Role of ICT in Optimal Management of Smart Buildings, Smart Cities & Smart Grids

Keynote Speech

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2023 IEEE President and CEO

Date	Recent and Upcoming Presentations and Webinars	Webinar/Presentation Slides
02-04 May 2024 ***Dhaka, Bangladesh***	**Role of ICT in Optimal Management of Smart Buildings, Smart Cities and Smart Grids** Keynote Speech, 6th IEEE International Conference on EE and ICT MIST, Dhaka, Bangladesh Advanced information and communication technology (ICT) applications in commercial buildings, schools, libraries, shopping centers, etc. offer low-cost but highly effective monitoring and control opportunities. Sensors deployed in key locations in buildings can monitor the building environment in real-time, collect information for intelligent decision making, and facilitate various services. Such large-scale deployment of sensors and controllers makes the building energy efficient.	

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The Smart Grid Ecosystem

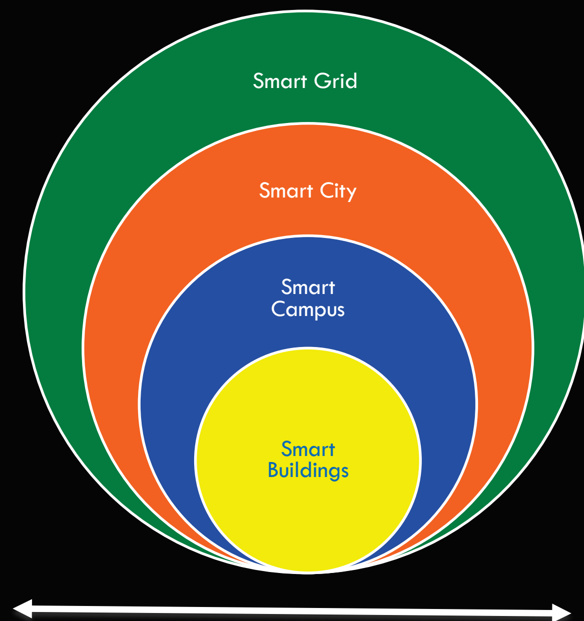
Smart grid: Bi-directional flows of energy, remote control/automation of power, integrated distributed energy…

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

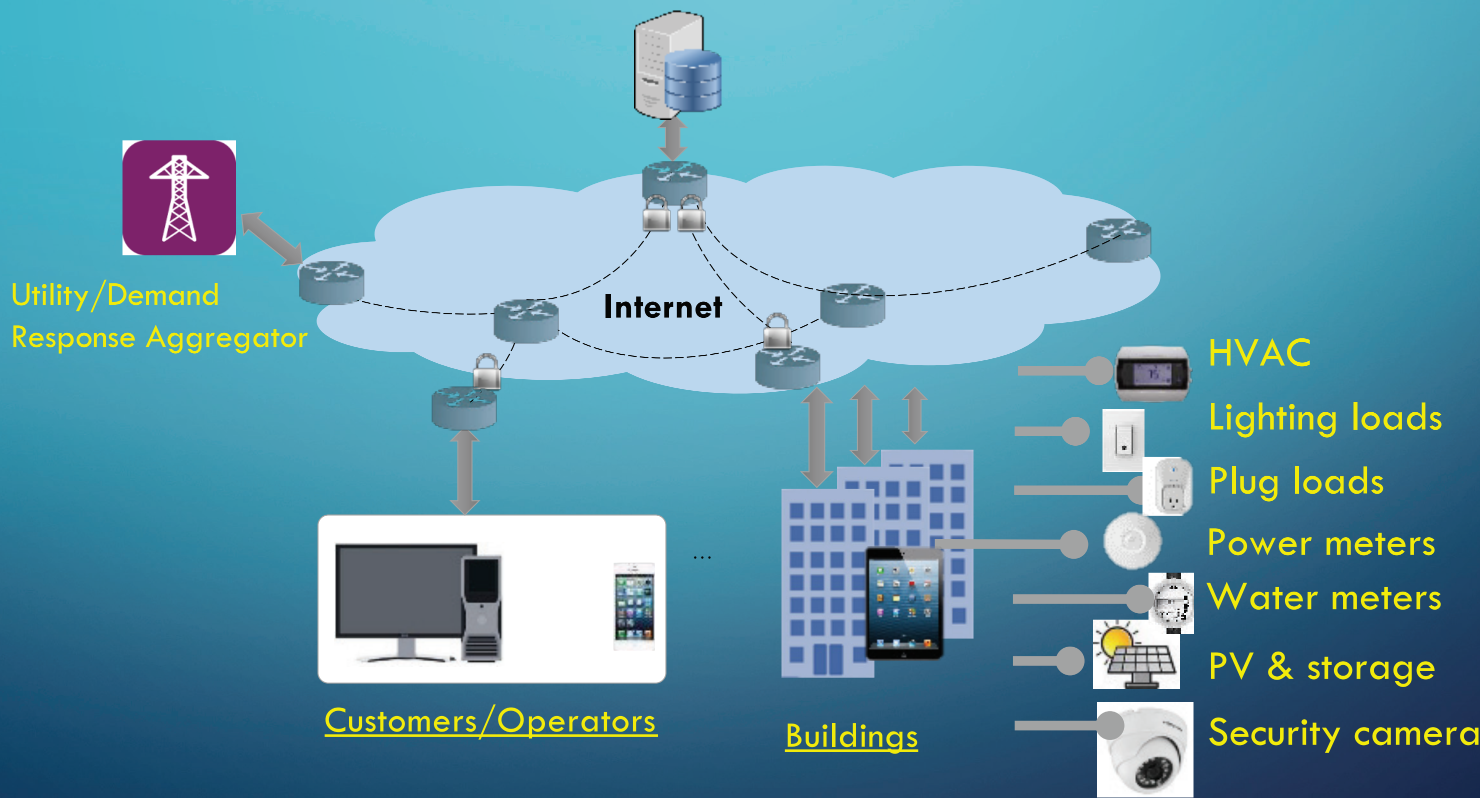
What makes a Building Smart

A single platform for monitoring and control of HVAC, lighting, water supply, sensor networks, security camera & fire emergency

Source: Smart Building Market To Grow 30% by 2020, http://www.iotsolutionprovider.com/smart-building/smart-building-market-to-grow-30-by-2020, December 2015.

An Open-Architecture Platform for IoT Device Integration in a Smart Building

Smart Campus Management using the Cloud



Building Blocks of a Smart City

Range of Deployments in Smart Cities

Cities across the world are deploying technology to gather data trying to become cleaner, reduce traffic, and improve urban life. Starting with energy management, to disaster preparedness, to public safety, to parking spot assistance, to paying bills online, to facilitate emergency vehicle movement, and much more.

Elements of a Smart City

A neighborhood in a smart city:

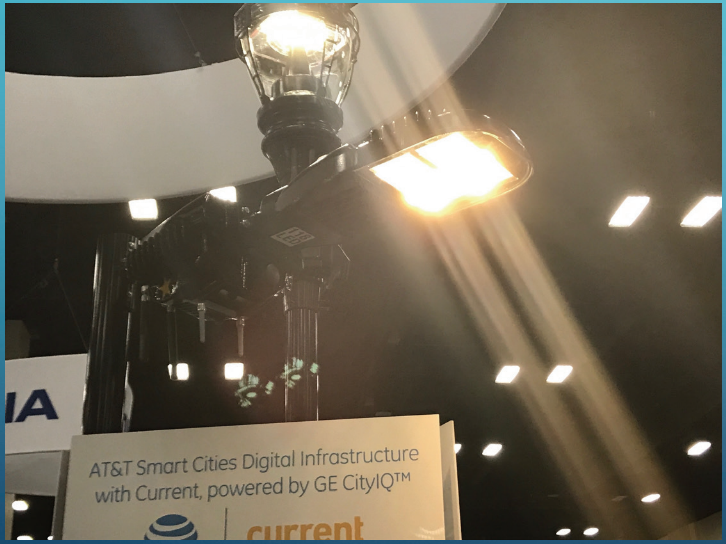
- A smart traffic crossing sensitive to traffic volume
- Synchronized traffic lights for smooth flow
- Emergency vehicle priority access

Stockholm City Traffic Management

The system allows buses that are more than a minute behind schedule to automatically receive priority at traffic lights

US Deployment: Smart Lamppost with Camera

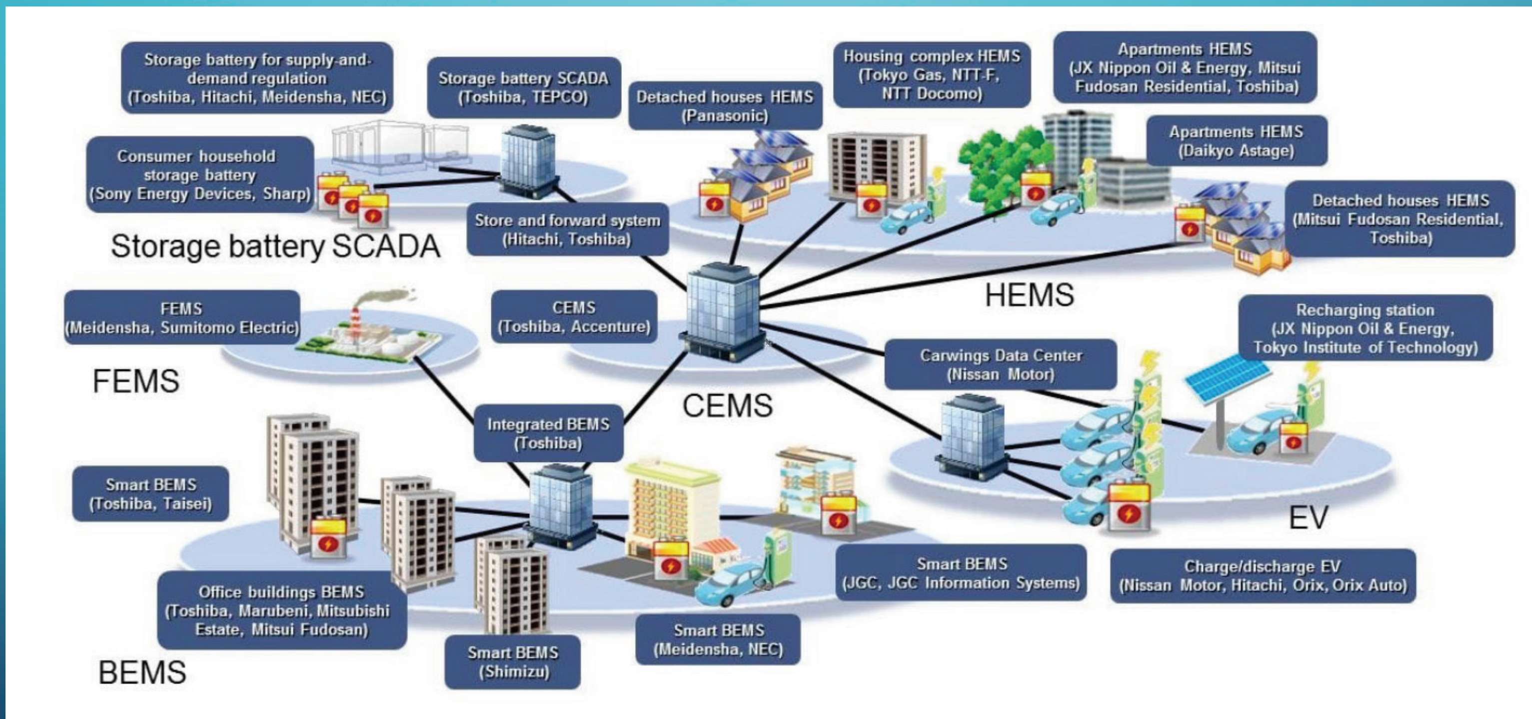
Camera provides surveillance and locates empty parking spaces



Smart Trash Can in Stockholm, Sweden

Regular trash cans need to be emptied 1–3 times per day
Smart ones only need to be emptied four times a week.

Smart City Demonstration Yokohama, Japan



Field Implementation Examples

Academic Building in Alexandria, Virginia

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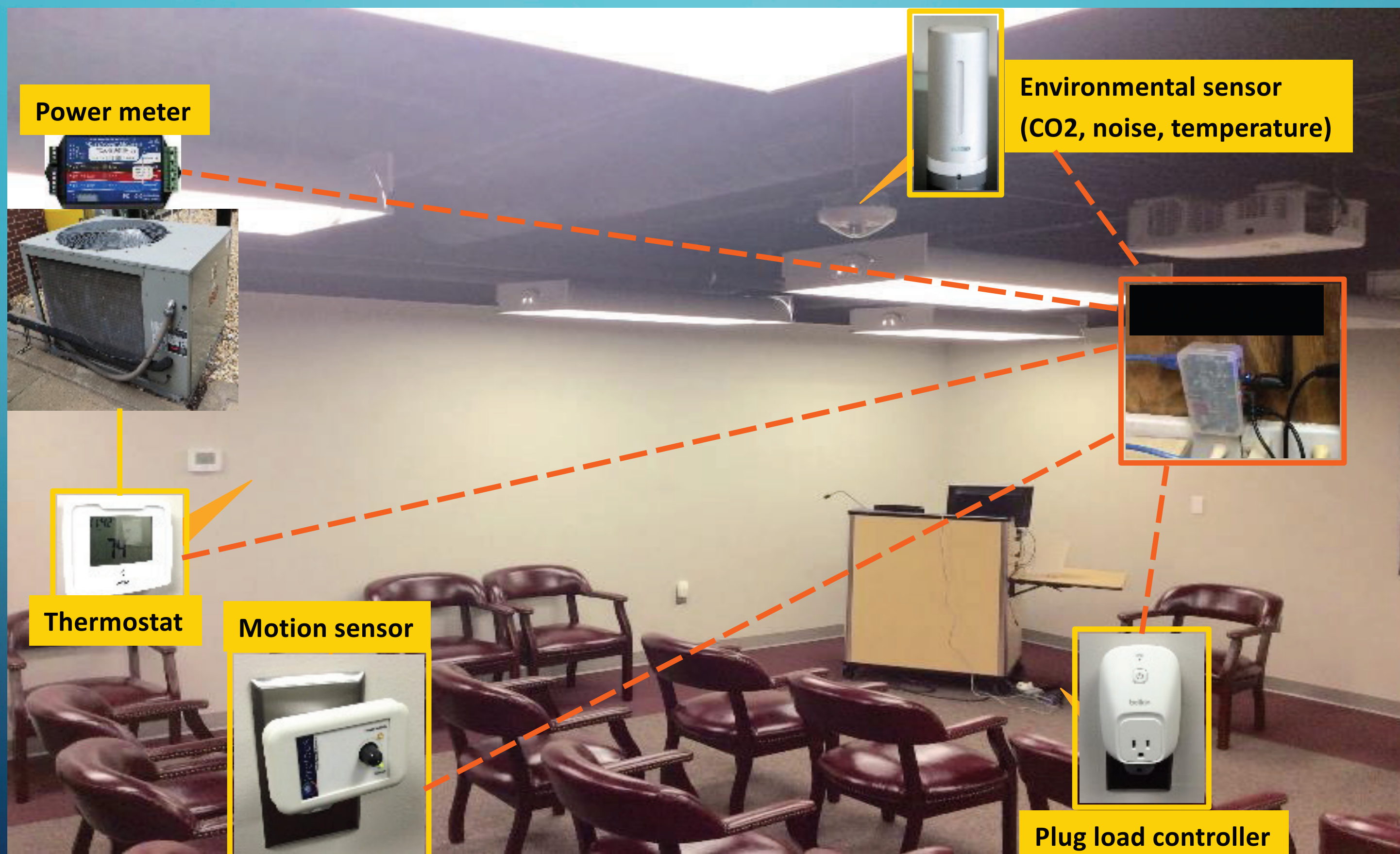
Classroom under Real-time Monitoring and Control



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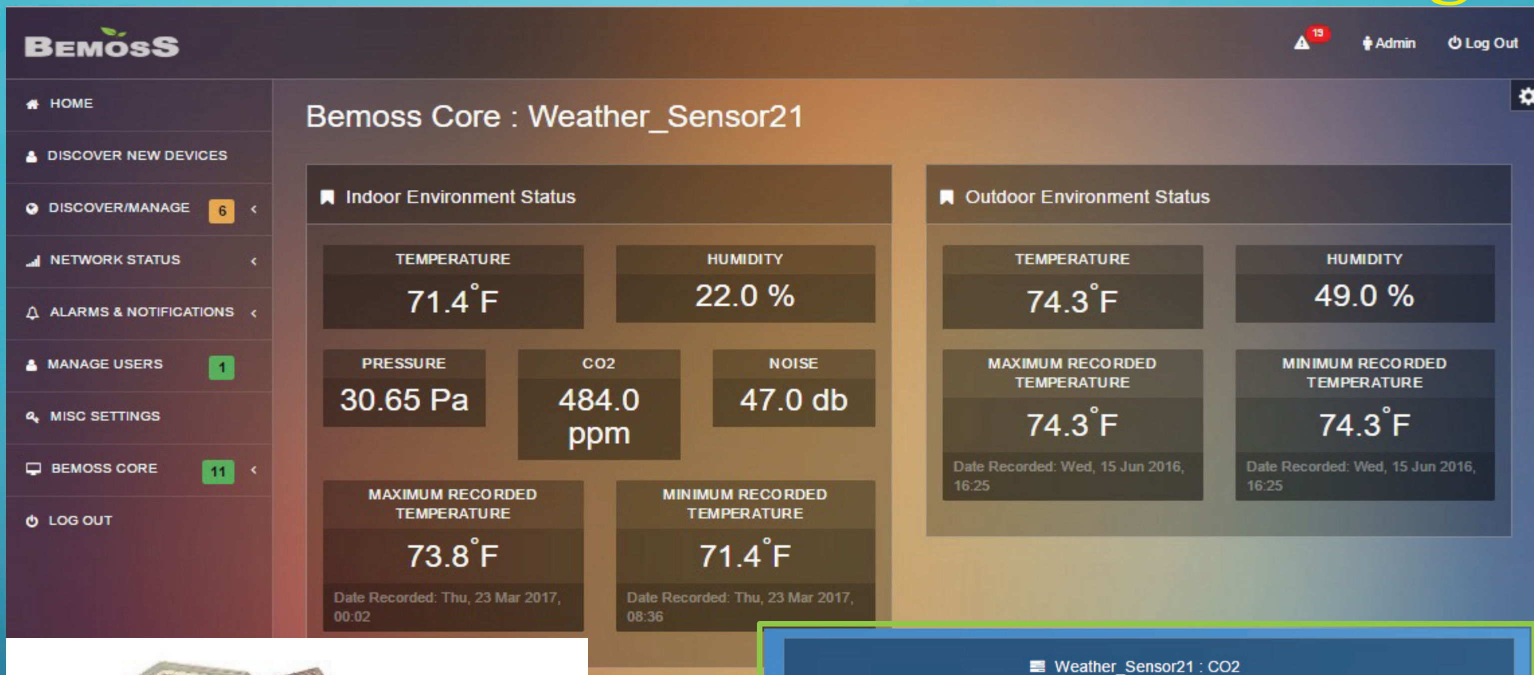
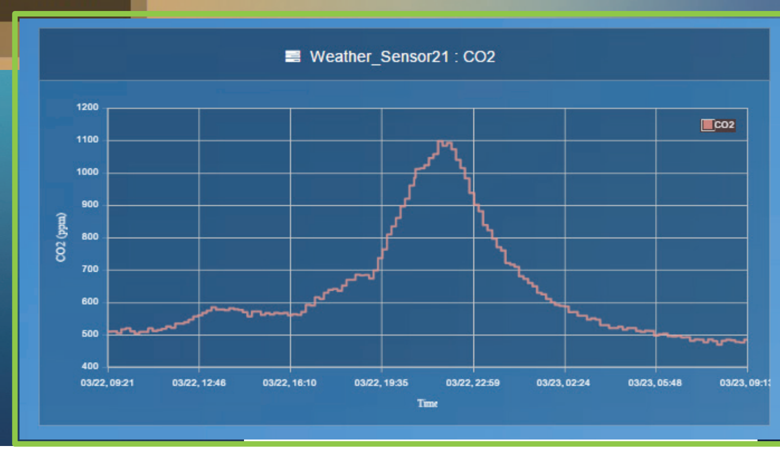
Indoor Environmental Monitoring





Energy Savings from Air Conditioning Control

Summer Months (June-July-August)	
Compressor consumption 2014 (Before Control)	8,340 kWh
Compressor consumption 2016 (After Control)	6,071 kWh
Average savings	**26.8% savings**

Office Building, Arlington, Virginia

Office building size: 500 sqm

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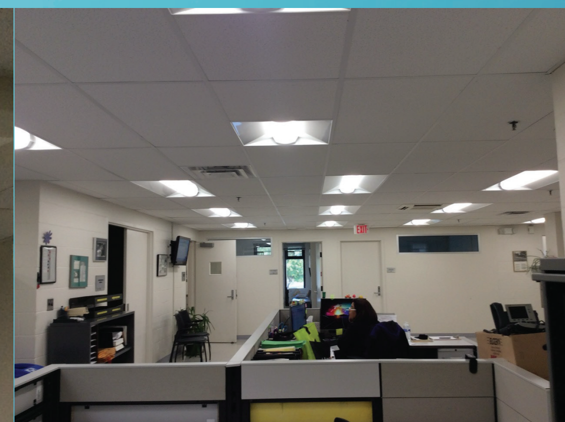
Lighting Intensity Control



Energy Savings by Controlling Lighting Intensity

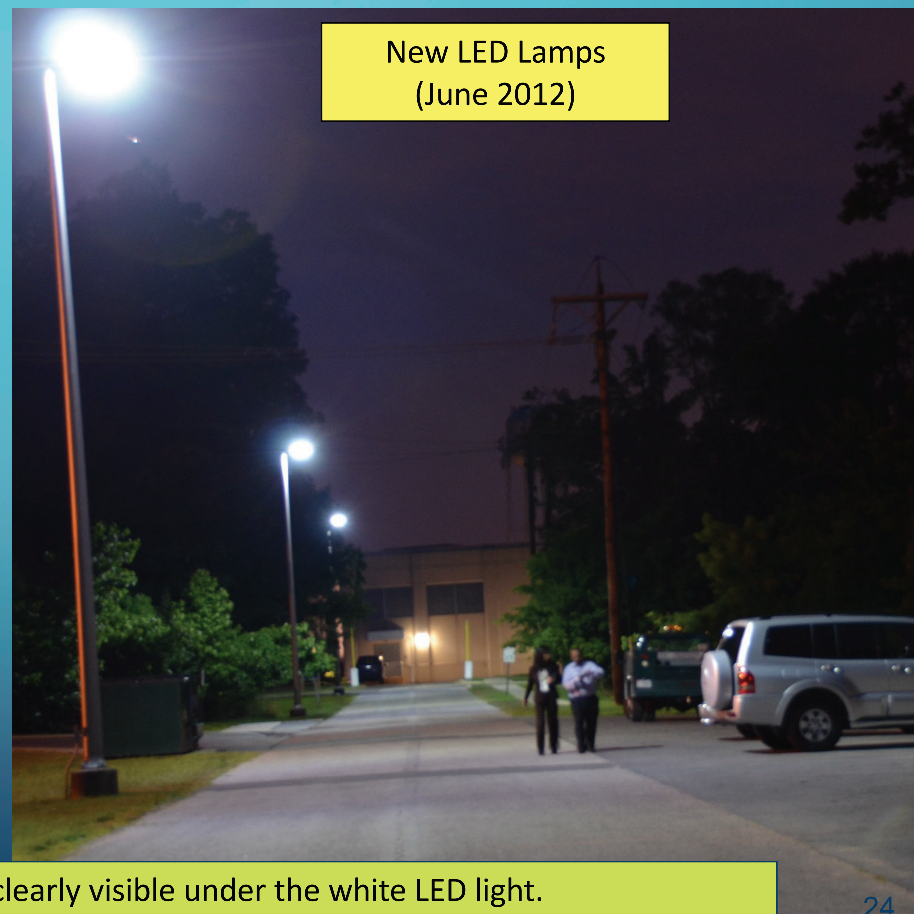
Based on occupant requirements, light intensity level was reduced during October – December 2016. Results indicate **the average kWh savings of about 34%**.

Month	Total Measured Energy Consumption (kWh)	Total Calculated Energy Consumption without Dimming (kWh)	Energy Savings by Dimming (%)
October 2016	264.37	399.90	33.89%
November 2016	278.13	423.78	34.37%
December 2016	280.76	426.40	34.16%
Total (October-December)	823.26	1250.08	34.14%

Note: Scheduled dimming level from 6:30am to 9:00pm. Open office area A: 50%; Open office area B: 45%; Chief office's desk area: 60%; Chief office's meeting area: 50%; Conference room A: 50%; Conference room B: 45%. Lights are off after 9:00pm.

Electricity Savings in Street Lighting

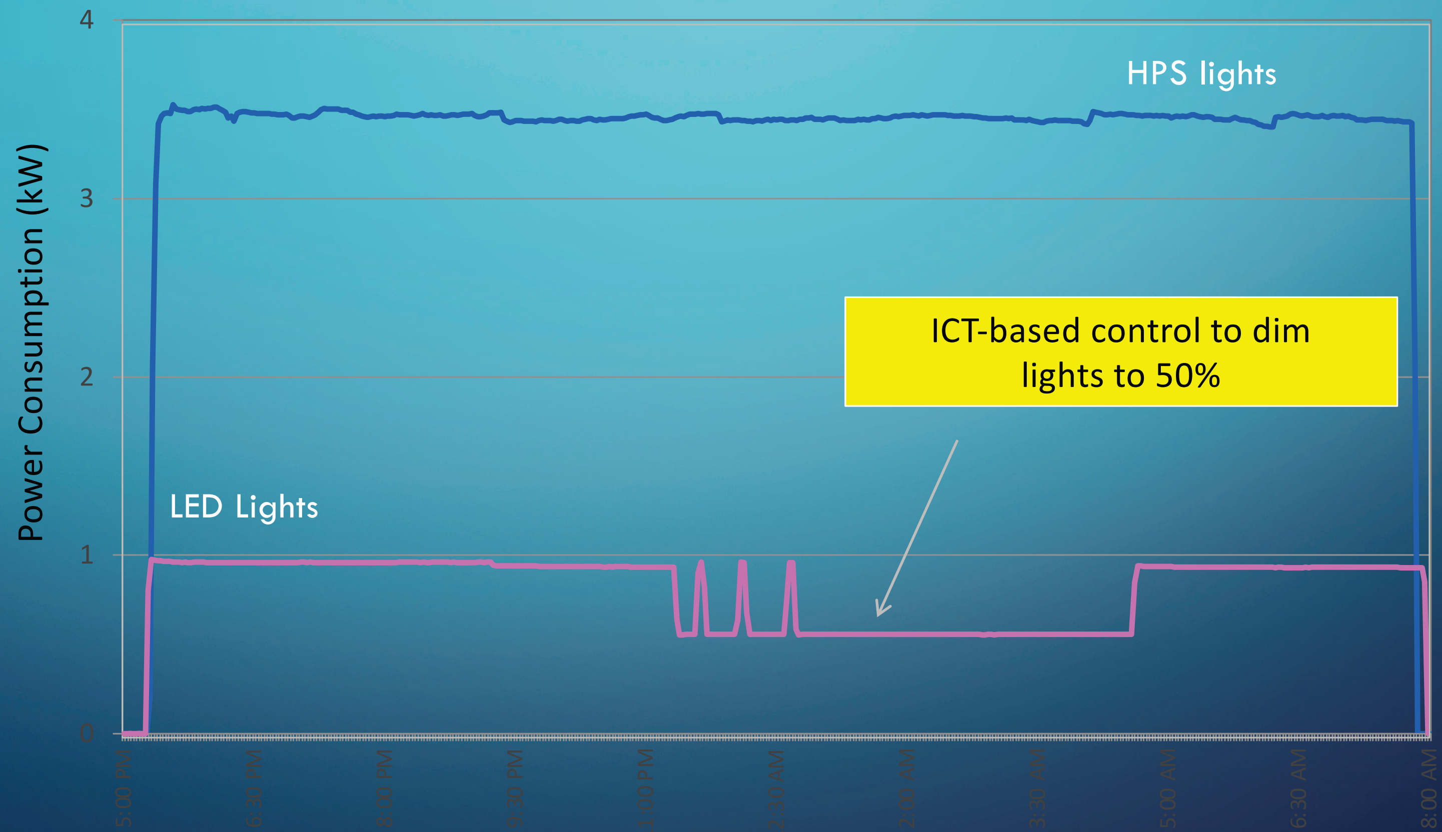
HPS vs LED



People/cars are clearly visible under the white LED light.

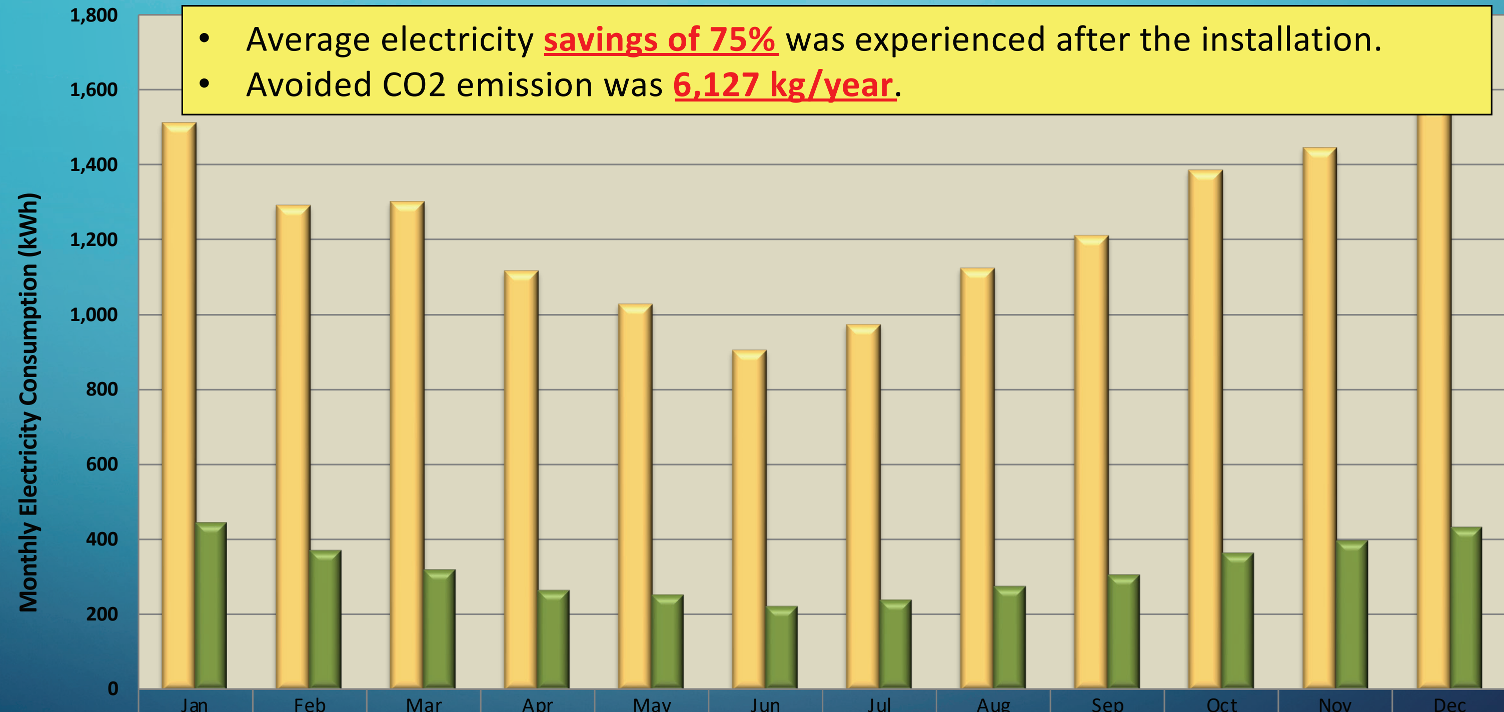
ICT-based Lighting Intensity control

Infrared Sensors to Monitor Traffic



HPS vs LED
Monthly Electricity Consumption

- Average electricity **savings of 75%** was experienced after the installation.
- Avoided CO_2 emission was **6,127 kg/year**.

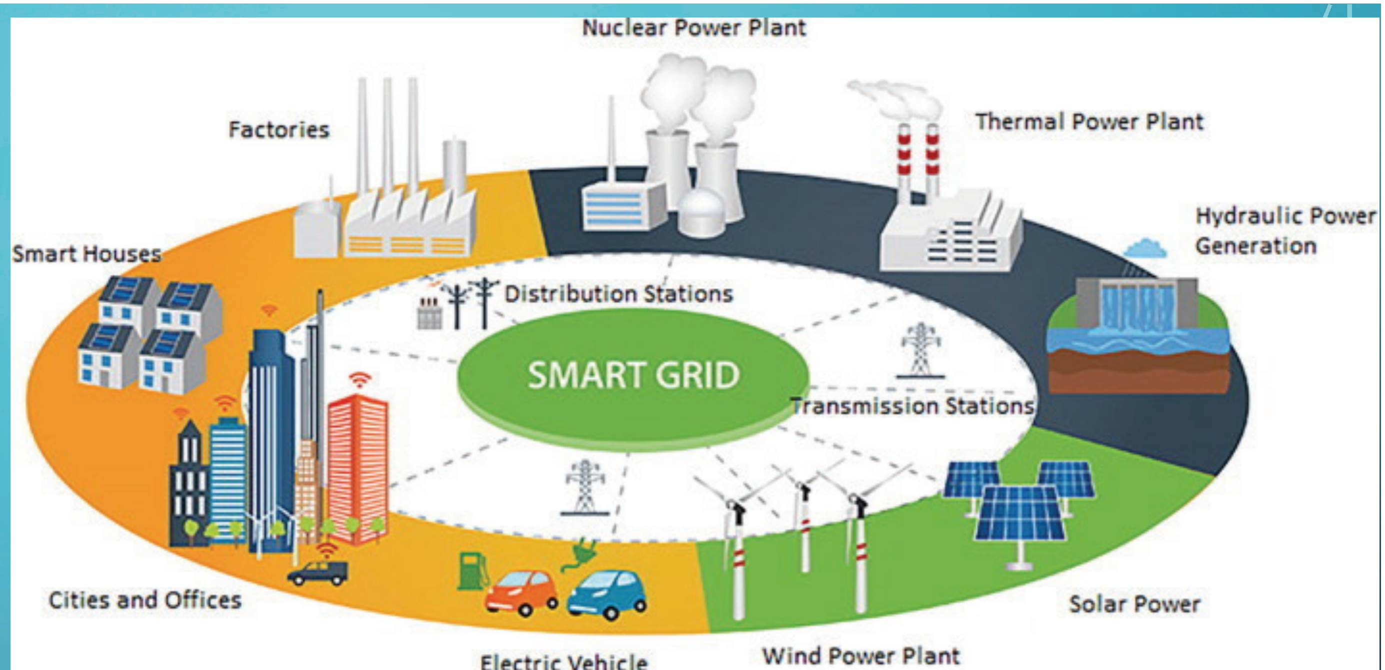


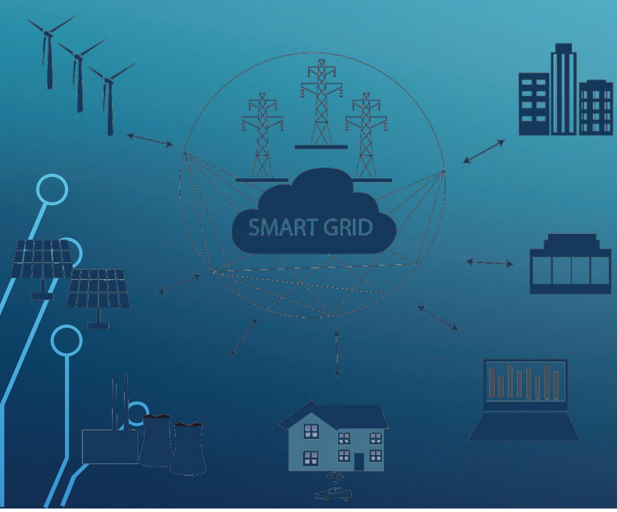
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HPS (2011)	1,510	1,289	1,300	1,116	1,027	903	972	1,123	1,210	1,384	1,444	1,552
LED (2012)	444	371	319	264	253	222	240	275	306	364	397	433

Changing Landscape for the Electric Utility

How Can the Smart Grid Help ?

What is a Smart Grid

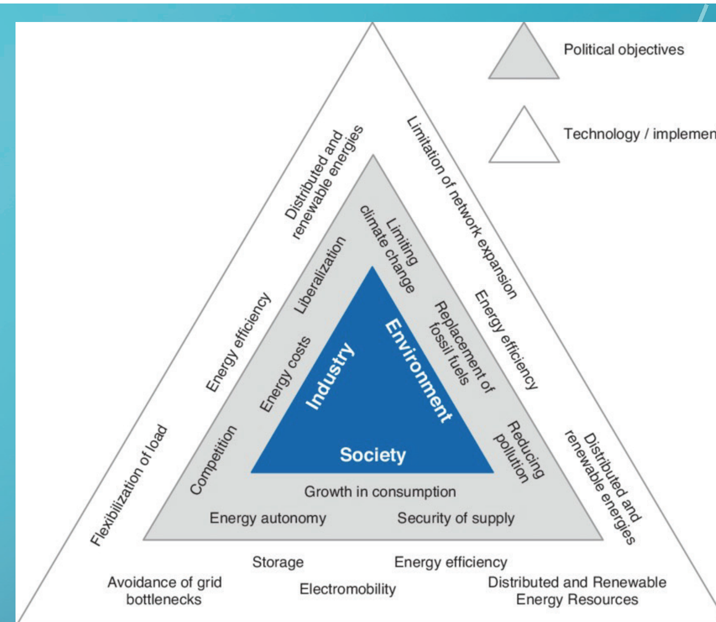




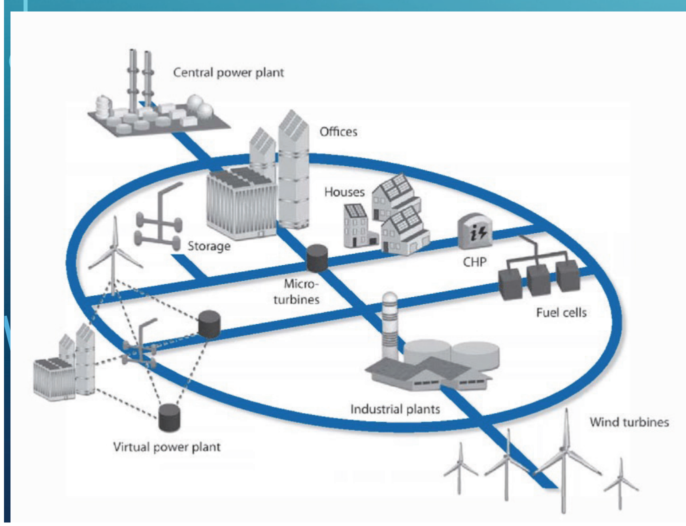
"Smart grid" is a concept with many elements where monitoring and control of each element in the chain of generation, transmission, distribution and end-use allow the electricity delivery and use to be more efficient.

Motivation for a Smart Grid

Motivation for a Smart Grid on the basis of the energy management triangle - political objectives and technical implementation.



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

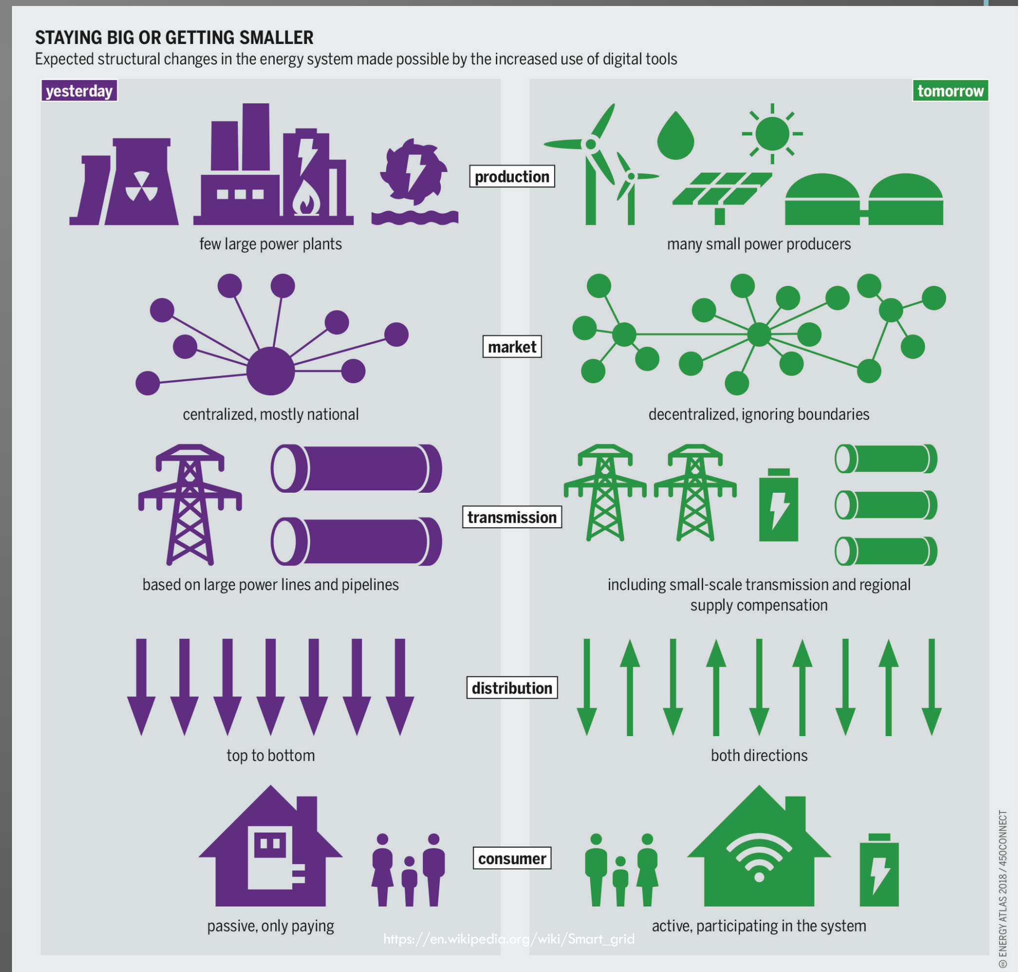


Desire to make the grid smarter, safer, reliable and more cost-effective using advanced sensors, communication technologies and distributed computing.

Difference Between a Normal Grid and a Smart Grid

Normal Phone

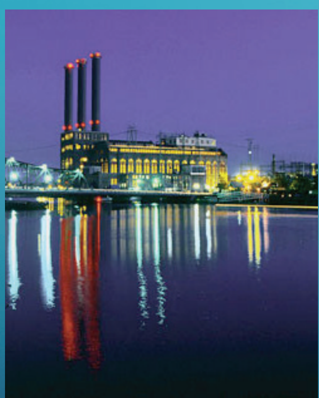
Smart Phone



https://en.wikipedia.org/wiki/Smart_grid

Starting and End Points of a Smart Grid

It starts at the Generator and ends at the Refrigerator



Power Plant

Transmission

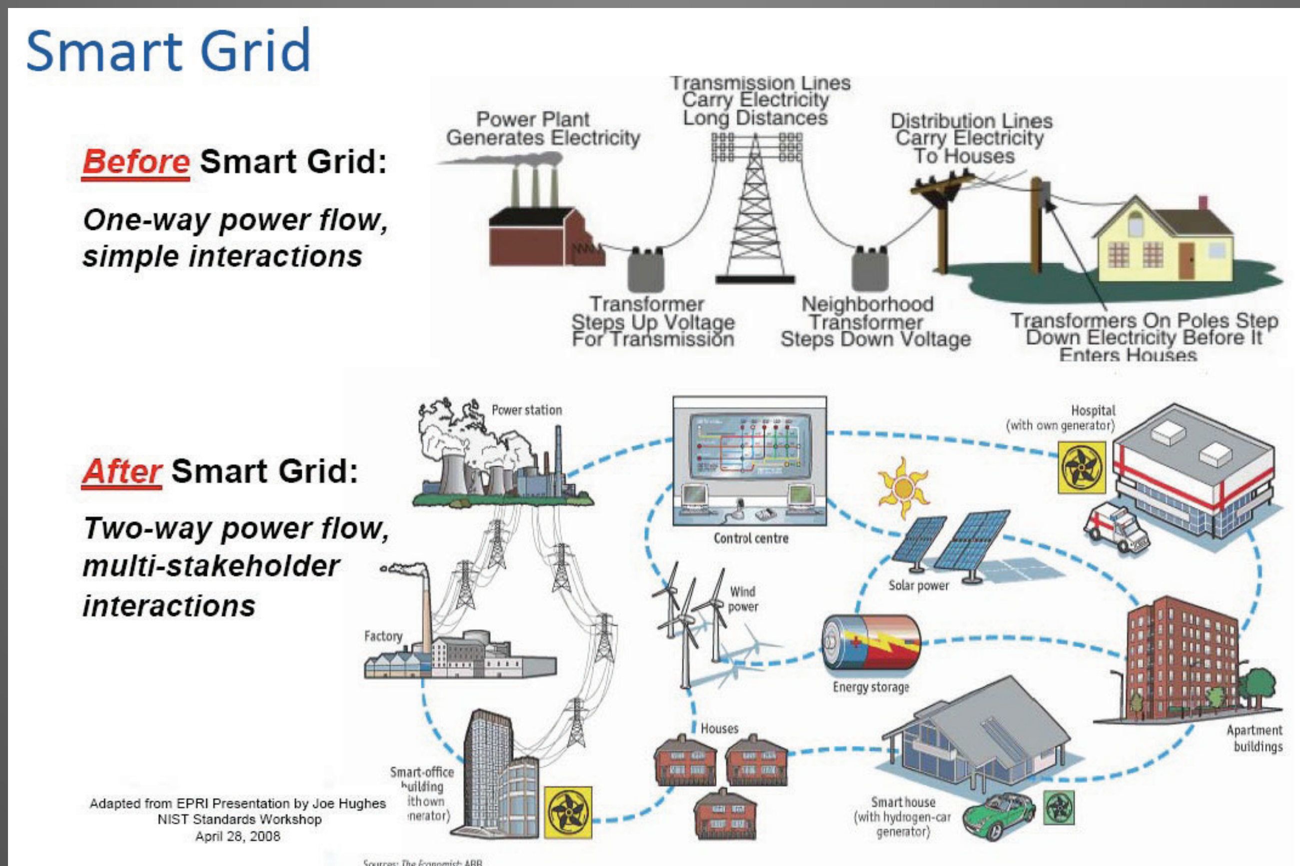
Distribution

Home Business

End-use Appliances

Smart Grid Building Blocks

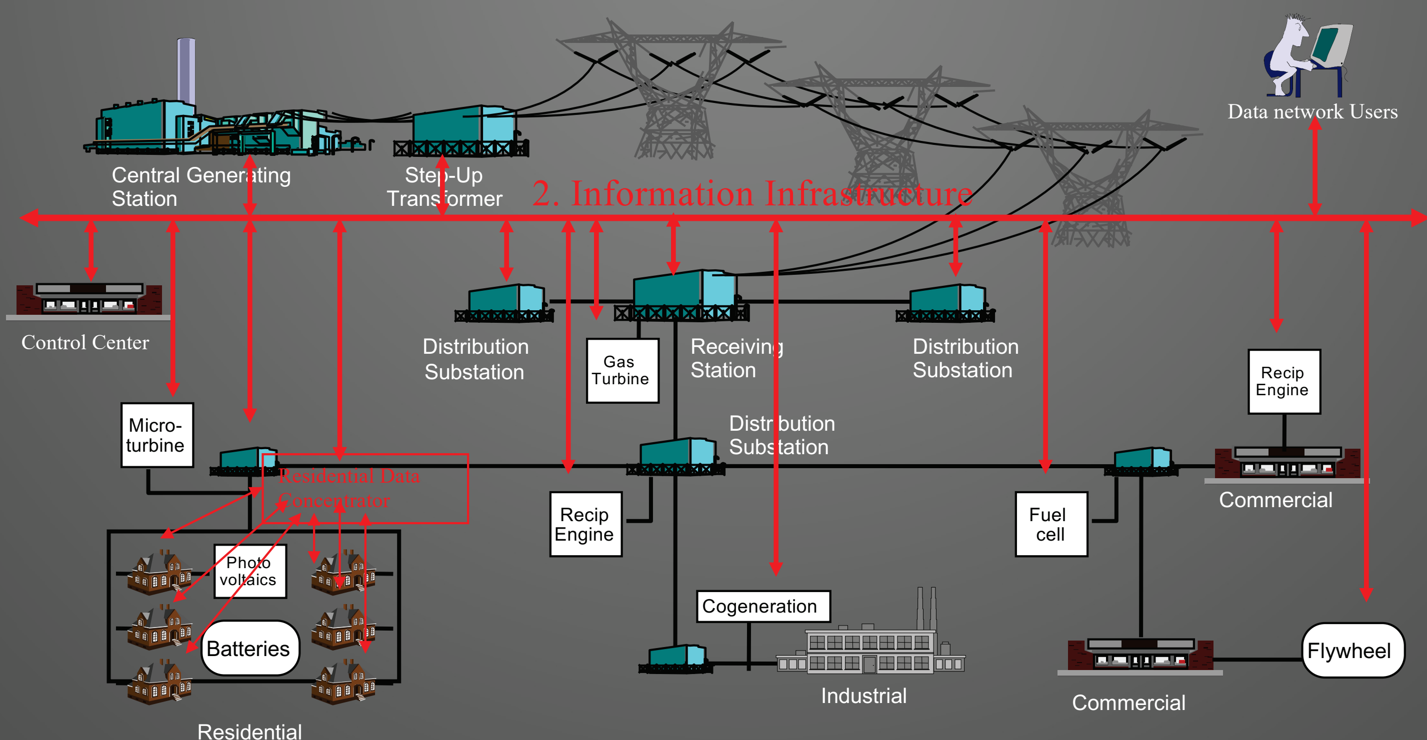
Evolution of the Grid



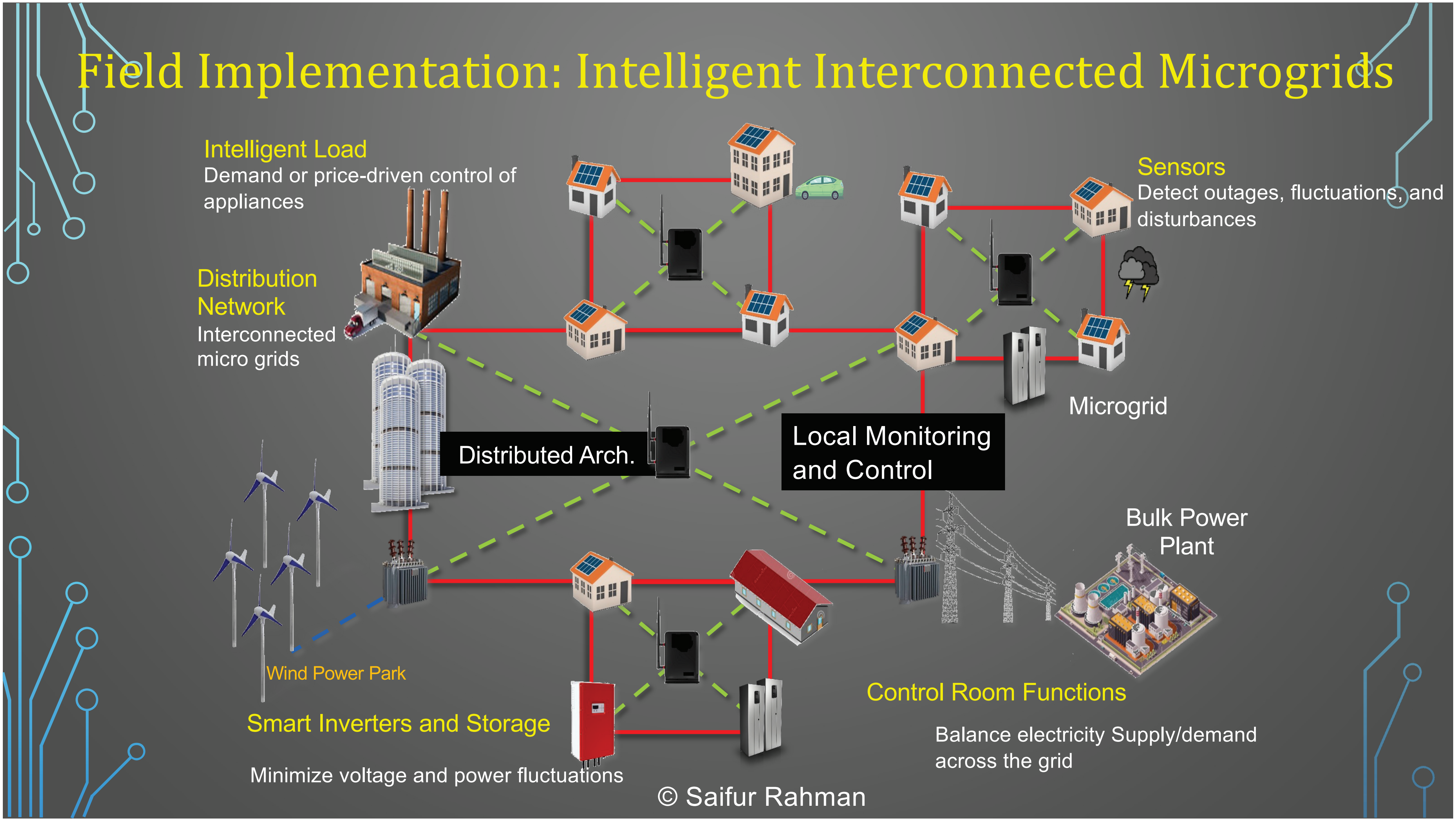
Source: Altalink, Alberta, Canada

Electric Power and Communication Infrastructures

1.Power Infrastructure



Source: EPRI



Field Implementation: Intelligent Interconnected Microgrids
Intelligent Load
Demand or price-driven control of appliances
Sensors
Detect outages, fluctuations, and disturbances
Distribution Network
Interconnected micro grids
Microgrid
Distributed Arch.
Local Monitoring and Control
Bulk Power Plant
Wind Power Park
Smart Inverters and Storage
Minimize voltage and power fluctuations
Control Room Functions
Balance electricity Supply/demand across the grid
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New Paradigm for the Electric Power System

Historically: Demand driven supply (supply responds to demand)

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


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рахмат
謝謝
ngiyabonga
teşekkür ederim
спасибо
faafetai lava
mersi
barka
welalin
tack
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vinaka
спасибі
blagodaram
dank je
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