

A Holistic View on Developing Smart Grids in Asia

The First Asian Energy Conference:
Smart Grids, Sustainability Transition, and Innovation in Governance
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John W M Cheng ^{PhD}

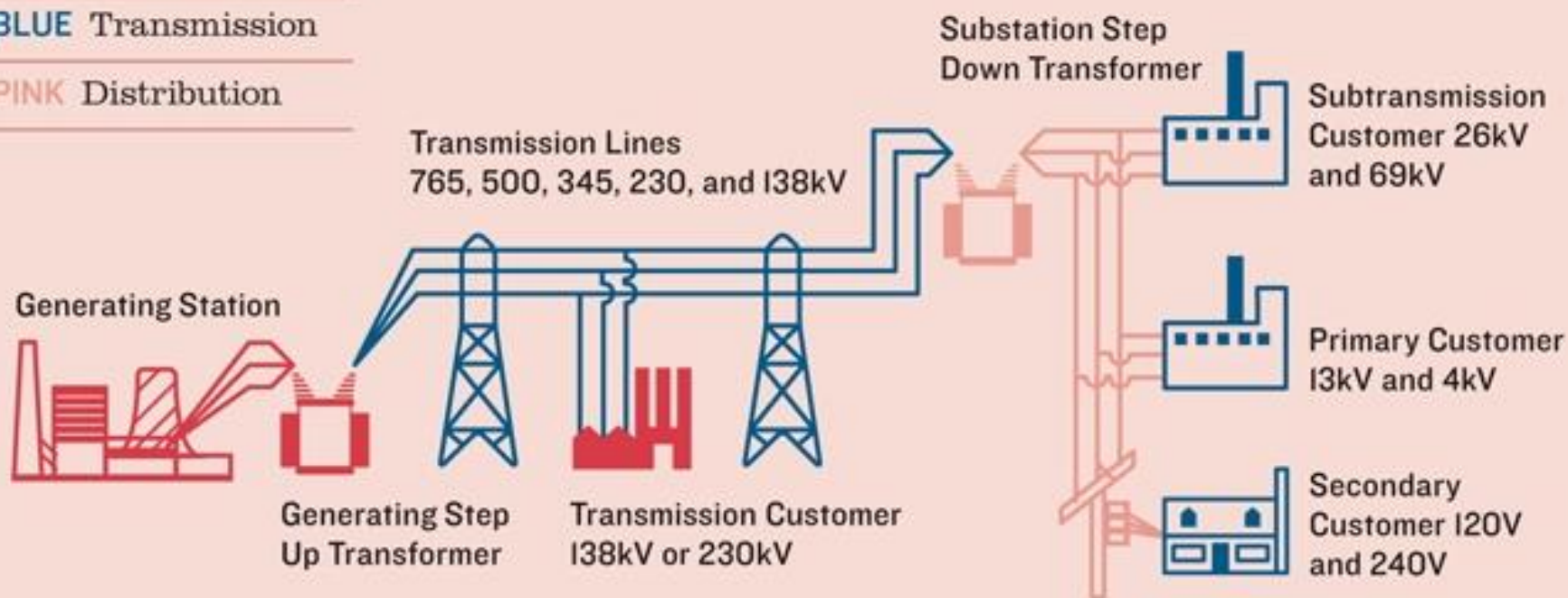
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Conventional (Existing) Grid Structure

RED Generation

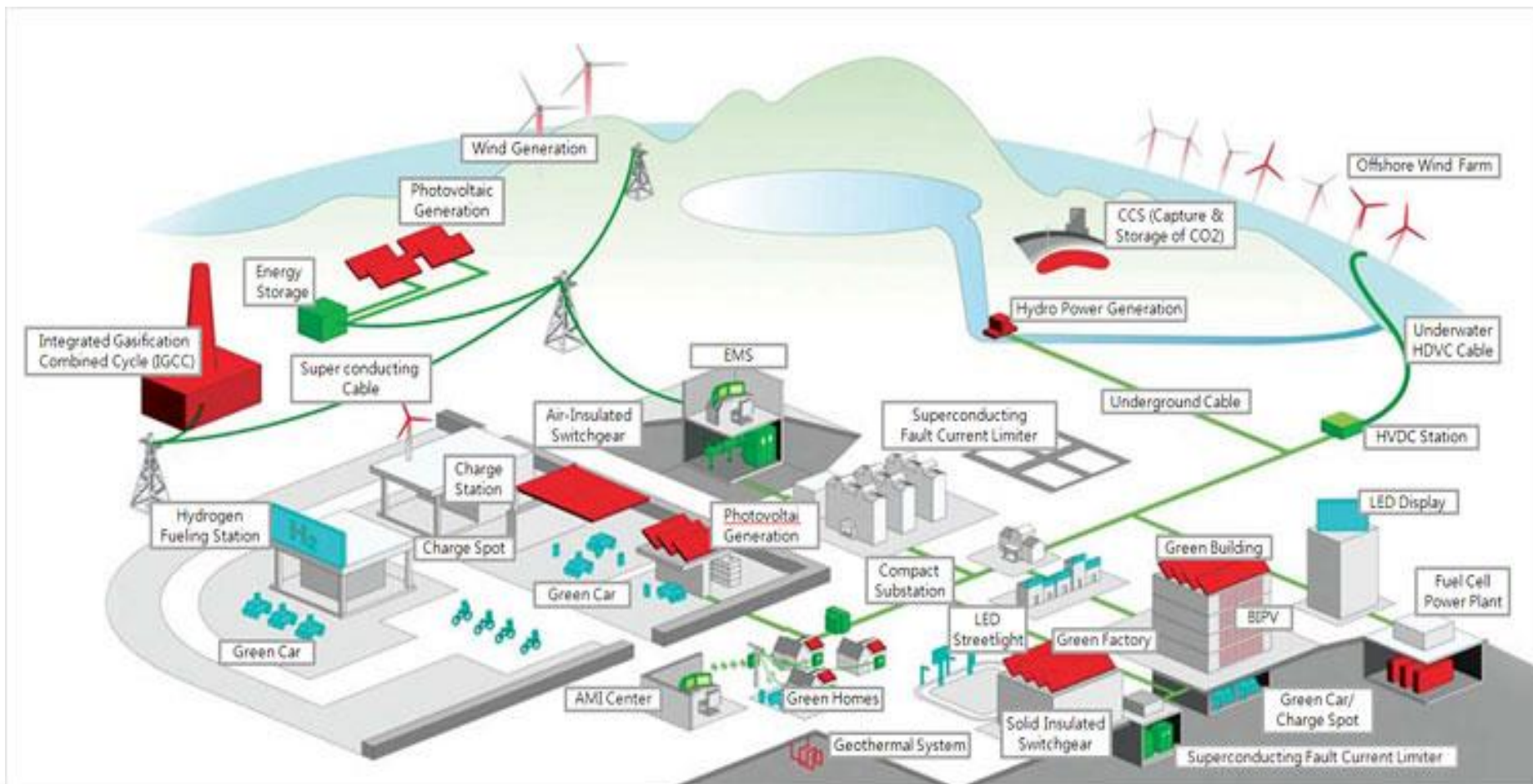
BLUE Transmission

PINK Distribution



SOURCE Federal Energy Regulatory Commission, 2006.

Smart Grids of the Future



source: www.lsis.com

How much the world have spent on Energy Smart Technologies

[source: Bloomberg New Energy Finance , August 2015]

Energy Smart Technologies =
Digital Energy + Efficiency + Storage + Electrified Transport

- **Public Market Investments:**
 - US\$17.7 b since 2004 to Q2, 2015 (i.e. US\$1.7 b per year)
- **Private (VC/PE) Investments:**
 - US\$21.6 b since 2004 to Q2, 2015 (i.e. US\$1.8 b per year)
- That is US\$9.4 million per day

Overview

- Introduction
- Drivers of Developments
- Smart Grid in Asia Pacific
- Benefits of Smart Grids
- Technology
- Regulation & Policy
- Economic & Market
- Social Impacts & Acceptance
- Research & Development Needs
- Neither a Silver Bullet nor One Size Fits All
- Conclusion



Drivers of Developments...

Social norm shifts: Environmental consciousness, increasing renewables contents, electrification of transportation, customers demand more transparency and higher expectation on services ...

Government's drives: Climate change policy, end-use efficiency, energy independence, economic stimulus, global competitiveness...

Technology pushes: Information age, telecom network expansion, advanced sensors, power electronics accessibility...

Utilities' own needs: Integration of intermittent demands, reliability, safety & efficiency improve competitive pressure...

Disasters:

September 11, 2001 - NY;
August 14, 2003 - NA;
Jan-Feb 2008 - China
Financial Crisis 2008...

Smart Grids in Asia Pacific

China

- Smart, strong and flexible grid, all rounded development
- Strong government directive, supports & implementation

Japan

- Smart meter deployment, customer engagements
- Intelligent systems (demand response, automation)
- Energy storage and EVs

Korea

- Smart grid development for whole nation planned but major cut back in 2015

Singapore/ Hong Kong

- Developed cities with high urbanization within a neighborhood of developing countries.

India

- Generation & transmission development
- Microgrids for rural electrification

South East Asia

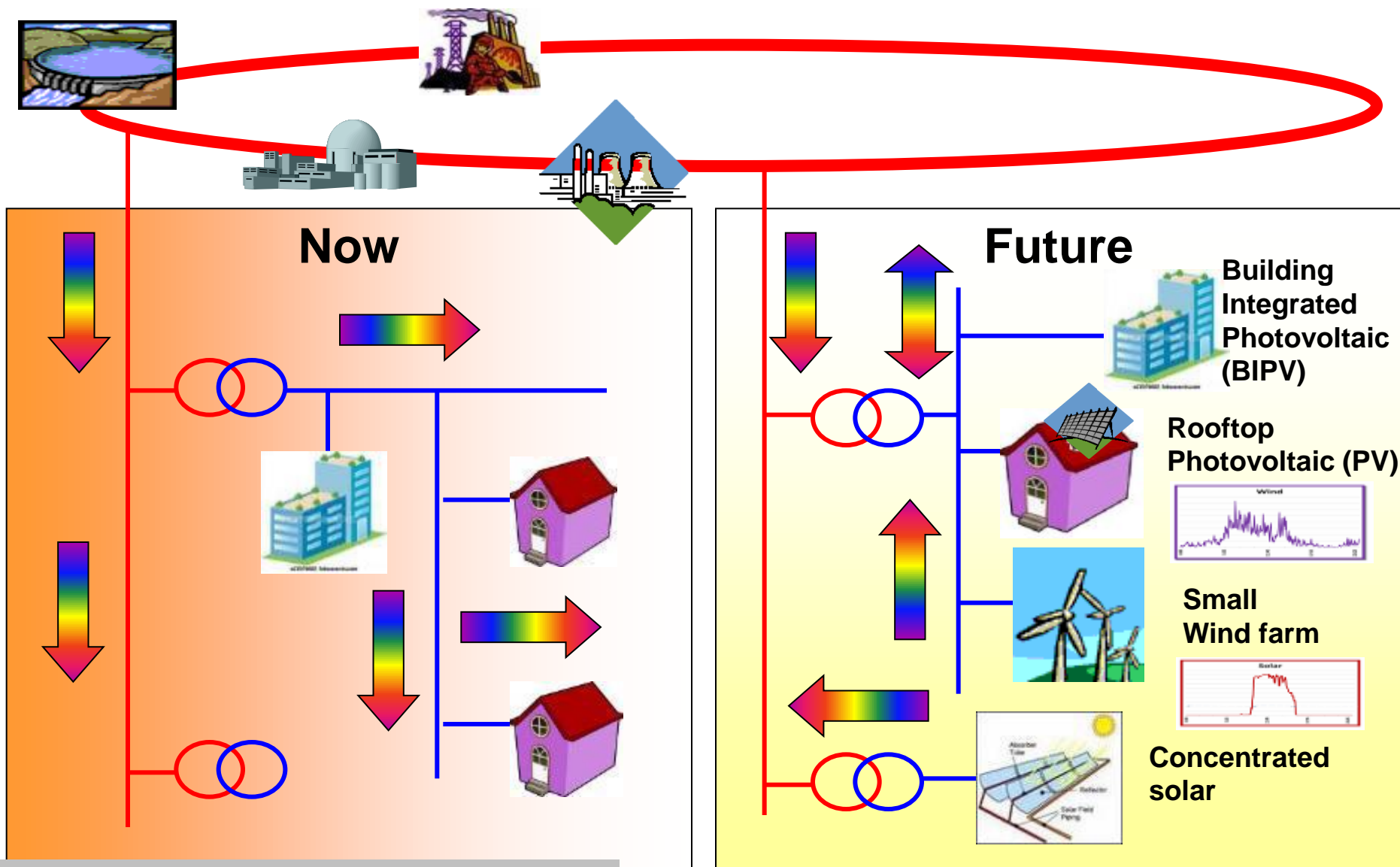
- Developing countries with limited resources and financial means to uptake major smart grid initiatives

Australia

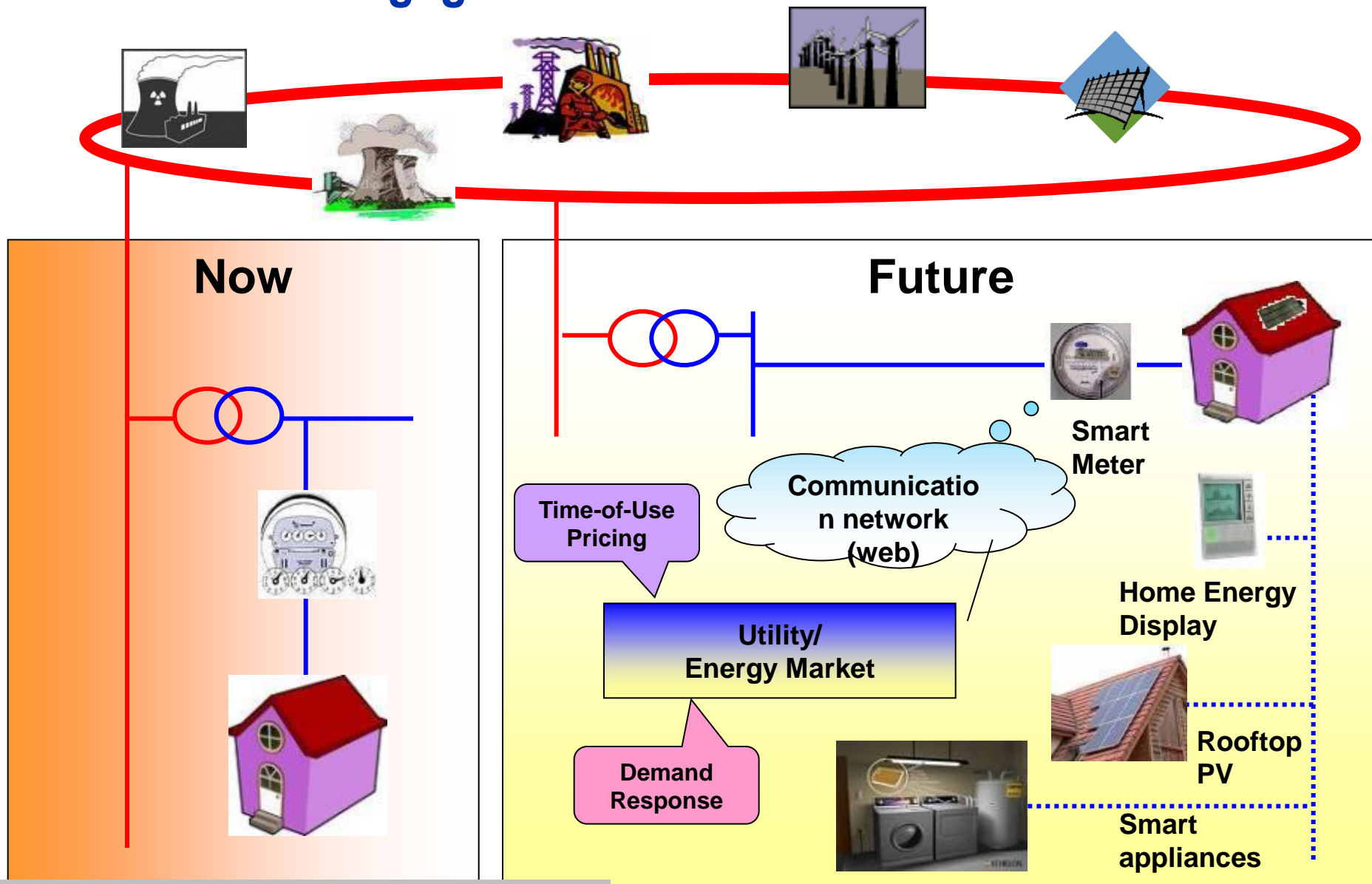
- Mandatory smart meter deployment in Victoria completed but further development halted due to significant over budget



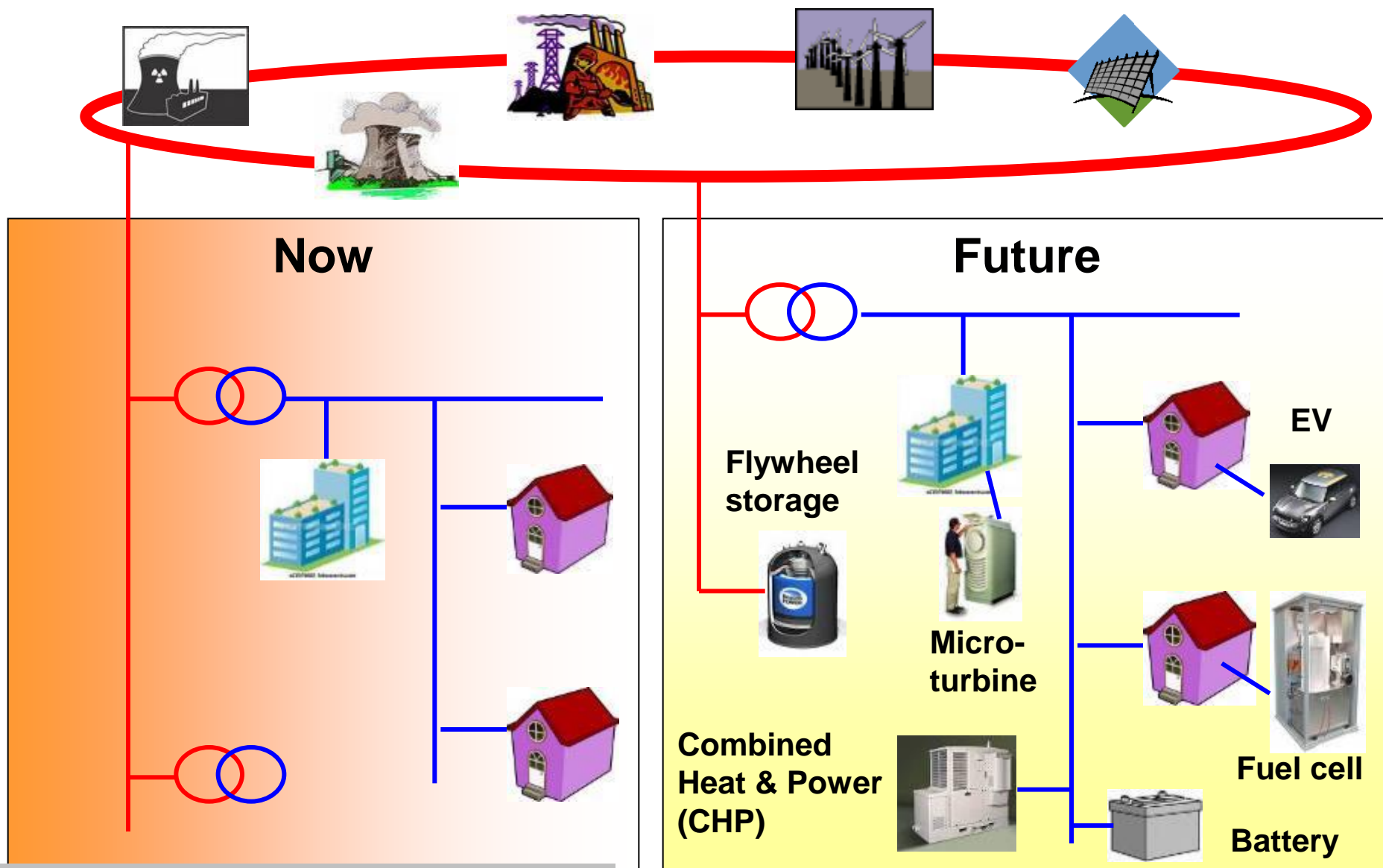
Smart Grid to Integrate Renewables



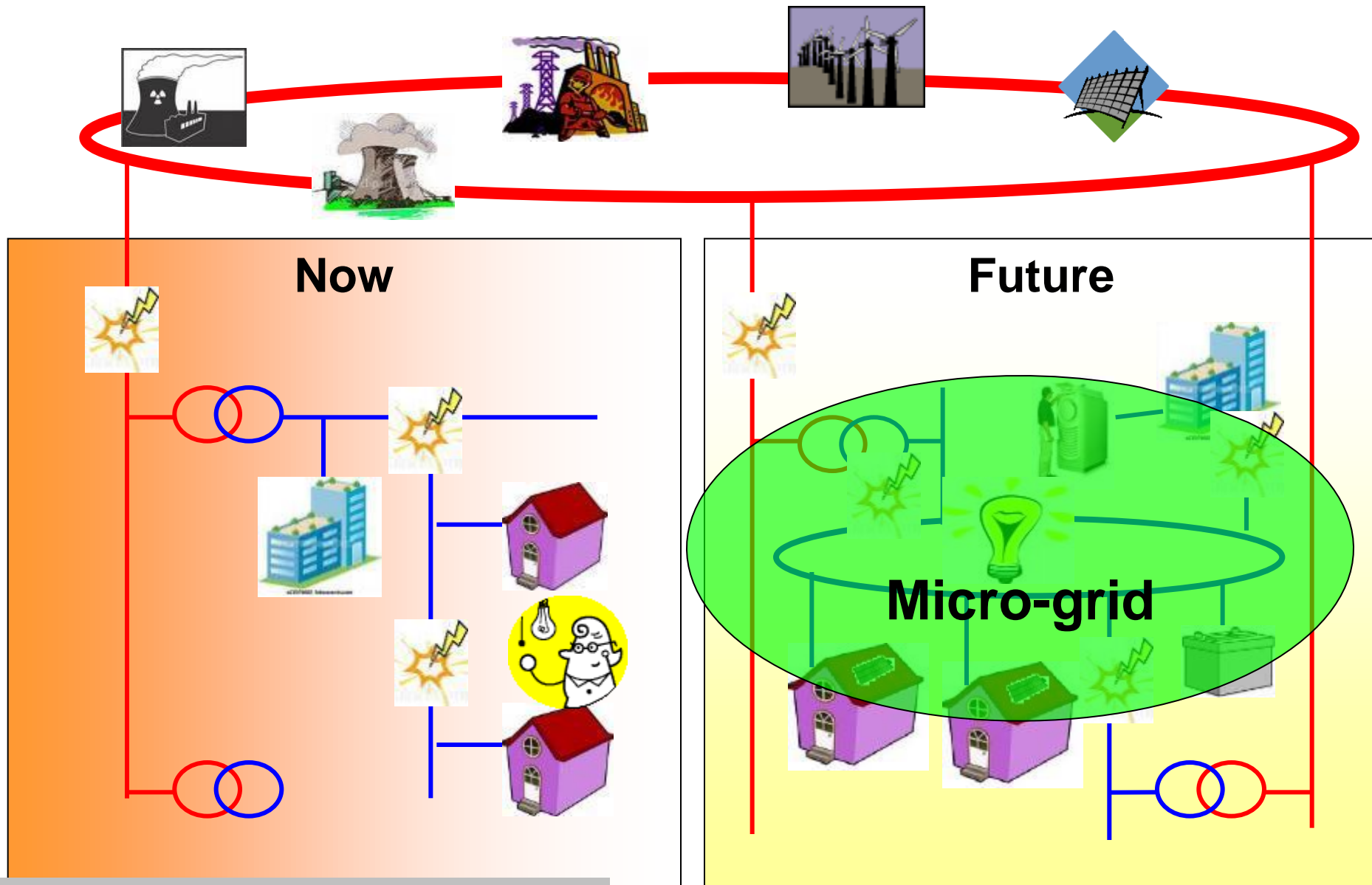
Smart Grid to Engage Customers



Smart Grid to Integrate Distributed Energy Resources



Smart Grid to Become More Resilient



Benefits of a Smart Grid

- Improve grid efficiency and reduce transmission losses;
- Integrate a larger share of renewables;
- Enable customers to participate;
- Accept new load entities such as electric vehicles (EV) and smart appliances;
- Integrate different distributed energy resources (DER) and micro-grids;
- Enable transactions and/or new businesses; and
- Recover robustly and more reliably after extreme disturbances.



Economic & Market

- **Transmission level**
 - **Increasing monitoring & controlling capabilities**
 - **Harnessing remote energy resources**
 - **Reinforcing the network to increase transfer capabilities**
 - **Upgrading aging infrastructure with new and/or intelligent systems**
 - **Resource sharing by building interconnections**



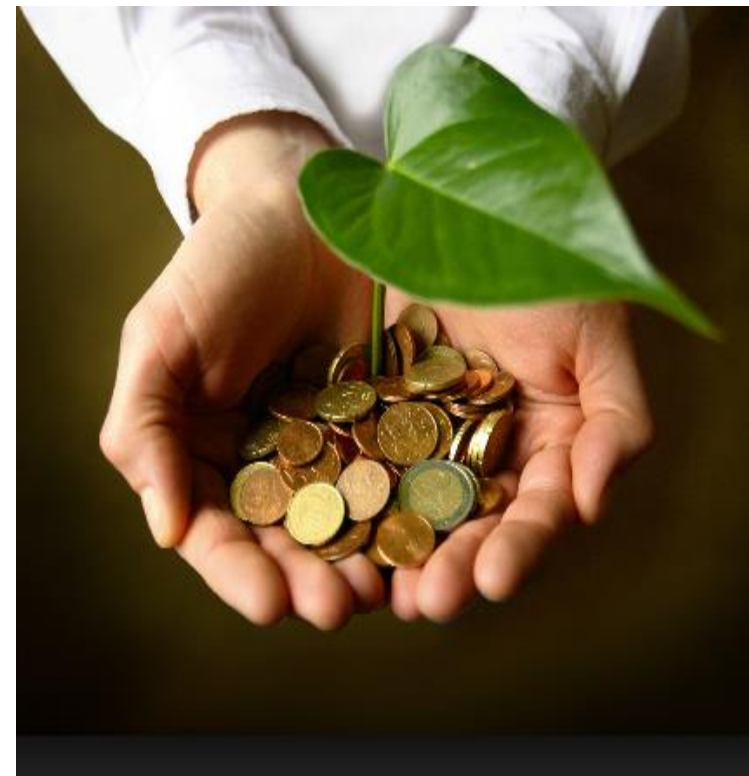
Economic & Market (cont'd)

- Distribution level
 - SAIFI, SAIDI, CML, CI based reliability and investment philosophy
 - Increasing Distributed Energy Resources (DER) change the formula and balance
 - Sharing of the network cost (Development & O&M)
 - New users and usages, e.g. Electric Vehicles and storage



Economic & Market (cont'd)

- Metering Level
 - Scope and costs of smart meters and Automated Metering Infrastructure (AMI)
 - New opportunities and business paradigms



Regulation and Policy

- Different industry & market structure
 - Vertically integrated;
 - ISOs; and
 - POU
- Common regulation objectives
 - Customer values, rate structure, investment cost recovery principle, socioeconomic development, efficiency incentives and measures, reliability standard, environmental considerations and others (e.g. pollution controls)



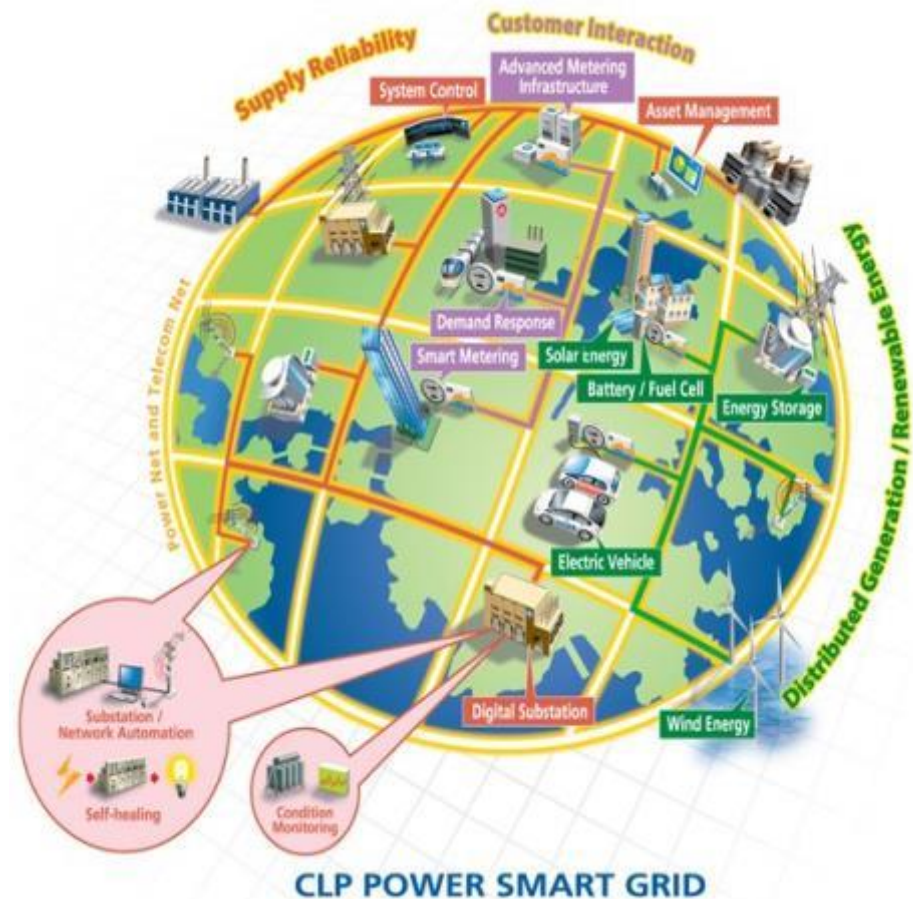
Regulation and Policy (cont'd)

- New objectives and regulation
 - National policy, generation mix, energy efficiency policy, grid charge, incentives and penalties, market design, cost recovery formula, standards, cyber security, privacy, workforce retraining program, R&D...

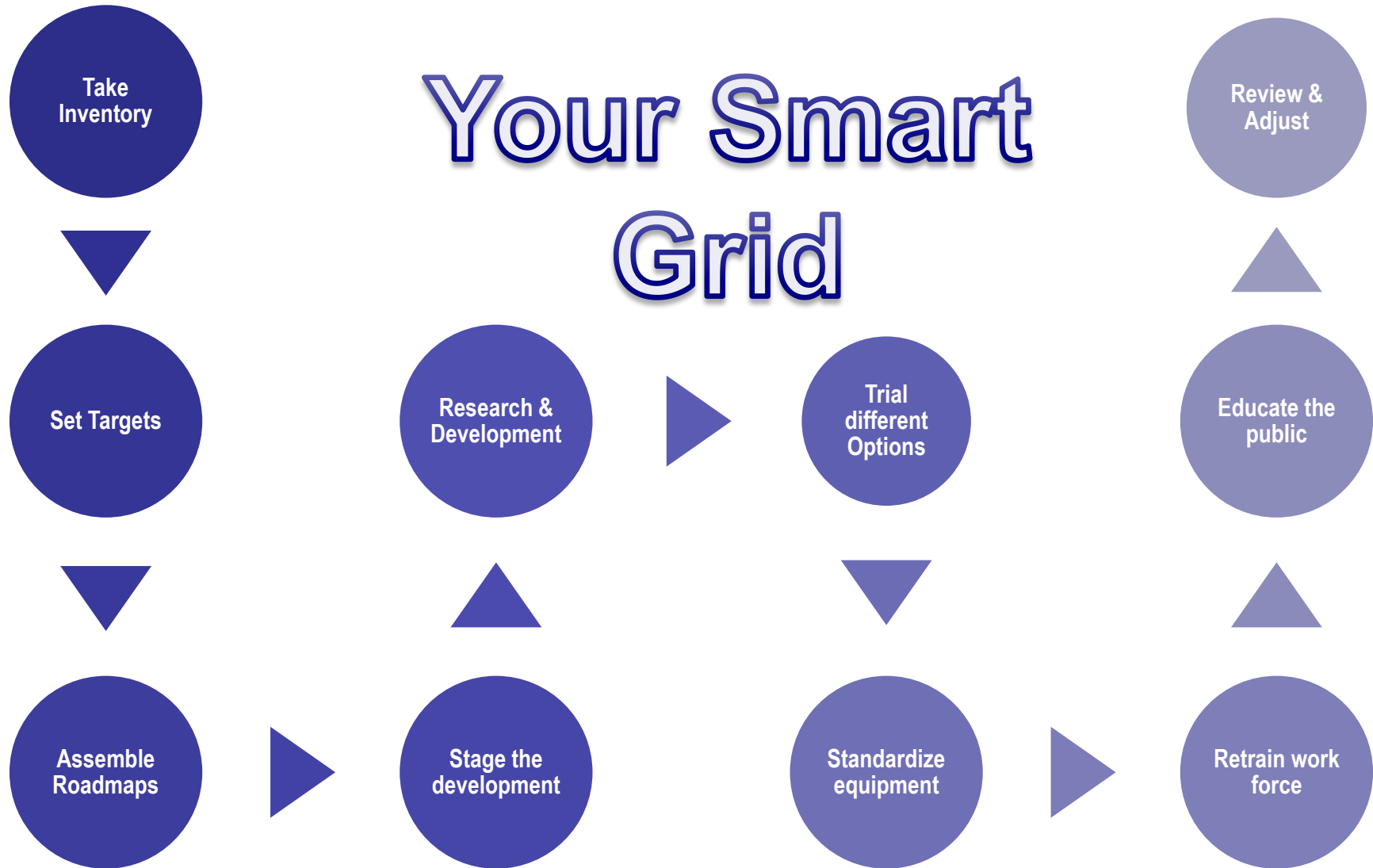


Societal Benefits, Impacts & Acceptance

- Economic growth competitiveness
- Jobs
- Emissions & pollutant reduction
- Customer engagements
- Reactions to the new prosumers
- Value of reliability
- Privacy
- Electric vehicles adaption rate



Neither a Silver Bullet nor a One-size Fit All

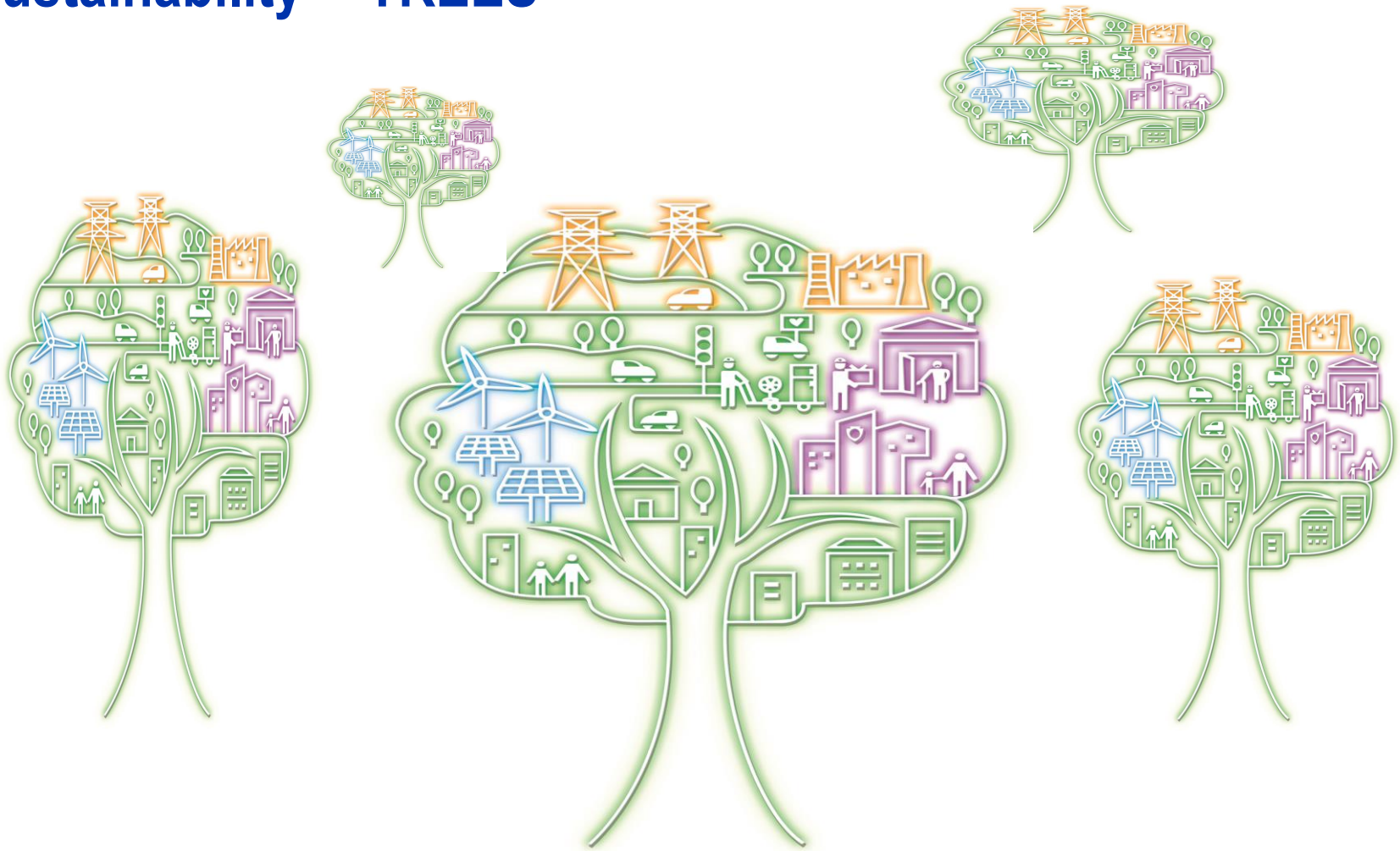


Research & Development Needs

- Renewables assessment, monitoring, and utilization;
- Internet-of-things and big data management;
- Integration of variable and mobile loads and micro-grids;
- Economic impacts and implications of distributed generation, renewables and energy storage;
- Equipment health assessment and asset management;
- Climate change and its impacts on extreme events



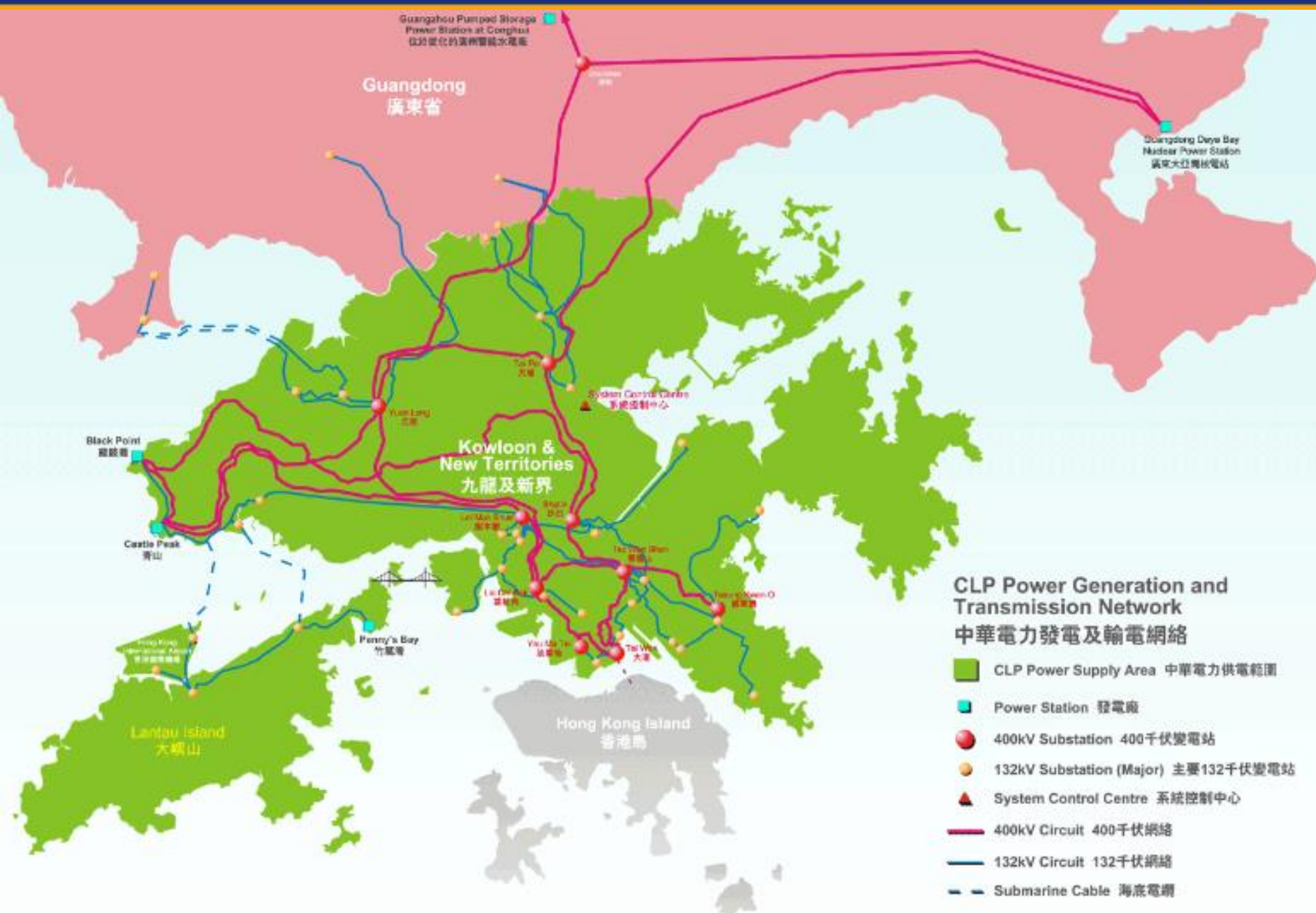
Sustainability \approx TREES

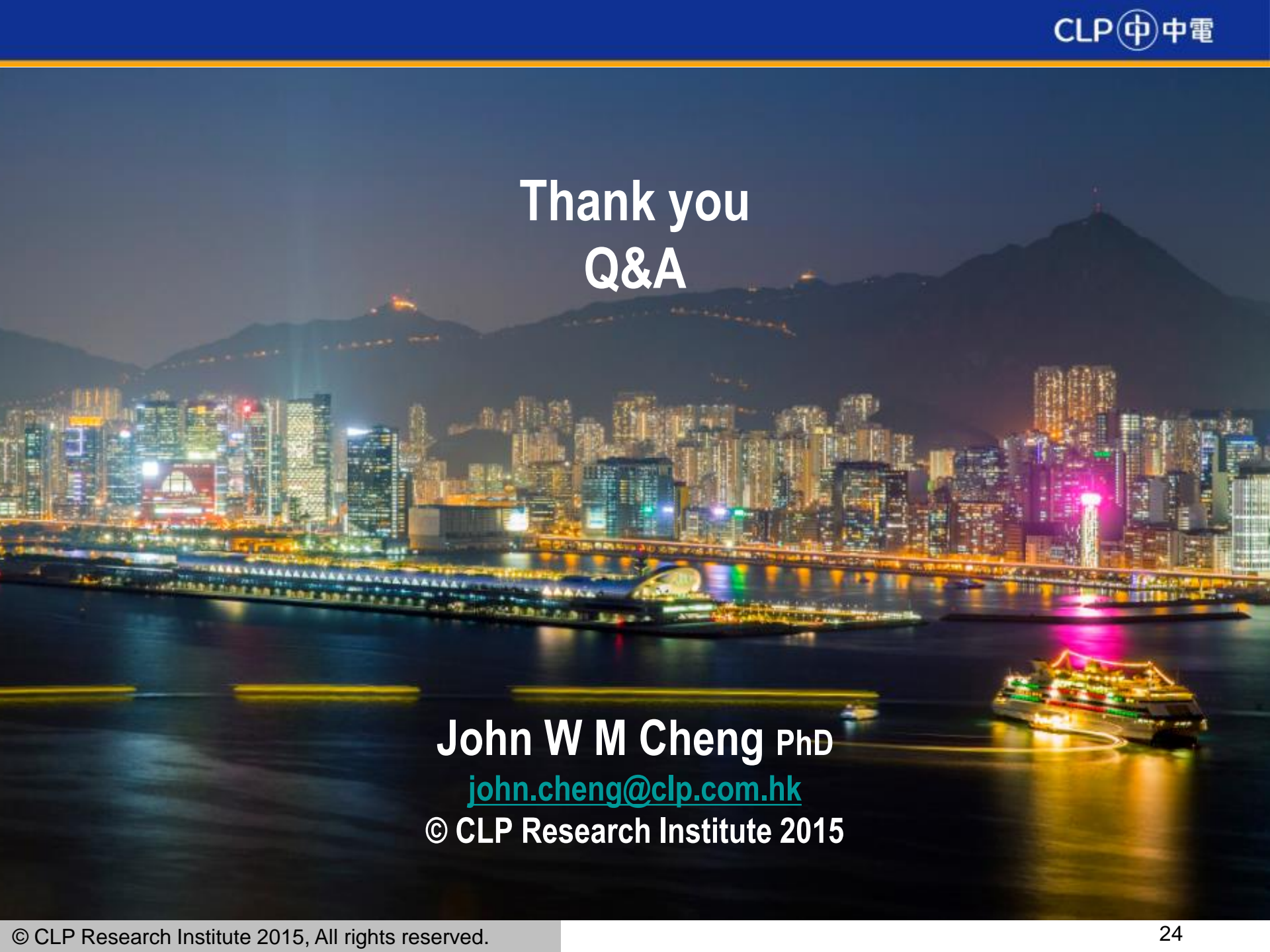


Technology-**R**egulation-**E**conomics-**E**nvironmental-**S**ocial

Conclusion

- Smart grid is a necessity to build a sustainable low-carbon future where customer engagements, renewables and distributed generation will become part of our electricity supply system.
- Globally, smart grids are going to have different flavors and paces. Asian countries are no exception. The commonalities rest on more complex, interconnected and intelligent systems will be deployed.
- There will be neither a silver bullet nor a one size fits all.
- With a clear vision, stable and long-term policy commitment, coordinated regulatory framework, reliable technology, healthy economics and social acceptance, developing and implementing it holistically will be the key to success.





Thank you
Q&A

John W M Cheng PhD

john.cheng@clp.com.hk

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