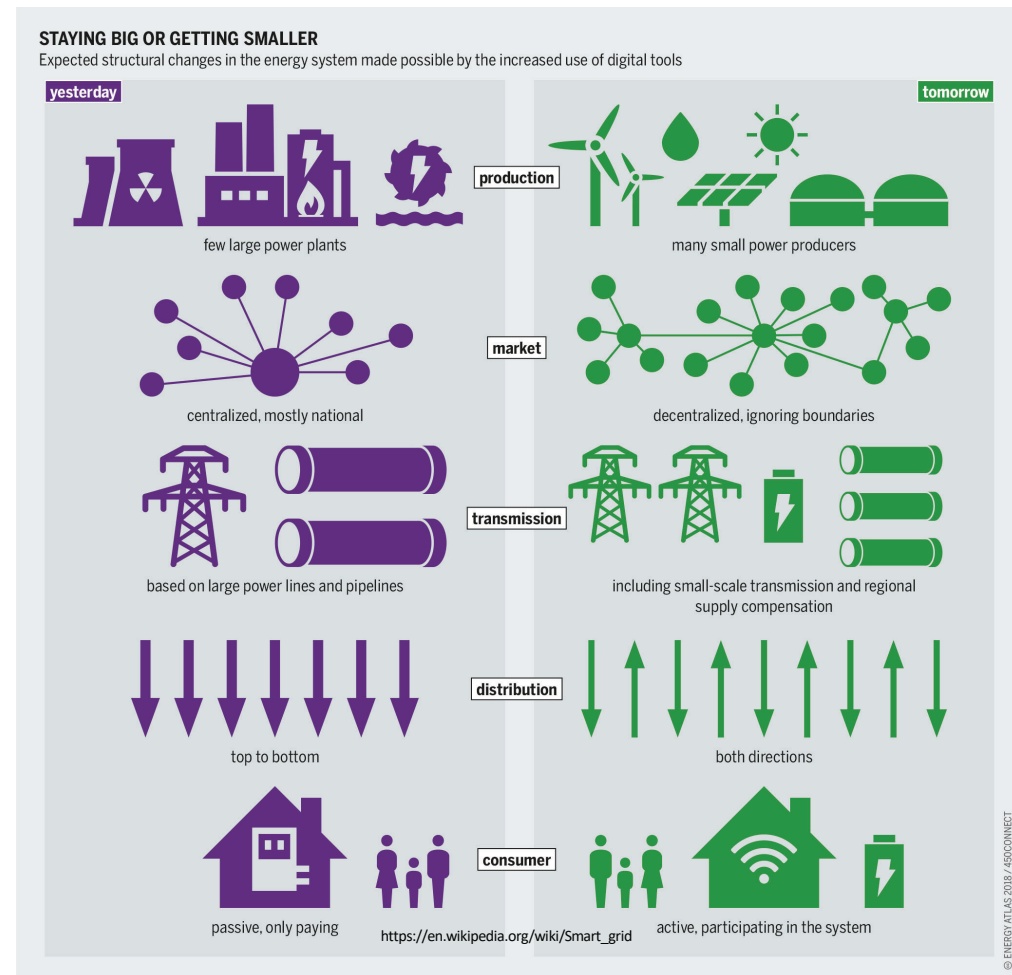
Difference Between a Normal Grid And a Smart Grid



Normal Phone



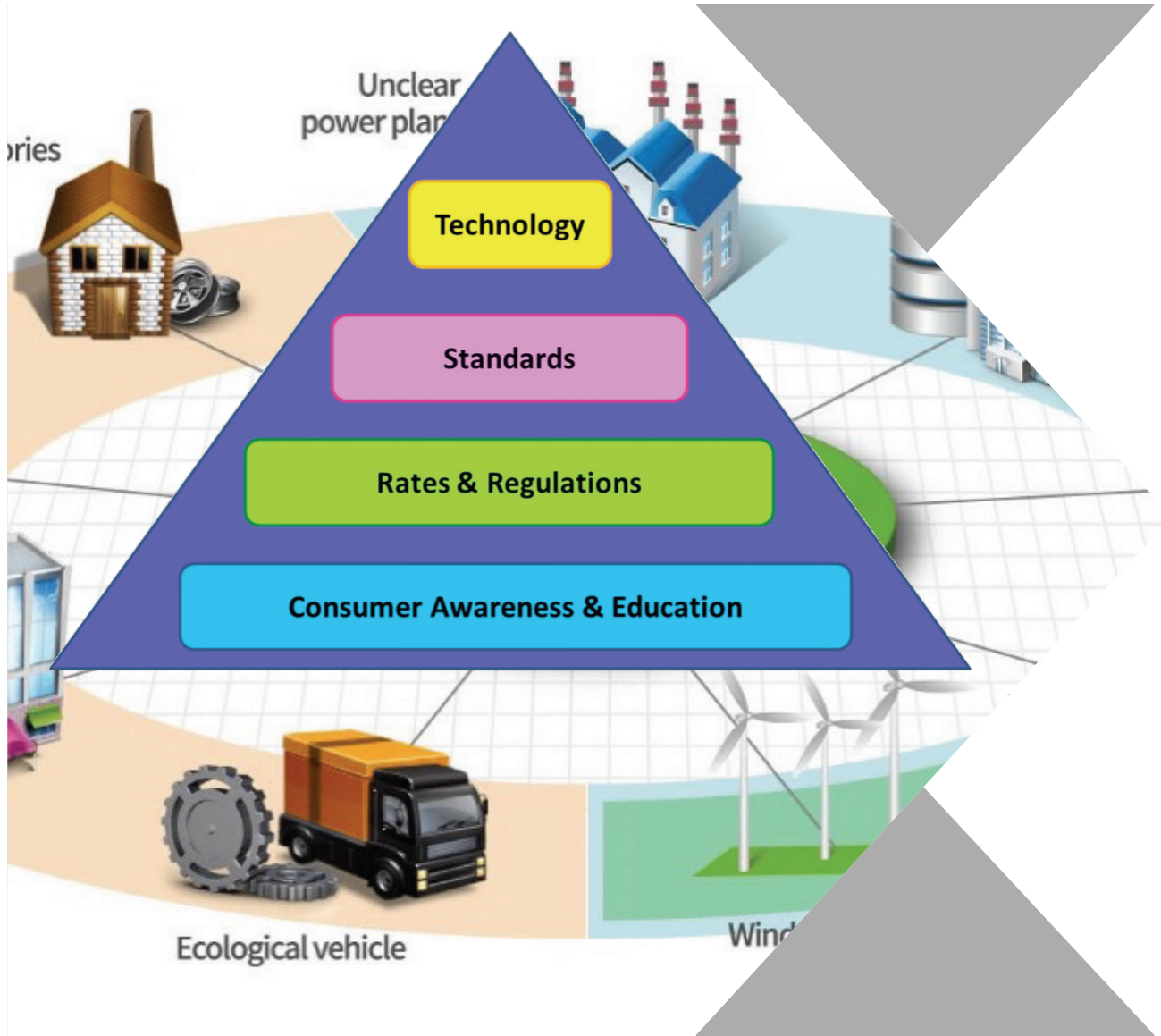
Smart Phone



Starting and End Points of a Smart Grid

It starts at the Generator and ends at the Refrigerator



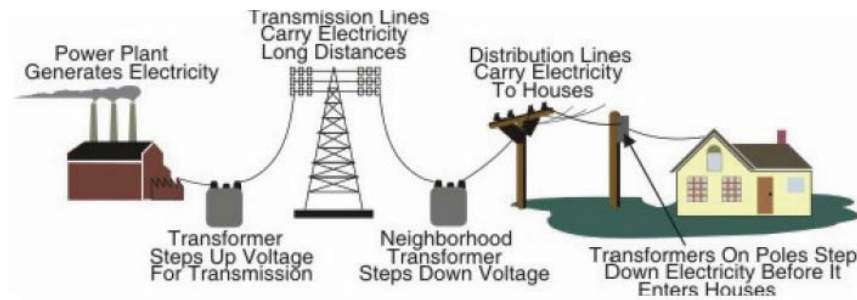


Smart Grid Building Blocks

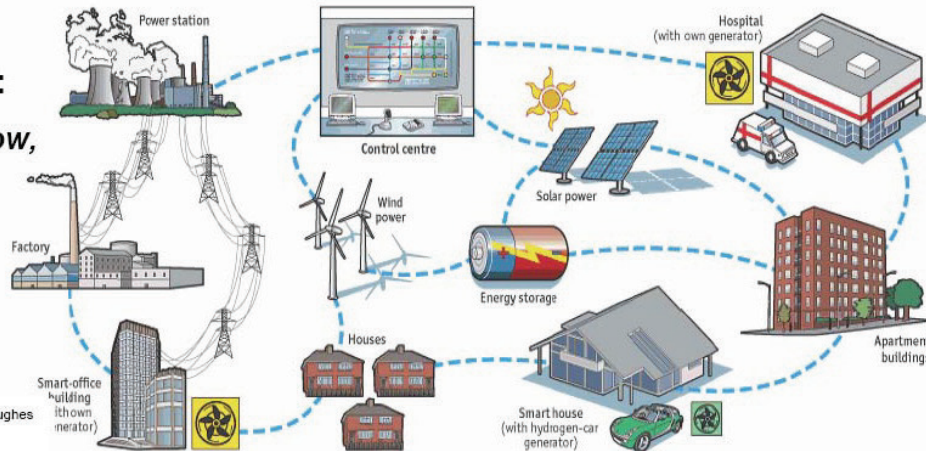
Evolution of the Grid

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

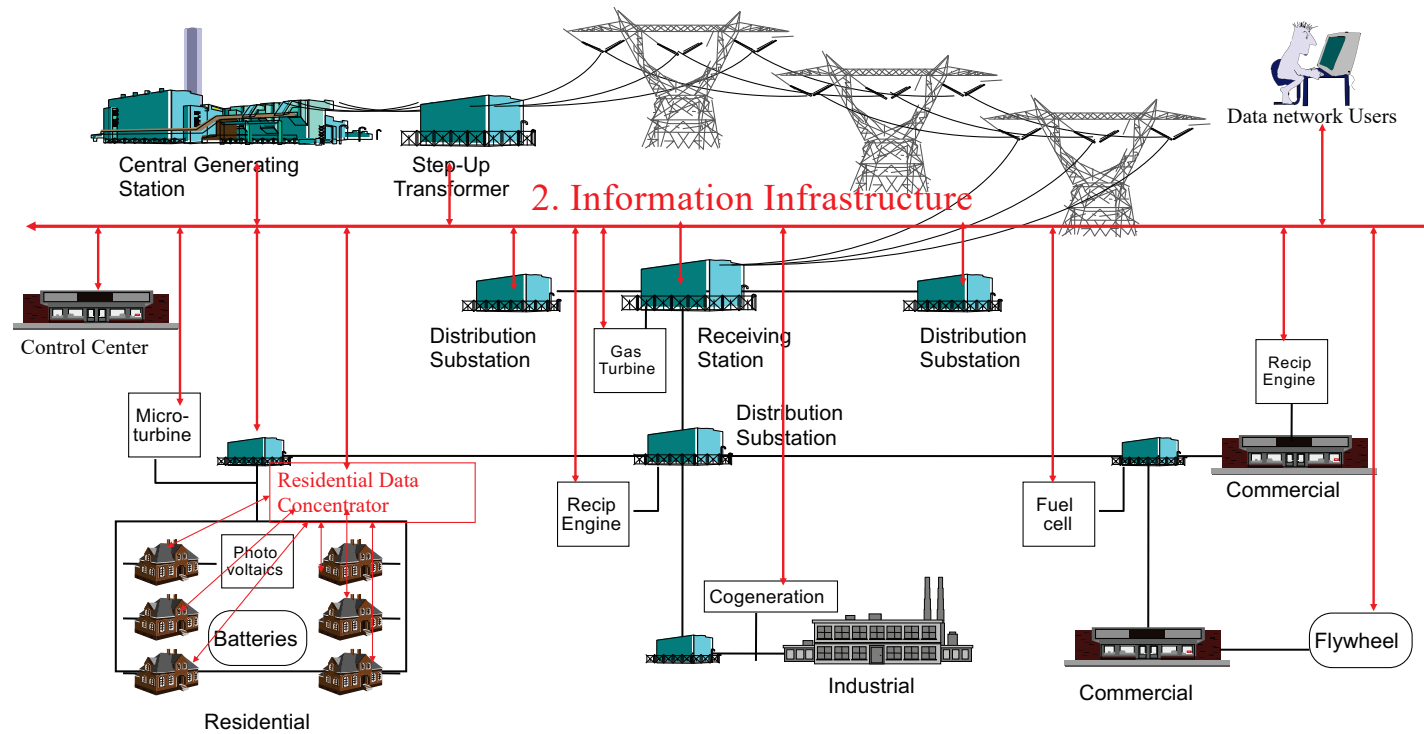
The background is a dark, textured field of glowing binary code (0s and 1s) in shades of gold and orange. Overlaid on this are several horizontal, wavy lines of light. A prominent, bright white and blue wave runs across the center, with other waves in purple, pink, and blue. The overall effect is a sense of dynamic energy and digital connectivity.

Merging Power Flow with Information Flow:

Integrated Communications

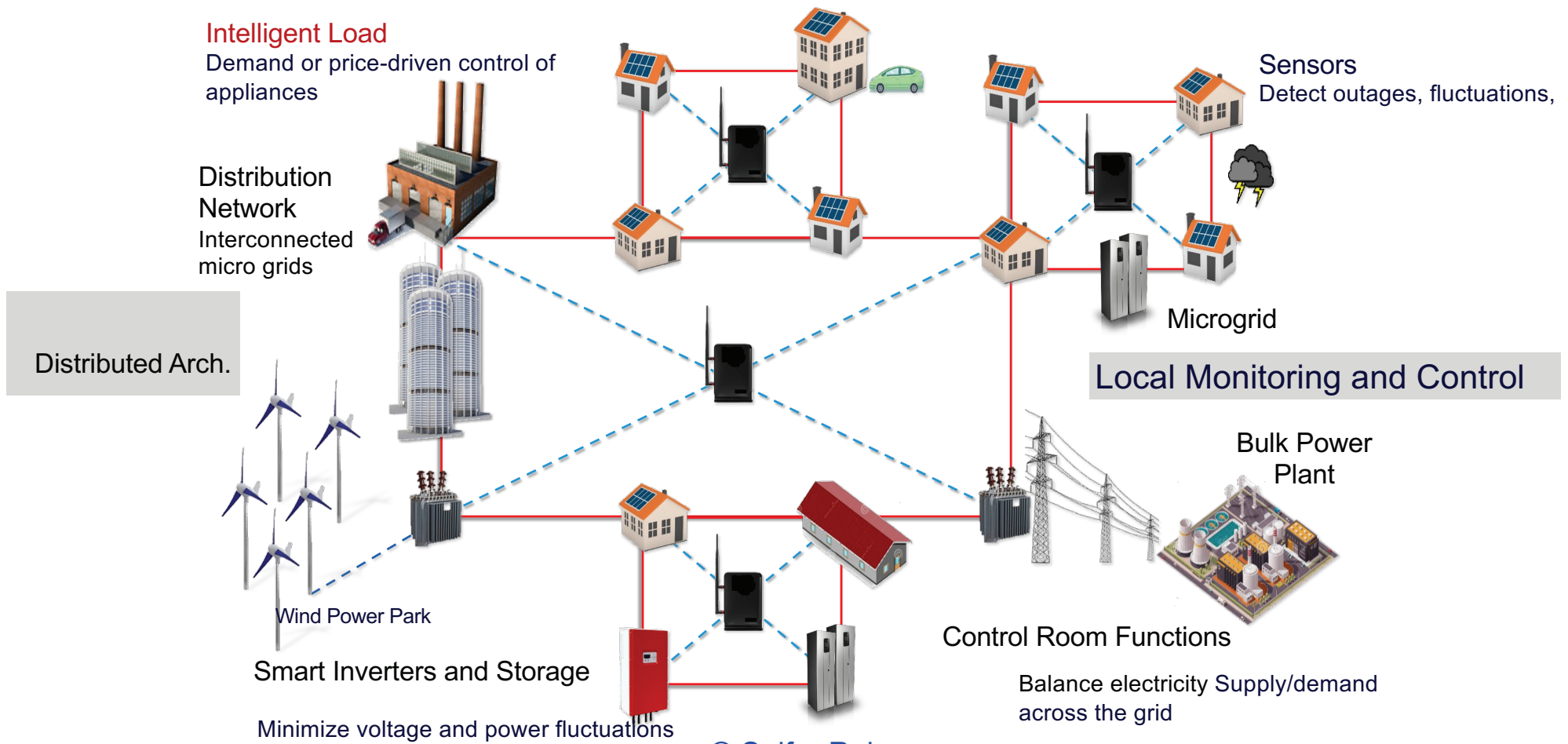
Electric Power & Communication Infrastructures

1. Power Infrastructure



Source: EPRI

Intelligent Interconnected Microgrids (CPS)



The Smart Grid Ecosystem

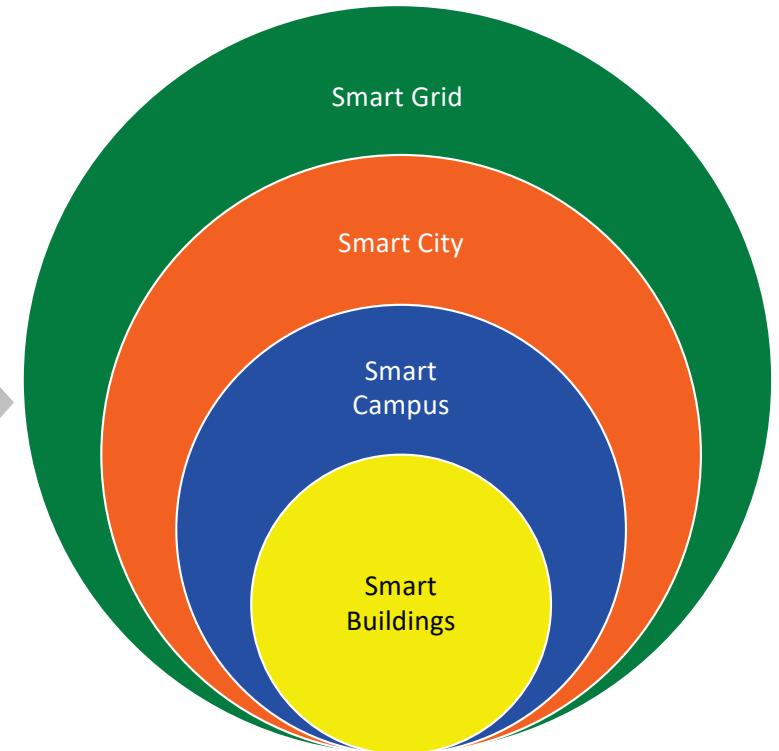
Smart grid: Bi-directional flows of energy, remote control/automation of power, integrated distributed energy...

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...

Ecosystem



← Supported by ICT and distributed networks of intelligent sensors, data centers/clouds →

THANK YOU!

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