Vision of the Electricity Industry Toward 2050

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1. The Social and Economic Environment Toward the year 2050 (1/2)

(1)
- Energy/ Electricity Internet, Smart grid, micro-grid, and Internet of Things (IoT) (e.g. Raspberry Pi + LoRa disruptive technology) mature and prevail

(2)
- Energy/Electricity Big Data and Open data Analytics for "smart disclosure" and user smart decision are the main driving force for energy economic growth

(3)
- For example, Green Button App for electricity usage data, Orange Button App for PV data(2016/4/25 U.S. DOE initiated)

1. The Social and Economic Environment Toward the year 2050 (2/2)

(4)
- Ubiquitous computing for predicting customer experience(CX) and user experience(UX) are the key for running an electric business

(5)
- Machine learning, AI, Robots, Drone, 3D printing become popular, e.g. U.S.DOE promotes AMIE (Additive Manufacturing Integrated Energy)

(6)
- An aging era when humans can live much longer

2. Vision of the Electric Power Utility in the Era of 2050

(1) Core competence/value proposition will be a Web 2.0 platform for diverse stakeholders to supply and demand electricity with abundant information

(2) Distributed generation and renewable electricity will be the main energy incremental sources due to advanced technology and environmental friendly

(3) Based on the Paris Agreement, INDC of carbon emission reduction targets are realized

Renewable Energy High Portfolio Countries

	2020	2025	2030	2040	2045	2050
Germany	35% (Generated)	45% (Generated)	55% (Generated)			80% (Generated)
Hawaii	30% (Generated)		40% (Generated)	70% (Generated)	100%	100%
Denmark	50% (Installed)					100%
California	33% (Generated)	45% (Generated)	50% (Generated)			

Integrated Renewable Electricity/Energy System

- Coordination among the renewable generation, electric storage and DR(demand response) for customer loads, greater use of local renewable electricity generation is practical.
- "Flexibility" (meaning adaptive to the intermittent renewable energy) such as DR or storage is a valuable asset for power system integration, because it minimizes the idled capacity of reserve margin and spinning reserve.
- Combining DR with energy storage in a system enhances the value/synergy and capabilities of both measures.

3. Challenges and Opportunities

Low –carbon society with
Intermittent electricity/energy source

electricity industry Paradigm Shift: From sequential supply-chain to dynamic ecosystem

Smart Grid/EIoT Standard setting

Smart Grid/EIoT System interoperability

Electricity Big Data access, and utilization

Personal privacy and Information security

4. Critical Successful Factors:

Policy and Measures

Policy and Measures

Market mechanism (with incentives)

- Competition and Liberalization Markets(ISO/DSO for wholesale power and ancillary service, etc.)
- Pigouvian approach (energy/environmental tax, disadvantaged group subsidy, Feed-In-Tariff(FIT), etc.)
- Coase approach (cap and trade for carbon emission, Renewable Portfolio Standards(RPS), etc.)

Non-market mechanism

- Command and control approach (emission reduction, safety and environment regulations)

Electric Power Utility

- Personnel need new competence and new mindset to deal with the fast-changing environment i.e. becoming a big/open data company

PPP (Public-Private-Partnership)

- third party, ESCO, aggregator, DER, etc.

5. Conclusion (1/2)

Paradigm shift of the electric power utility:

WEB 1.0 → **WEB2.0** → **WEB3.0** (Multi-utility)

Taiwan's comparative advantages (abundant in renewable wind, sunshine, biomass, geothermal, ocean energy)：

IT country (Information Technology) → **ET** country (Energy Technology)

Green IT + EICT (Energy Information Communication Technology)

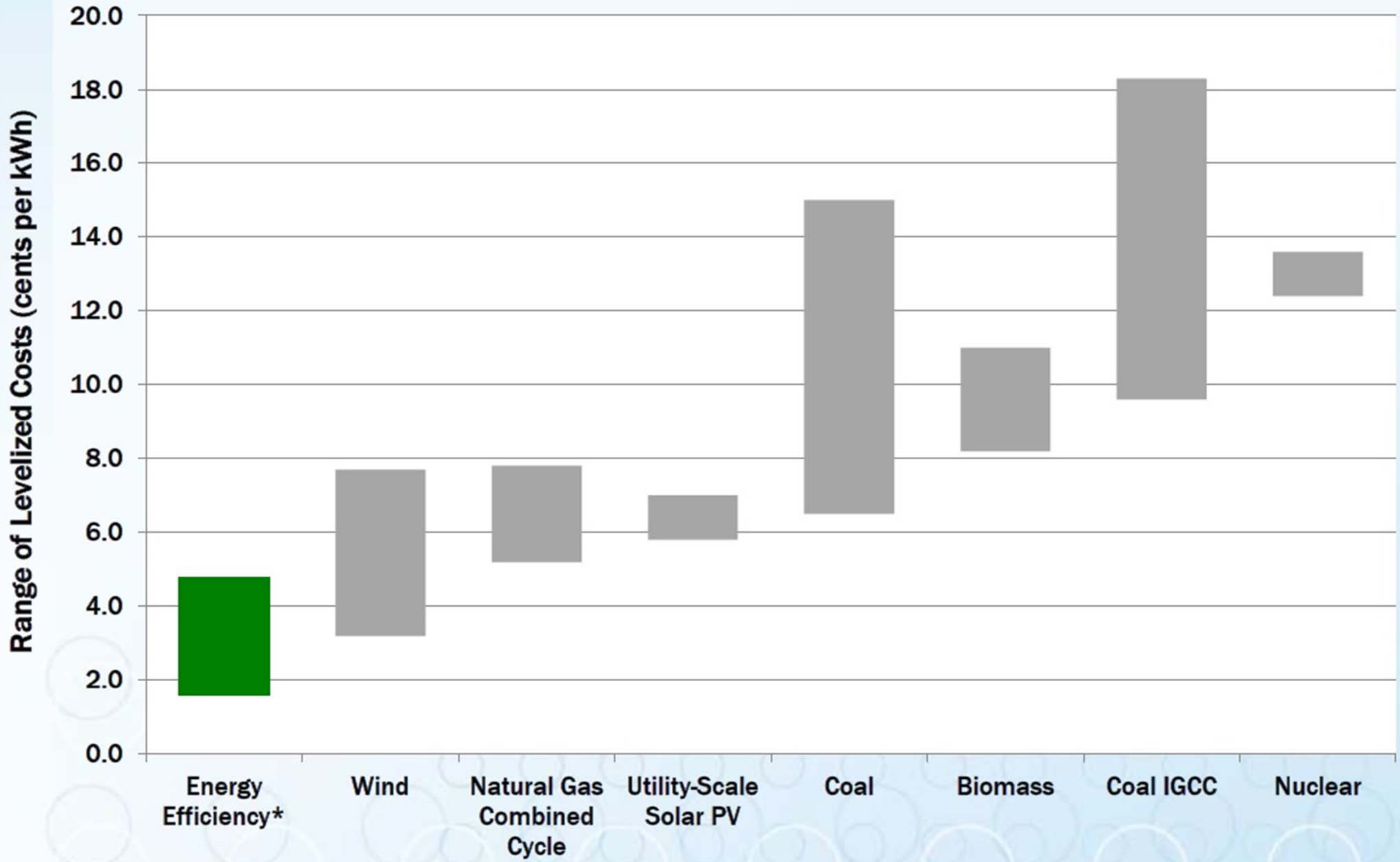
TPC got first-tier telecom license in 2014 (with fiber optics)

HEMS (Home Energy Management System)	BEMS (Building Energy Management System)
FEMS (Factory Energy Management System)	CEMS (Community Energy Management System)

5. Conclusion (2/2)

- With computer control to create a highly automated, responsive, and resilient power system, customers will be empowered/informed to make smart big-data decisions (including crowdsourcing).
- Customer choice is imperative as needs vary across customer classes with diverse preferences.
- Customers can better manage their electricity/energy needs, and communication is needed to understand new application benefits and costs, and ways to capture value.
- Education, demonstration, and customer awareness and acceptance are the keys to a successful multi-utility with electricity/energy intelligence, including HEMS, BEMS, CEMS, and FEMS.
- Collaborative effort among all the stakeholders is needed to develop a sound electricity industry 2050.

Levelized electricity resource costs



*Notes: Energy efficiency program portfolio data from aceee.org/research-report/u1402; all other data from https://www.lazard.com/perspective/levelized-cost-of-energy-analysis-90/. High-end range of coal includes 90% carbon capture and compression.

ACEEE American Council for an Energy-Efficient Economy


Q&A