

# Smartgrid

## Is it a Revolution or an Evolution in Electric Power Industry?

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# The Catchphrase

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in Korea  
Right Now  
is

the Green Growth  
Smartgrid

# Driving Forces of Korean Economy



- ▶ Country ranking:
  - GDP: 15th
  - Primary Energy Consumption\*: 11th
    - Petroleum consumption: 9th
  - Electricity consumption: 10th
  - Carbon Dioxide Emission: 9th

\* Energy dependency overseas: 96.9%

# New Economy and New Direction

- ▶ Set carbon emission reduction target: **30% cut** from the expected 2020 level
  - Less than other developed nations but a **huge challenge** for Korean industries, where carbon emissions doubled in the period from 1990 to 2005, the fastest rate in the OECD.
- ▶ Avoid the carbon-related tariffs
- ▶ Push to develop new businesses in pollution-fighting technology

# Leading the Effort

- ▶ The Presidential Green Growth Committee



# Short-term Solution

## ▶ Negotiated Energy Agreement

- Pilot programs

- Industry, transportation, building and public sectors

	2010	2011	2012
<b>Qualifications</b>	<b>&gt; 500k TOE's</b>	<b>&gt; 50k TOE's</b>	<b>&gt; 20k TOE's</b>
<b>Percent consumption</b>	<b>35%</b>	<b>50%</b>	<b>54%</b>
<b>No. of Participants</b>	<b>50+</b>	<b>200+</b>	<b>400+</b>

# Long-term Solution

- ▶ Electrification
    - Electric vehicles
  - ▶ Efficient Renewable Energy Sources
    - Photovoltaic, solar thermal, wind, geothermal, biomass, etc.
- ⇒ Key to Success: Implementation of Smart Grid Architecture

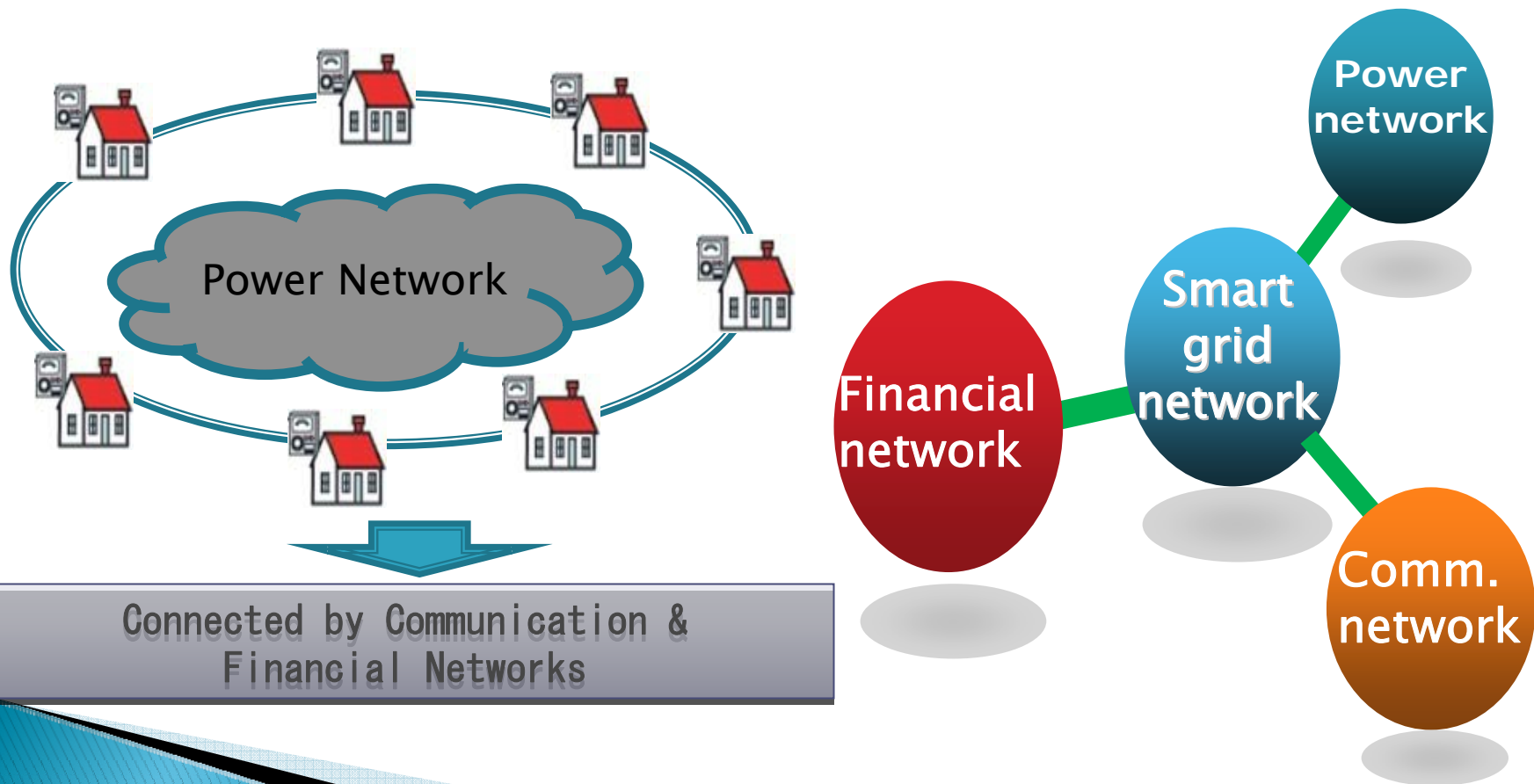
# Designing Principles

- ▶ A la EPRI (Smart Grid Implementation Workshop, June 2008)
  - Enable active participation by customers
  - Accommodate all generation and storage options
  - Enable new products, services and markets
  - Provide power quality for the digital economy
  - Optimize asset utilization and operate efficiently
  - Anticipate and respond to system disturbances
  - Operate resiliently against attacks and natural disasters



# Underlying Architectures

- ▶ System Consisting of Three Networks



# Power Transmission Network

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- ▶ Large-scale renewable resources connected according to traditional generation standards

# Power Distribution Network

- ▶ Three (high-quality, traditional and low-quality) networks\*
  - Intermittent sources and tolerant loads (i.e. renewables and EV charging) connected to low-quality network
  - One-way power flow from traditional distribution network to high-quality and low-quality networks
  - One-way power flow from low-quality network to high-quality network through storage (including EV discharging)

\* Concepts similar to FRIENDS project in Japan

# Wiring in Zero-energy Buildings

- ▶ Three (high-quality DC, traditional and low-quality DC) networks
  - Building-integrated renewables and tolerant loads (PHEV and water heater) connected to low-quality DC network
  - One-way power flow from traditional network to high-quality DC and low-quality DC networks
  - One-way power flow from low-quality DC to high-quality DC through building-integrated storage

# Communication Network

- ▶ Consistent and complete solution
  - Home-area network (HAN)
  - Neighborhood-area network (NAN)
  - Wide-area network (WAN)
  - Integration support for
    - Public network for customer services and private network (and legacy systems) for utility services
    - Energy portal services

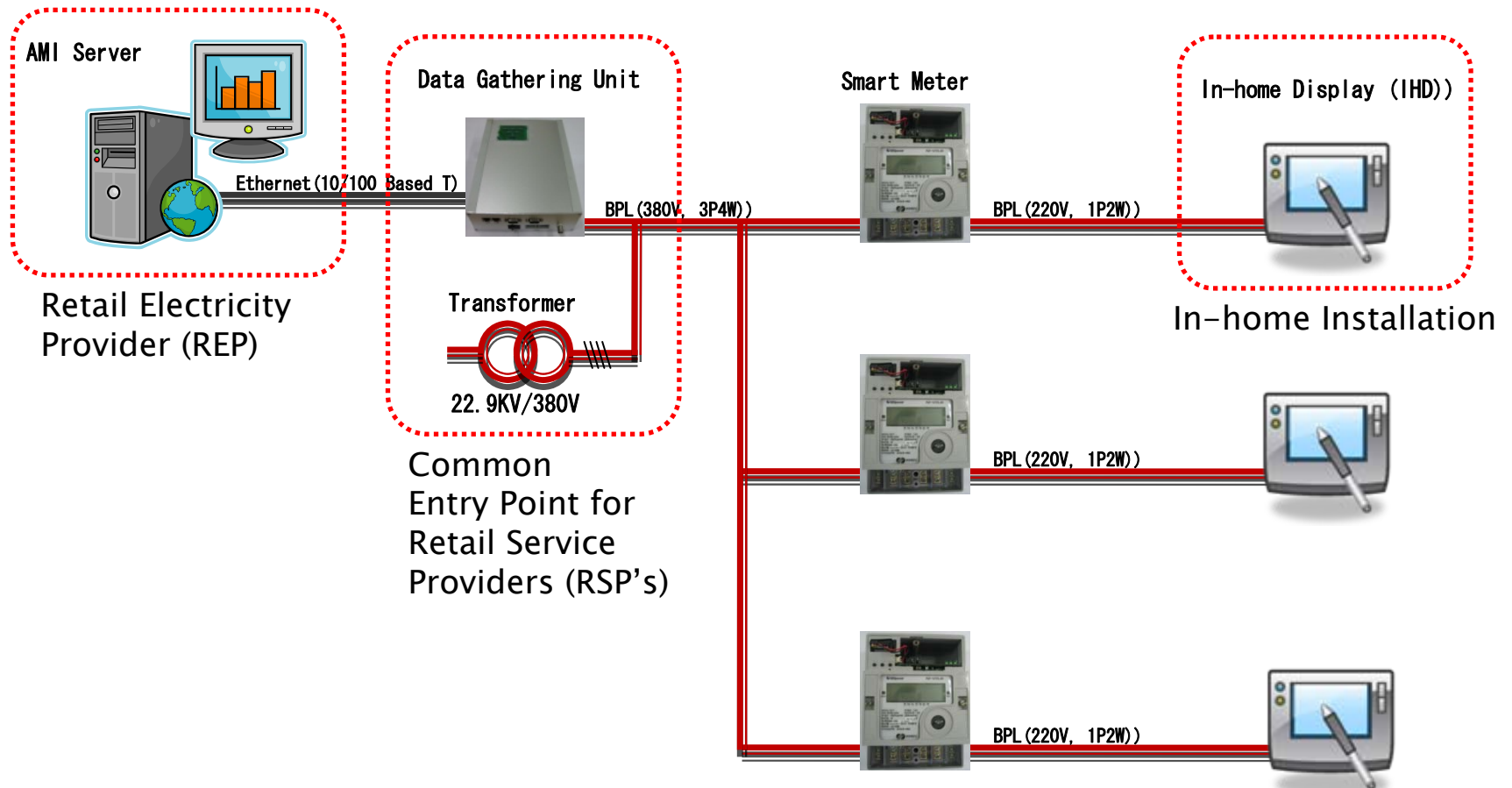
# Financial Networks

- ▶ Complete Market
    - Real-time (balancing) market
      - Ex-post pricing in every 5 minutes
    - Day-ahead (dispatch scheduling) market
    - Market for direct load control
      - Three days ahead
    - Market for energy forward
    - Market for transmission forward
    - Market for reserve
    - Market for frequency control
    - Market for voltage support
- ⇒ Ex-post real-time pricing at wholesale level

# Customers and Retail Pricing

- ▶ Regulator approving KEPCO's retail prices
  - Uniform price
  - Real-time retail price: real-time wholesale price plus
- ▶ Single retail electricity provider (REP) entering into a contract with KEPCO per substation
  - Managing last 1-mile communication network
  - Offering
    - Uniform price and real-time retail price on behalf of KEPCO
    - Various derived pricing schemes (TOU's and CPP's) on behalf of customers
- ▶ Multiple retail service providers (RSP) offering
  - Price prediction services
  - Other various customer services including renewable support

# Architecture for Last 1-mile





# Testing SG Architecture

- ▶ Jeju-Island SG Demonstration Project
  - Smart utility services
  - Smart electricity services
    - Wholesale market
  - Smart place services
    - Retail market
  - Smart renewables
    - At transmission, distribution and building levels
  - Smart transportation
    - EV's at distribution level and PHEV's at building level
  - ⇒ Incentive-, information-, intelligence-compatible
  - ⇒ Integrated, iterative and interactive system

# Fundamentals of Jeju-Island SG Demonstration Project

- ▶ Smart Grid Industry
  - Concept still being developed
- ▶ Smart Grid Business
  - AMI, Renewable DERs, Electric Vehicle Charging Stations, etc.
- ▶ Smart Grid Infrastructure
  - Architecture
  - Platform

# What is Important for KEPCO

- ▶ Designing and Implementing Appropriate Smart Grid Architecture
  - Optimizing network capabilities
  - Supporting various Smart Grid businesses

# Smart Grid Architecture similar to Computer Operating Systems

- ▶ Smart Grid Business
  - Application Software
    - Word, Power Point, Excel, Game, GOM Player, etc.
- ▶ Smart Grid Architecture
  - Operating Systems (System Software)
    - Windows, Mac OS, UNIX, etc.

# Significance of Owning/Building Operating Systems

- ▶ Optimizing System Capabilities
- ▶ Supporting Various Applications
- ▶ Application Software tailored for Specific Operating Systems
  - How many do application software programming companies exist?
  - How many do operating system software coding companies exist?

# KEPCO's Strategy

## Purpose of Smart Grid Platform

- ▶ Near term
  - Price reform
- ▶ Short term
  - Electric power industry structure rectification
- ▶ Long term
  - Electrification advocacy

# KEPCO's Focus

## Principles of Smart Grid Platform

- ▶ Interoperability
- ▶ Scalability
- ▶ Upgradability
  - Compliance to existing system
  - Preparation for post-Jeju Island demonstration project

# Lead (and Working with) Ministry of Knowledge Economy

- ▶ Near term
  - Completing electric power industry reform within smart grid platform
- ▶ Short term
  - Meeting energy and environmental challenges
- ▶ Long term
  - Championing smart grid industry



# Q&A

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# THANK YOU