An Intelligent Energy System Singapore's Smart Grid Initiative

Energy Regulators Forum on Regulation and Energy Sustainability
Bangkok, 23 March 2011
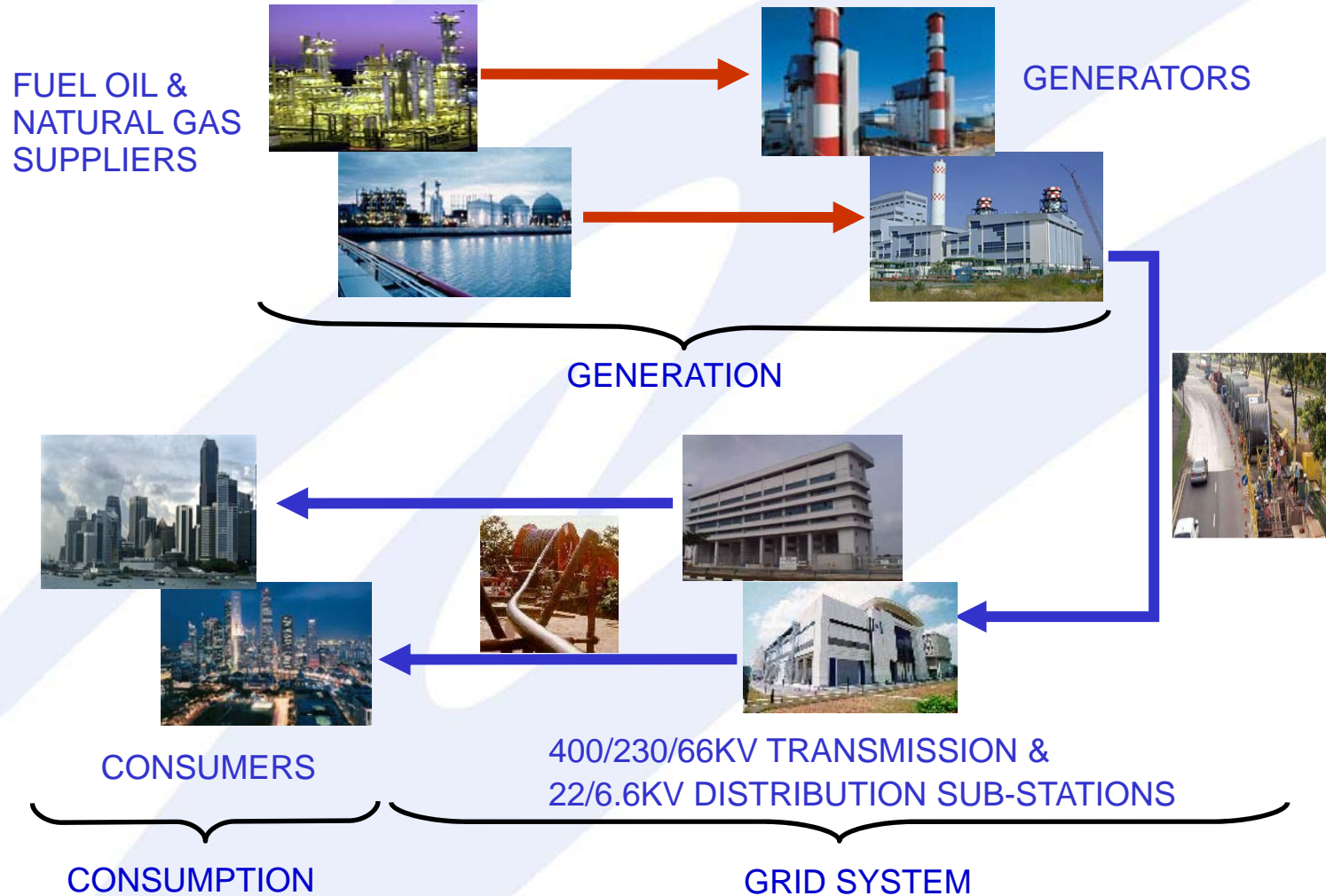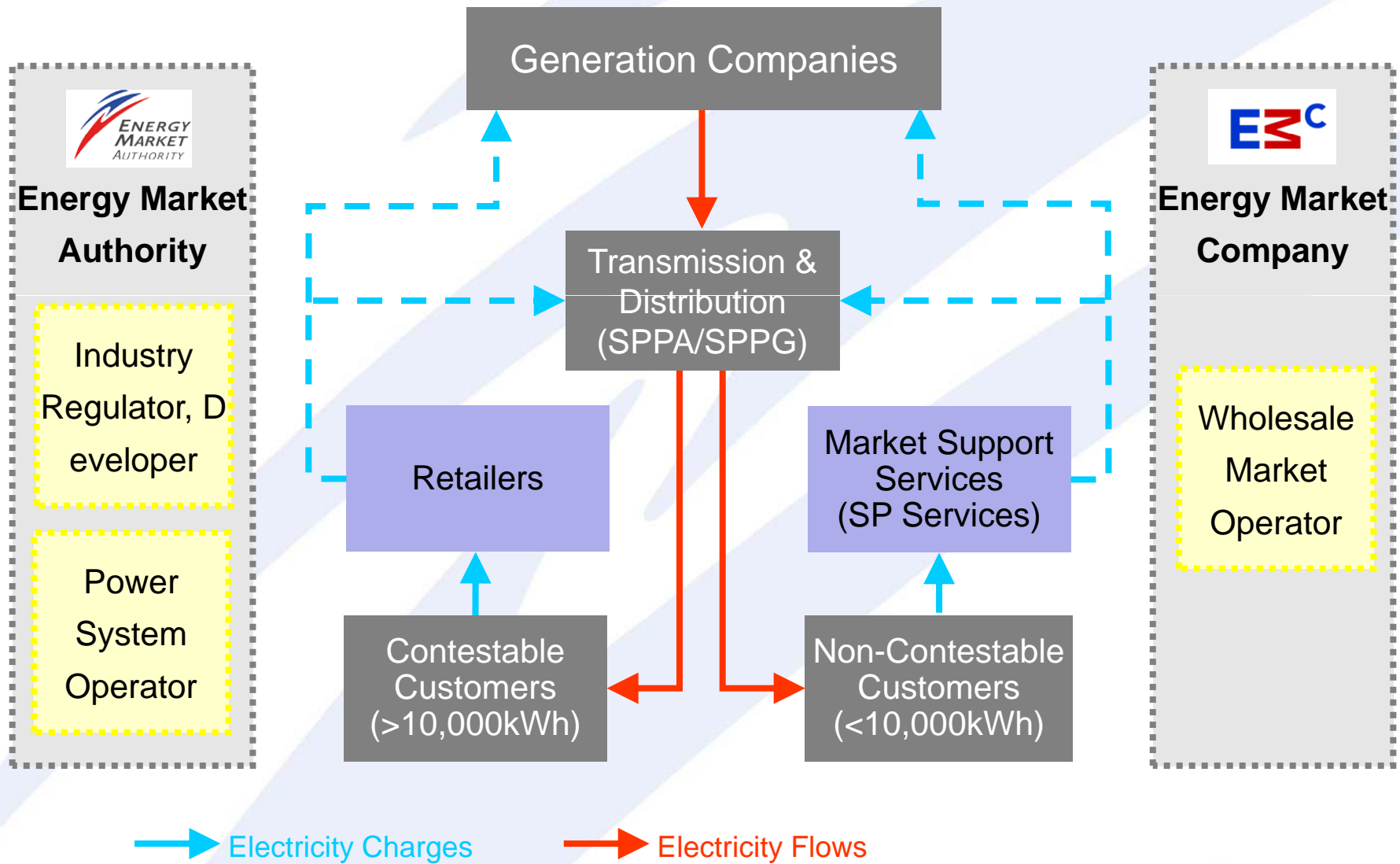
ENERGY MARKET AUTHORITY

Agenda

- Background on Singapore's System

- The Intelligent Energy System (IES)

- The Pilot Project – challenges & status
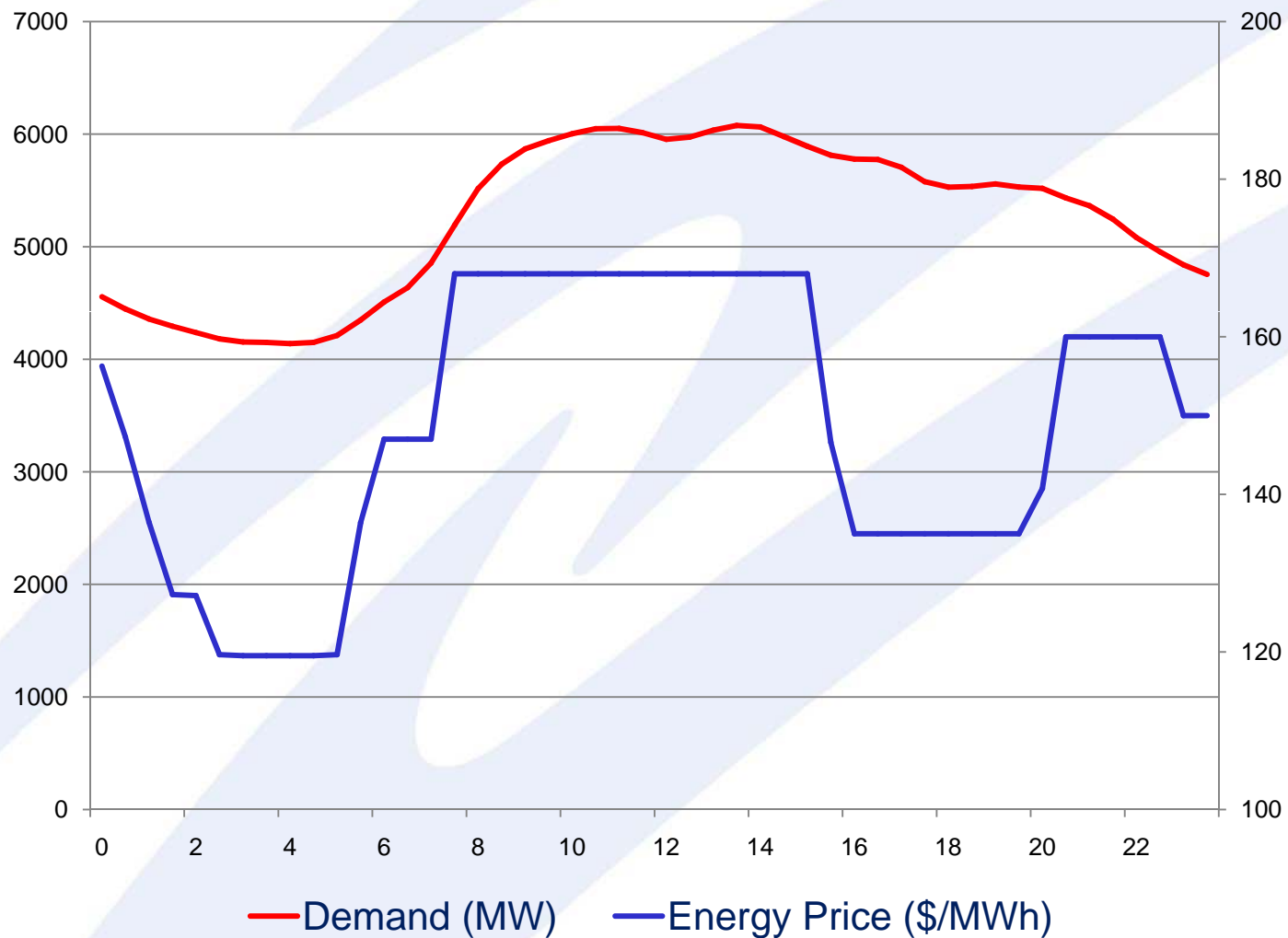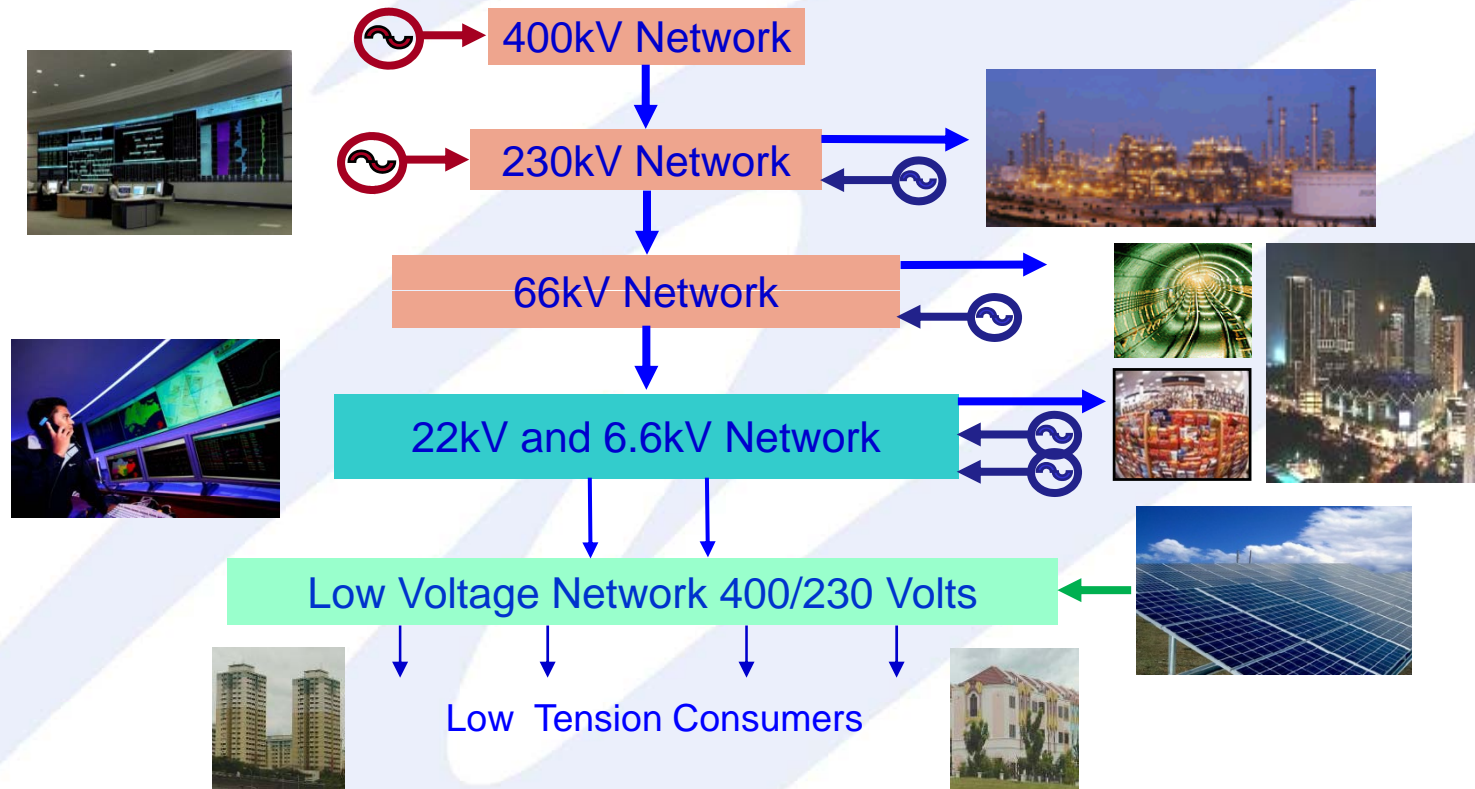
Singapore's Electricity Industry

FUEL OIL & NATURAL GAS SUPPLIERS

GENERATORS

GENERATION

CONSUMERS

400/230/66KV TRANSMISSION & 22/6.6KV DISTRIBUTION SUB-STATIONS

CONSUMPTION

GRID SYSTEM

Electricity Market Structure

Generation Companies

Transmission & Distribution (SPPA/SPPG)

Retailers

Market Support Services (SP Services)

Contestable Customers (>10,000kWh)

Non-Contestable Customers (<10,000kWh)

Energy Market Authority

Industry Regulator, Developer

Power System Operator

Energy Market Company

Wholesale Market Operator

→ Electricity Charges   → Electricity Flows

Typical Energy Demand & Price

Demand (MW) — Energy Price ($/MWh)

Singapore's Grid System

400kV Network

230kV Network

66kV Network

22kV and 6.6kV Network

Low Voltage Network 400/230 Volts

Low Tension Consumers

Network automated down to MV distribution level
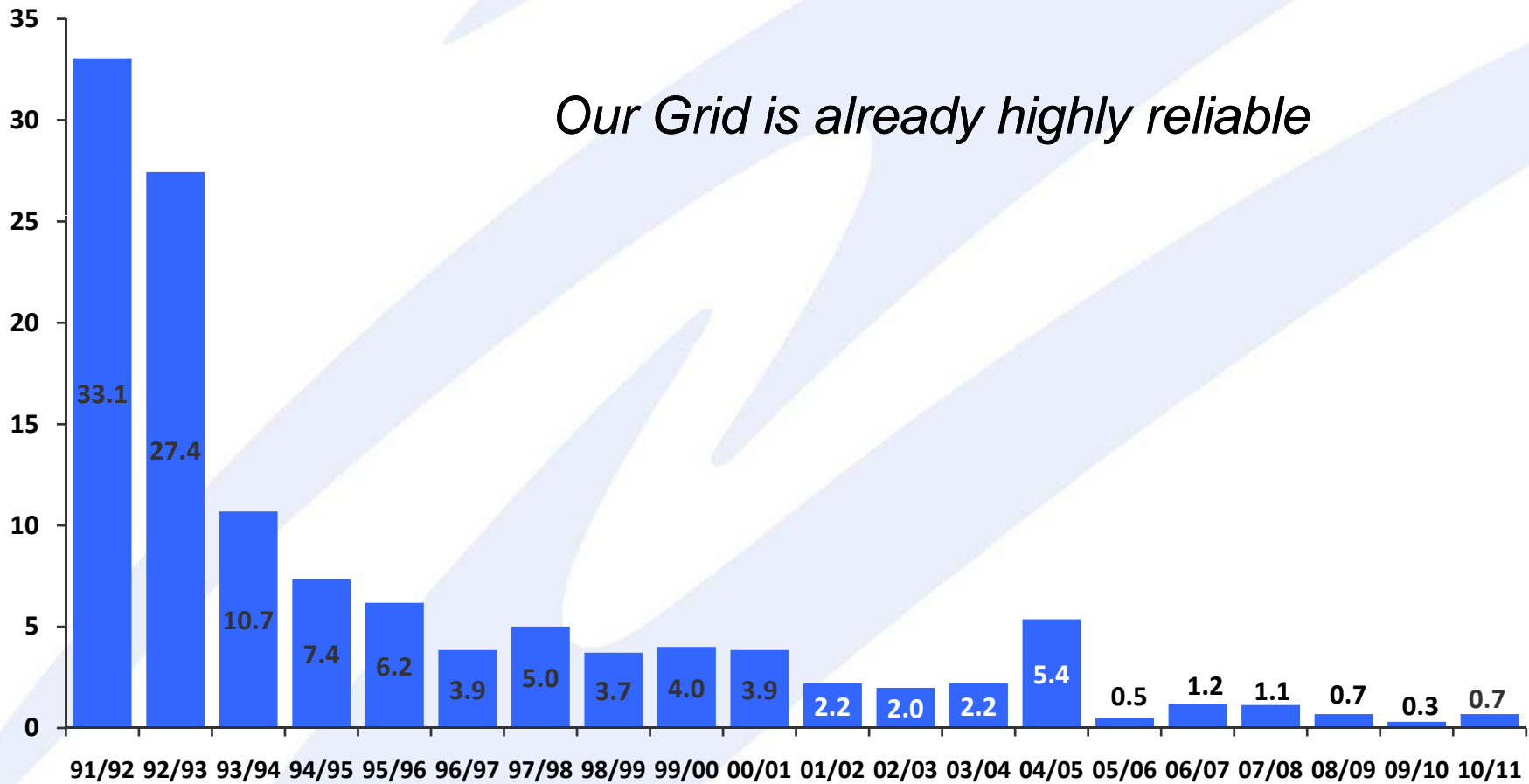
Key Drivers

- ✓ Technology assessment for a scalable end-to-end Advanced Metering Infrastructure (AMI) solution

- ✓ Enable the management of Distributed Energy Resources including renewable and embedded generation

- ✓ Enable the integration of new initiatives such as demand response and Electric Vehicles (G2V and V2G)

- ✓ Integration of new Outage Management System (OMS) to enhance management of power outage

What will the IES mean for Singapore?

We will bring the capabilities of our power grid to the next level
and ensure that our electricity infrastructure is ready for the future

HOUSEHOLD

- Choice of electricity retailer and pricing plan
- More information to monitor and manage energy usage
- Better control of major home appliances to reduce energy usage

BUSINESS

- Choice of electricity retailer and pricing plan
- More information for building owners and occupants to manage energy usage
- Better control and automate systems at the building level to reduce energy usage

GRID OPERATOR

- Effective communication with households and businesses to enhance delivery of electricity
- Enhanced capability to detect and respond promptly to localised power outages
- Easier integration of new energy sources into the grid

RESEARCH & DEVELOPMENT

- Develop and test promising smart grid applications and technologies for commercialisation
- Opportunities for the research community to test-bed energy solutions in real-world environments.

Energy Market Authority

An Intelligent Energy System

Consumer Choices

Accessible
- Embedded generation
- Renewable energy
- Energy storage

Flexible
- Demand response
- Home automation
- Building management

Generation → Transmission → Distribution → Consumer

SCADA / EMS — SCADA / DMS — A M I

Reliable
- 7x24 monitor & control
- Outage detection and supply restoration

Economic
- Network Optimization
- Assets utilization

Consumer Expectations

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Pilot Project Approach

❑ Establish technical solutions for roll-out

❑ Quantify the costs and benefits

❑ 4500 smart meters to be deployed

❑ Nanyang Technological University to be the focal point, where the full suite of applications and solutions will be tested
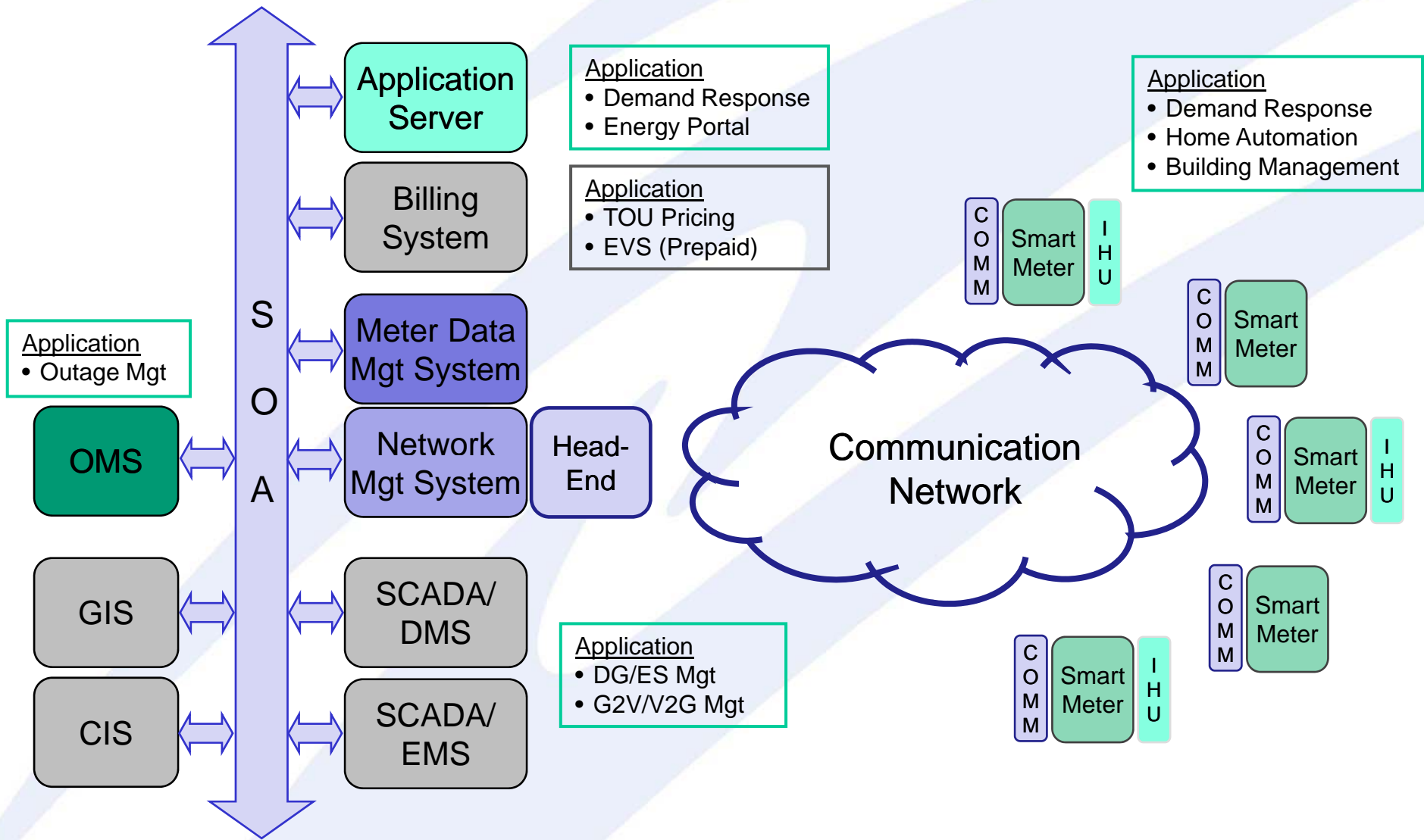
Key Phases of the IES Pilot

❏ Phase 1 – develop backend systems and infrastructure

   ✓ Commenced in October 2010

   ✓ Expected to be completed by mid 2012

❏ Phase 2 – evaluate customer applications which ride on advanced metering infrastructure

   ✓ Expected to commence in Q1 2012 and completed by mid 2013

Phase 1 – Developing the Enabler

❑ Establish two-way data communication
  ✓ advanced metering infrastructure (AMI)

❑ Develop applications to ride on AMI
  ✓ time-of-use tariff
  ✓ distributed generation management
  ✓ demand response and energy management
  ✓ outage management
 ✓ integration of EV charging and V2G

System Architecture

Application
- Demand Response
- Energy Portal

Application
- TOU Pricing
- EVS (Prepaid)

Application
- Demand Response
- Home Automation
- Building Management

Application
- Outage Mgt

Application
- DG/ES Mgt
- G2V/V2G Mgt

Application Server	
Billing System	
Meter Data Mgt System	
Network Mgt System	Head-End
SCADA/DMS	
SCADA/EMS	

OMS

GIS

CIS

S O A

Communication Network

COMM Smart Meter IHU

COMM Smart Meter

COMM Smart Meter IHU

COMM Smart Meter

COMM Smart Meter IHU

Design Consideration

❑ Design with the end in mind

❑ Ability to integrate new technologies in future

❑ Leverage industry-adopted standards

❑ Data live in one place

❑ Utilise standard/best-fit functionality and avoid customisations

❑ Customisations developed outside the core system

Smart Meter – Open and Modular
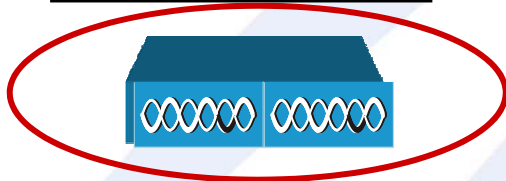
plug-in communication module
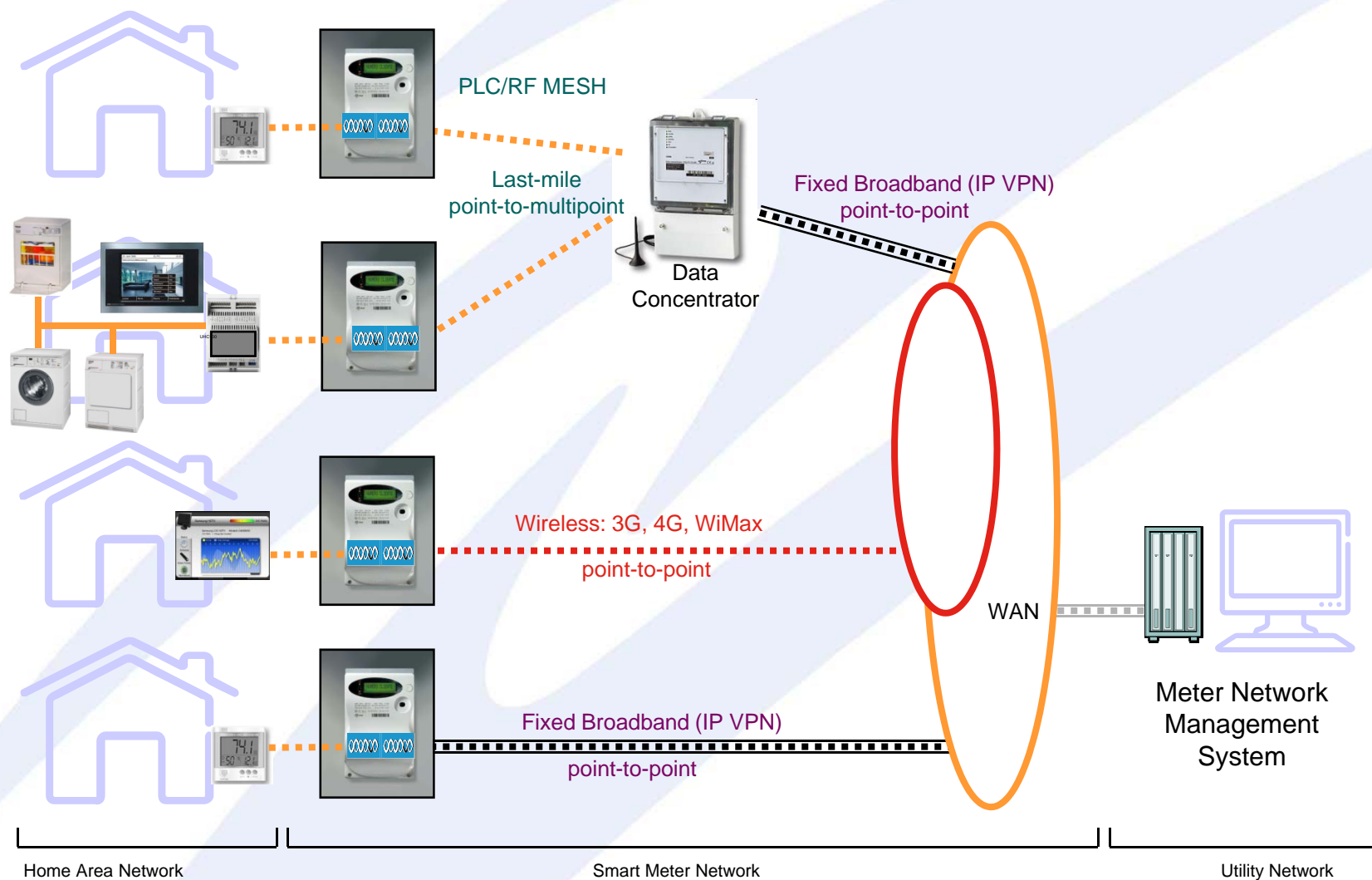
Basic metering:

- ✓ Half-hour interval metering

- ✓ At least 30 days interval data

- ✓ DLMS-COSEM compliance

- ✓ Remote turn-on and cut-off

- ✓ Prepaid and postpaid functions

- ✓ Alarms – tampering, power outage

Smart Meter Communication

✓ Access meter data via DLMS-COSEM protocol

✓ 2-channel communication gateway

✓ able to pair different communication method

Communication Concept

PLC/RF MESH

Last-mile
point-to-multipoint

Fixed Broadband (IP VPN)
point-to-point

Data
Concentrator

Wireless: 3G, 4G, WiMax

point-to-point

WAN

Meter Network
Management
System

Fixed Broadband (IP VPN)

point-to-point

Home Area Network

Smart Meter Network

Utility Network

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Phase 2 – Engaging the Consumers

❑ Applications trial with the "enabler" infrastructure
  ✓ Commercial / industrial / household consumers
  ✓ Include CleanTech Park and Eco-Precinct

❑ Electricity retailers offer to consumers
  ✓ Time-varying packages
  ✓ Value added services such as energy efficiency measures riding on Building Management Services and Home Automation Systems

Phase 2 – Challenges

- ❑ Engaging the consumers
  - ➢ benefits

- ❑ Engaging the retailers and service providers
  - ➢ business model

  - ❑ Regulatory framework revision
  - ➢ paradigm shift

Conclusion

Centrally managed intelligent communications interconnects various smart grid technologies

Industry