
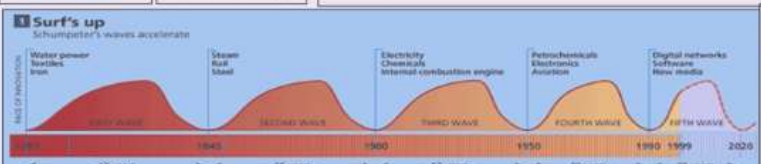
	<p>IEEE-IISc Student Branch In Association with CRAFITTI , Bangalore</p>	 <p>Crafting Innovation Together</p>
		<p>One day workshop on (6WoI) INVENTING in and for THE SIXTH WAVE OF INNOVATION ECE Dept, Indian Institute of Science 7 July 2018 (Saturday)</p>	<p>Potential Drivers for the Sixth Wave of Innovation (Next 25 years)</p> <ol style="list-style-type: none"> (1) THINGS - NANO, NETWORKED, AUTONOMOUS & HYPERSONIC (2) ALGORITHMIC INTELLIGENCE WITH QUANTUM COMPUTING (3) SYNTHESIZED - BIOLOGY, ENERGY & REALITY

Inventing for Internet of Energy, Microgrids and Wireless lighting

Dr. Priya Ranjan Mishra
Crafitti Consulting

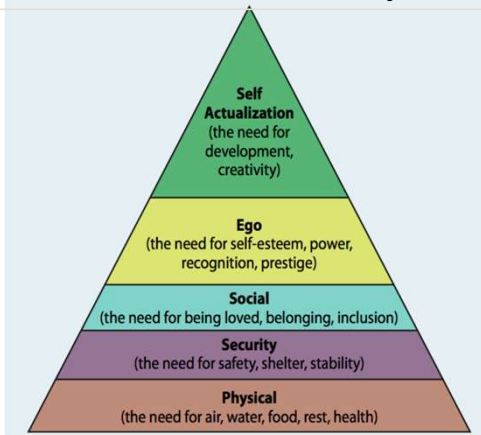


Agenda

- Human Needs- Changing pattern
- Global Energy Trends and Inventing Opportunities in
 - a) Microgrids
 - b) Internet of Energy (IoE)
 - c) Wireless Lighting
- Inventive Layers
- Conclusions

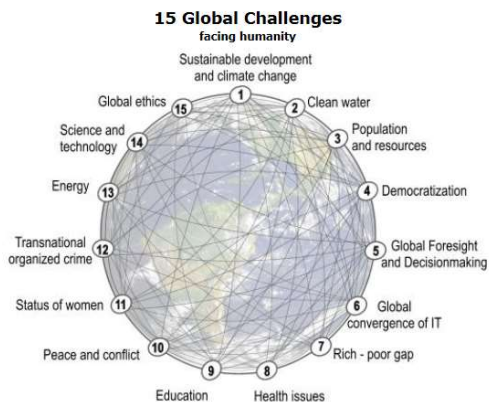
Human Needs- Changing pattern

Abraham Maslow's hierarchy of needs

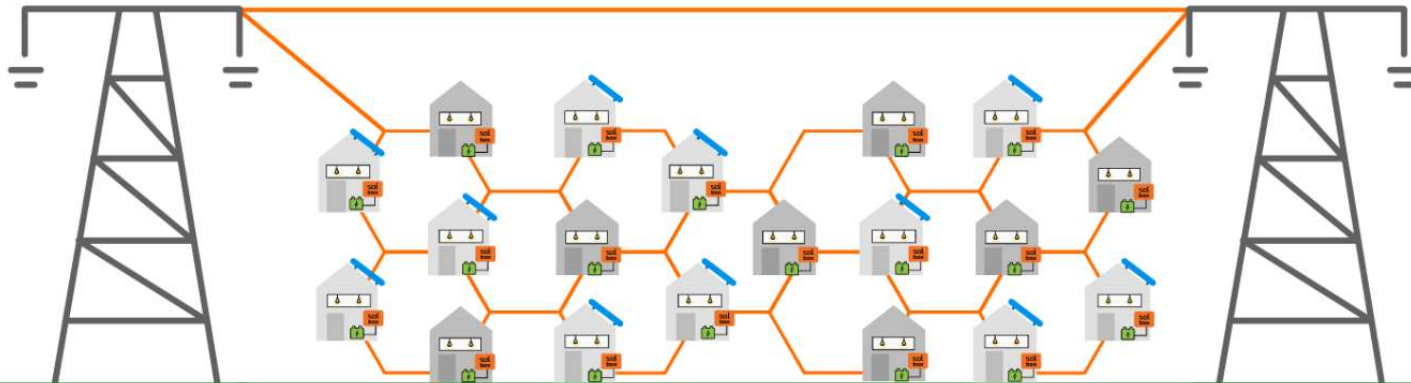
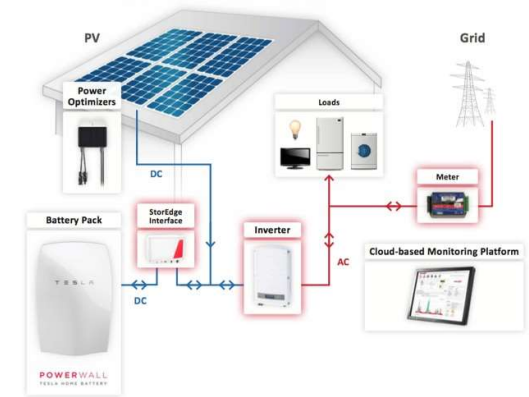


- To fulfill higher and higher needs, the human civilization became intensive energy guzzlers
- Lower conflict and better healthcare resulted in higher population
- Environmental pollutions and depletion of available resources
- Democratization across globe
- Gender and race sensitiveness leading to universalization of education, healthcare, food security etc.,

Sustainability and quality of basic physical needs???



Global Energy Trends



Weeding, inter cultivation, plant protection

Harrow, Tiller, Sprayer, Duster

Sowing and planting

Drill, Seeder, Planter, Dibbler

Harvesting and threshing

Harvester, Thresher, Digger, Reaper

Seed bed preparation

Tractors, Leveller, Ploughs, Dozers

Post harvest and agro processing

Seed extractor, Dehusker, Huller/Dehuller, Cleaner, Grader



The democratization of energy will be disruptive.

Changing needs, technologies, and customers are outpacing regulation.

20 TH CENTURY GRID	21 ST CENTURY GRID
Reliable, safe, & least-cost	Clean, resilient, & consumer choice
Centralized hierarchy & monopoly	Decentralized networks & peer-to-peer
Ratepayers	Customers & prosumers
Pay for what has been built	Pay for what people want
Rigid rates designed by <i>government</i>	Flexible prices determined by <i>markets</i>

In recent years, farmers, urban dwellers and small and medium-sized enterprises **established** electricity cooperatives across Germany.

According to Peter Terium, CEO of RWE, that **a massive shift is taking place in Germany from centralized to distributed power**, and said that the bigger power and utility companies “have to adjust to the fact that, in the longer term, earning capacity in conventional electricity generation will be markedly below what we’ve seen in recent years.”

Inventing opportunities- Microgrid

Benefits

- Need of availability of quality energy at the time of use.
- Microgrids provide effective solution.
- **Solar Microgrids** are becoming more and more common as they are scalable, time to deployment is short, efficient, reliable and easy to install in remote areas.
- Developed countries like US and Japan also have increased interest in microgrids due to increased climatic challenges and also due to terrorist threats.

Different Architecture

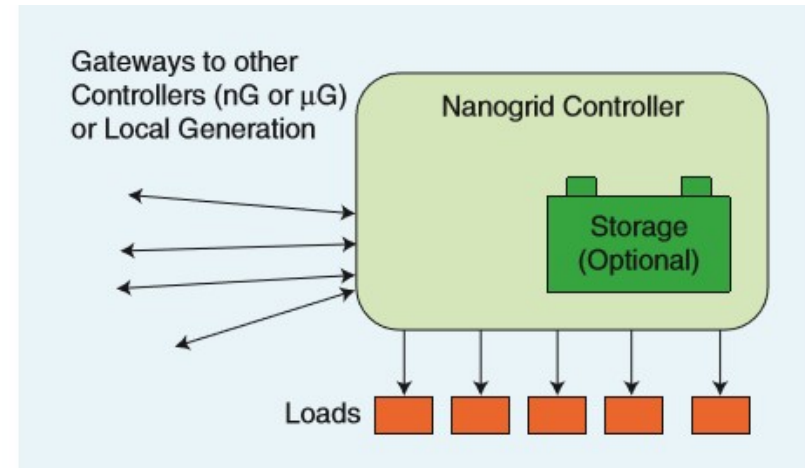
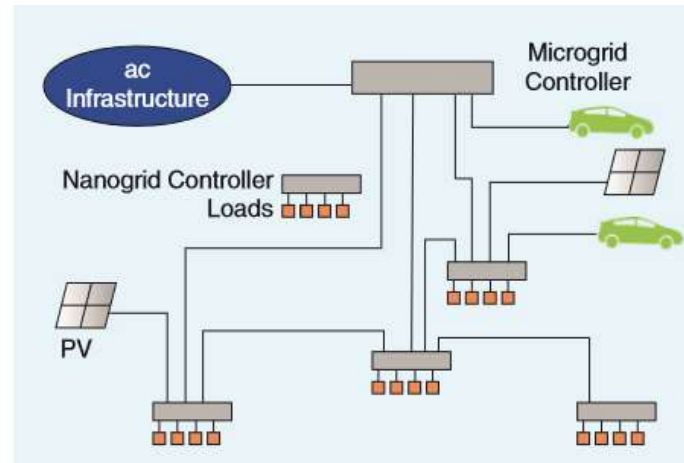
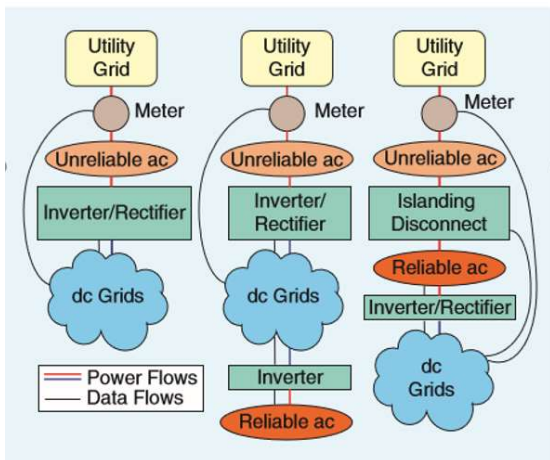
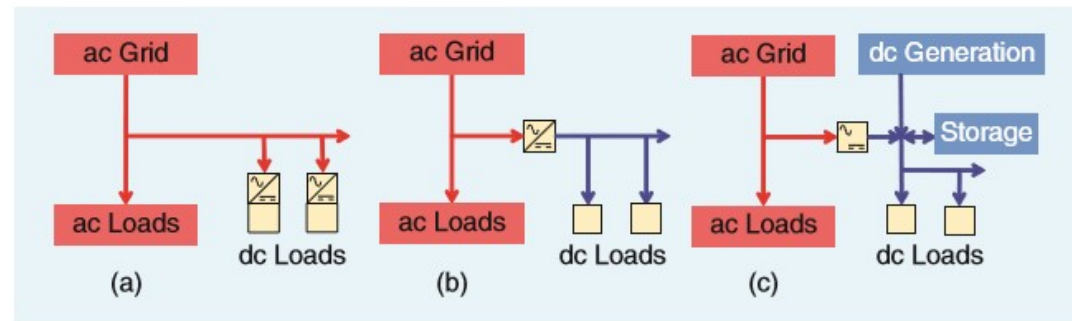
- AC microgrid
- DC microgrid
- Renewable microgrid
- Hybrid microgrid
- Battery Integrated microgrid
- Off grid microgrid or remote microgrid

grid categorization

	Size (kW)	Capability	Complexity
Stand-alone systems	0 - 0.1		
Pico-grid	0 - 1	<ul style="list-style-type: none"> • Single controller 	
Nano-grid	0 - 5	<ul style="list-style-type: none"> • Single voltage • Single price • Controllers negotiate with other across gateways to buy or sell power 	<ul style="list-style-type: none"> • Both grid-tied and remote systems • Preference for DC systems • Typically serving single building or single load • Single administrator
Micro-grid	5 - 100	<ul style="list-style-type: none"> • Manage local energy supply and demand • Provide variety of voltages • Provide variety of quality and reliability options • Optimise multiple-output energy systems 	<ul style="list-style-type: none"> • Incorporate generation • Varying pricing possible
Mini-grid	0 - 100 000	<ul style="list-style-type: none"> • Local generation satisfying local demand • Transmission limited to 11 kV 	<ul style="list-style-type: none"> • Interconnected customers

Inventing opportunities- Microgrid

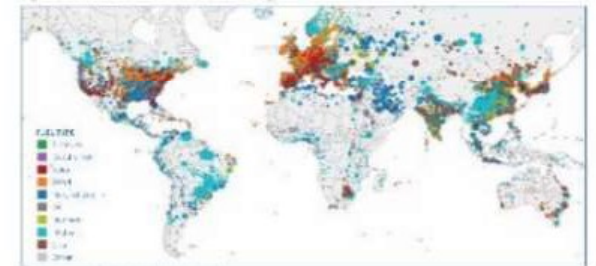
- Evolving standard P2030.10
- Opportunity to participate in standards development organisations and get first to know the associated problems/ solutions
- Problems leads to new inventive solutions
- Trigger ideas to integrating different type of microgrid with one another and with different types of appliances.



World-Wide Grid

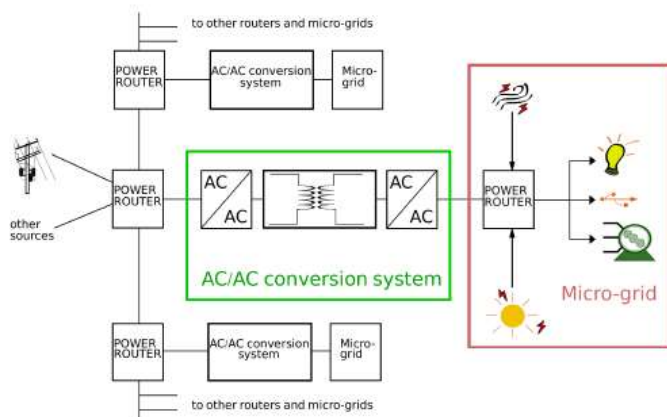


Figure 2. Global Power Plant Heat by Technology

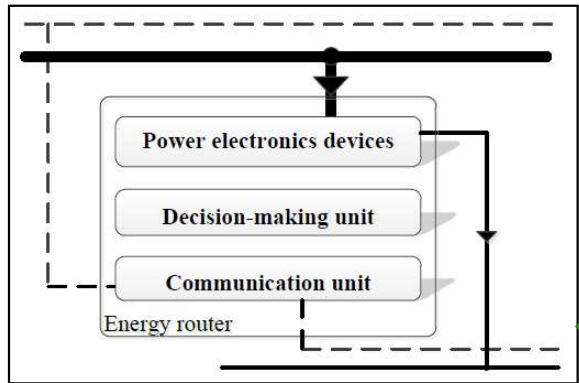
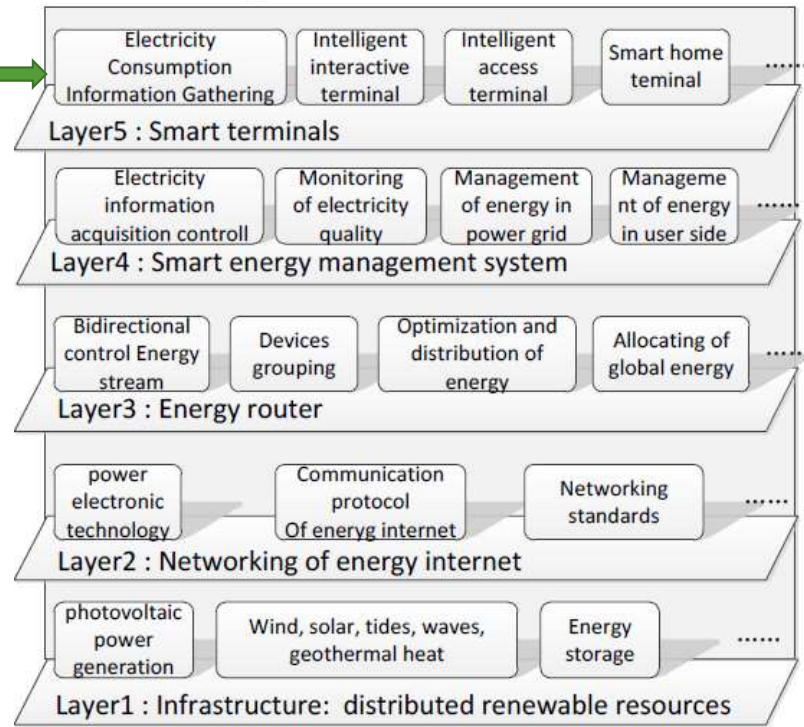


Inventing opportunities- IoE

Basic building block of smart grid to connect microgrids

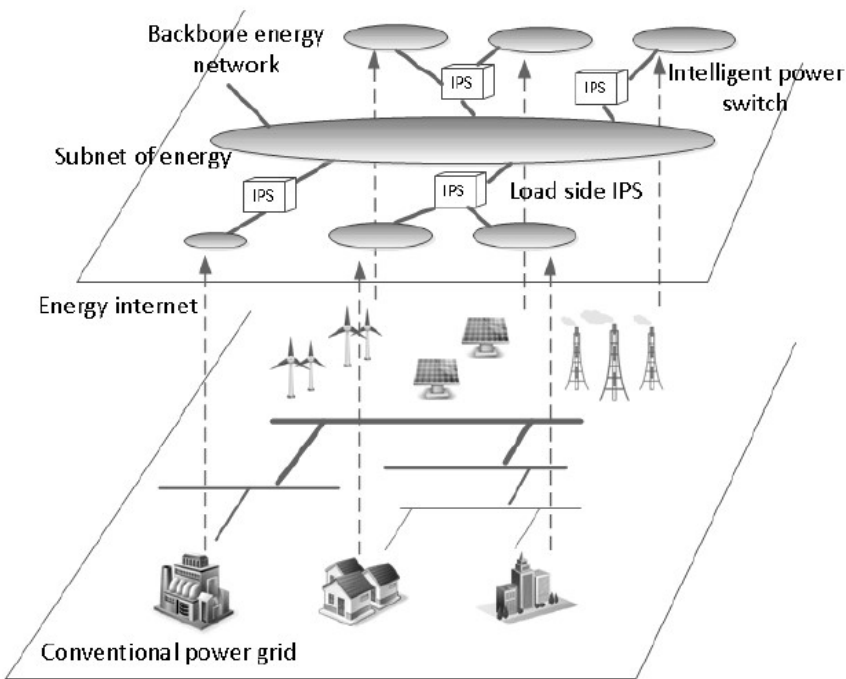


System architecture of energy internet

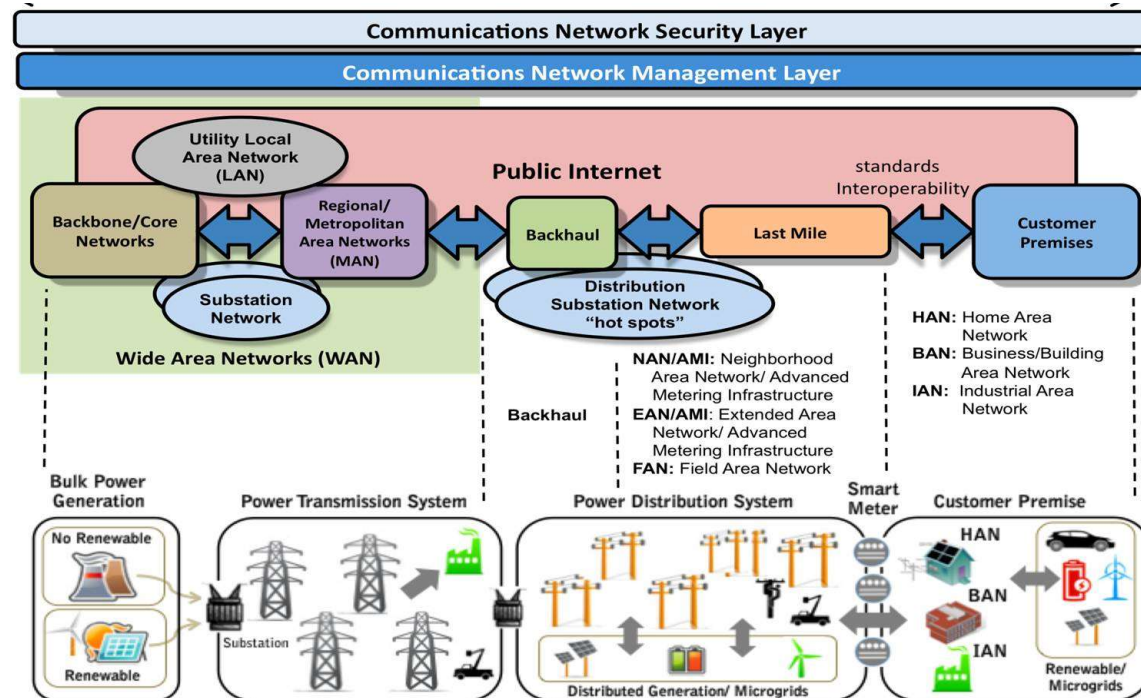


General architecture of an energy router

Inventing opportunities- IoE



Energy Internet – Towards Smart Grid 2.0



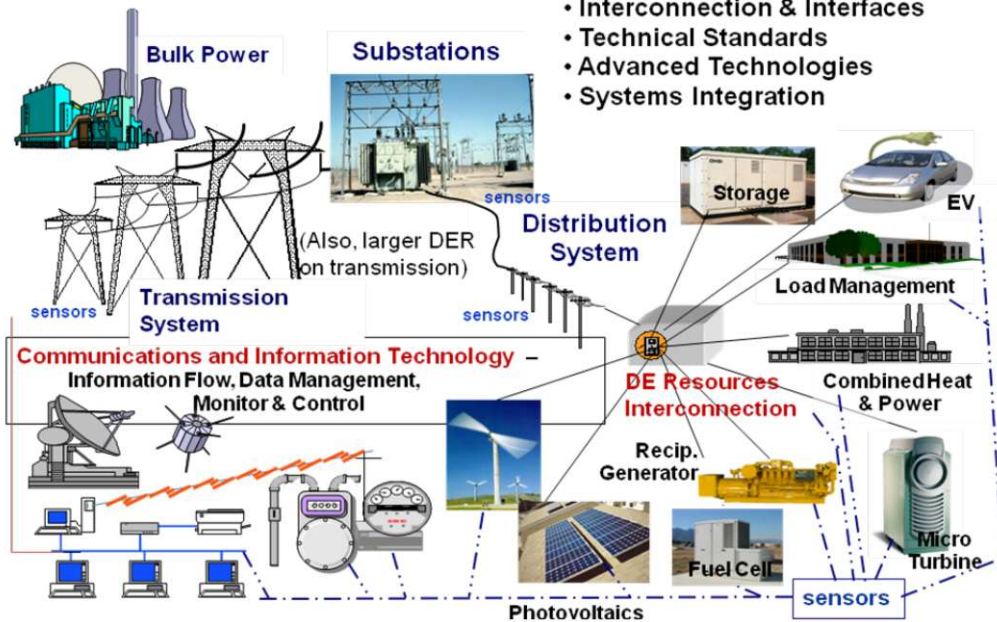
Complex Microgrid and IoE

Inventing opportunities- IoE

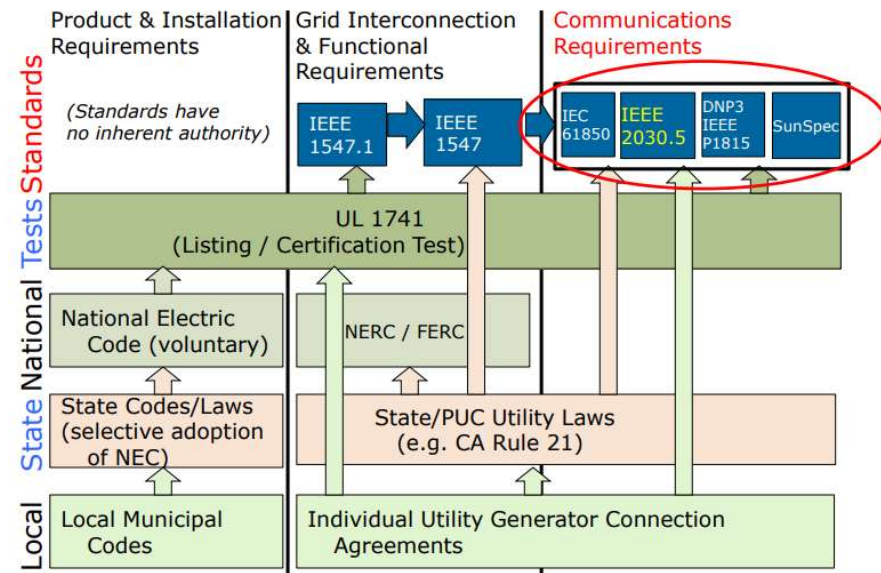
VISION SMART GRID 2050

Systems Approach

- Interconnection & Interfaces
- Technical Standards
- Advanced Technologies
- Systems Integration



of IEEE Standards 2030.5, 1547, 1815, IEC 61850 and SunSpec



Inventing opportunities- Wireless Lighting

- Smart Lighting Technology is basically Connected Lighting
- With emergence of multiple wireless technologies multiple connected platforms are proposed e.g, WIFI, ZigBee, BLE mesh, LoRo, TV white space for remote installation
- City wide connected lighting system
- Power on Ethernet (PoE) Lighting
- LIFI – internet connectivity through lighting medium
- Power transfer and Communication through invisible lighting
- Interactive Lighting
- Wireless power transfer e.g. inductive charging
- DSM in lighting

Inventive Layers

- Architecture Level (Top overview)
- System Level
- Functional Level e.g. either power or communication or hybrid control
- Sub-system Level: communication module, power module,
- New Application propositions
- Interface or connectors
- Improvement in efficiency, quality, cost etc.



Conclusions

- Microgrids, IoE and wireless lighting is emerging technologies is fertile bed for inventive ideas
- Data flow through communication platform is very important.
- Data analytics is emerging area for emerging business models for complex energy flow.
- Real time control needs artificial intelligence AI and machine learning with human in loop technologies
- Cyber security is intertwined with IoE.



Thankyou
Questions????

[You can reach me](#)
priyaranjan@crafitti.com
priya.r.mishra@ieee.org