

IEA DSM IA (Task 17) Country Reports of Korea

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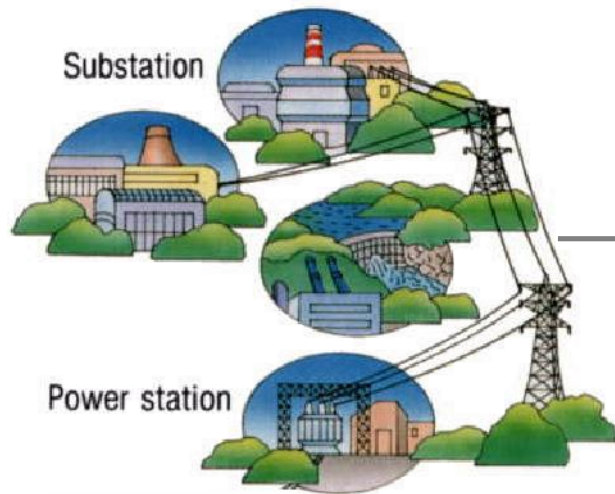
Korean Expert of DSM Task 17



I

Scope of the Task 17 (Integration of Dispersed Energy Resources)

Dispersed Small Generation



When excessive power,

Energy Supply



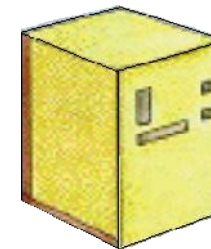
When power shortage,

Energy Demand



CHP (Cogeneration)

(Industrial Complex,
District Heating, etc.)



**Fuel Cell, Bio (LFG, etc.), Wind,
Small Hydro, Solar Thermal,
Photovoltaic, Geo-thermal, etc.
(11 Categories in Korea)**

Demand Response

Load Management “*Demand Response*”

- ▶ Provide customers new options from load shedding to TOU rate for assuring reliable supply costs
- ▶ Improved System Reliability, Cost Avoidance, Greater Market Efficiency, Improved Risk Management, Reduced Negative Environmental Impacts, Improved Customer Services, Market Power Mitigation

Load Response Program: Reliability

- ▶ Provide load relief to maintain system reliability
- ▶ Interruptible and curtailment program

Price Response Program: Dynamic Pricing

- ▶ Real-time Pricing, Demand Bidding, etc.

Operational Structure of DR (Now, Planning Stages)

**Master:
Load Mgmt. Center**



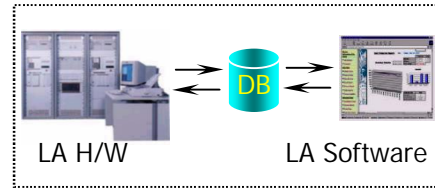
LMC H/W



EMS/MOS
(System Operator in Markets)

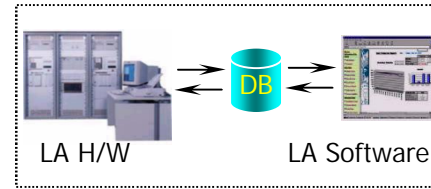


**Sub Masters:
Load Aggregator**



LA H/W

LA Software



LA H/W

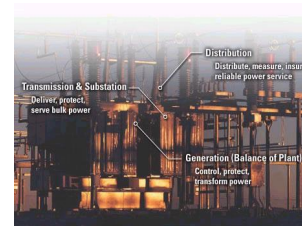
LA Software

...

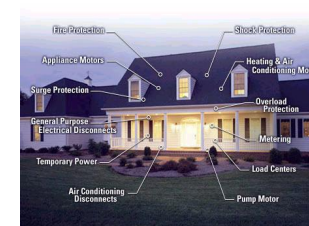
Customers



Industrial Customer

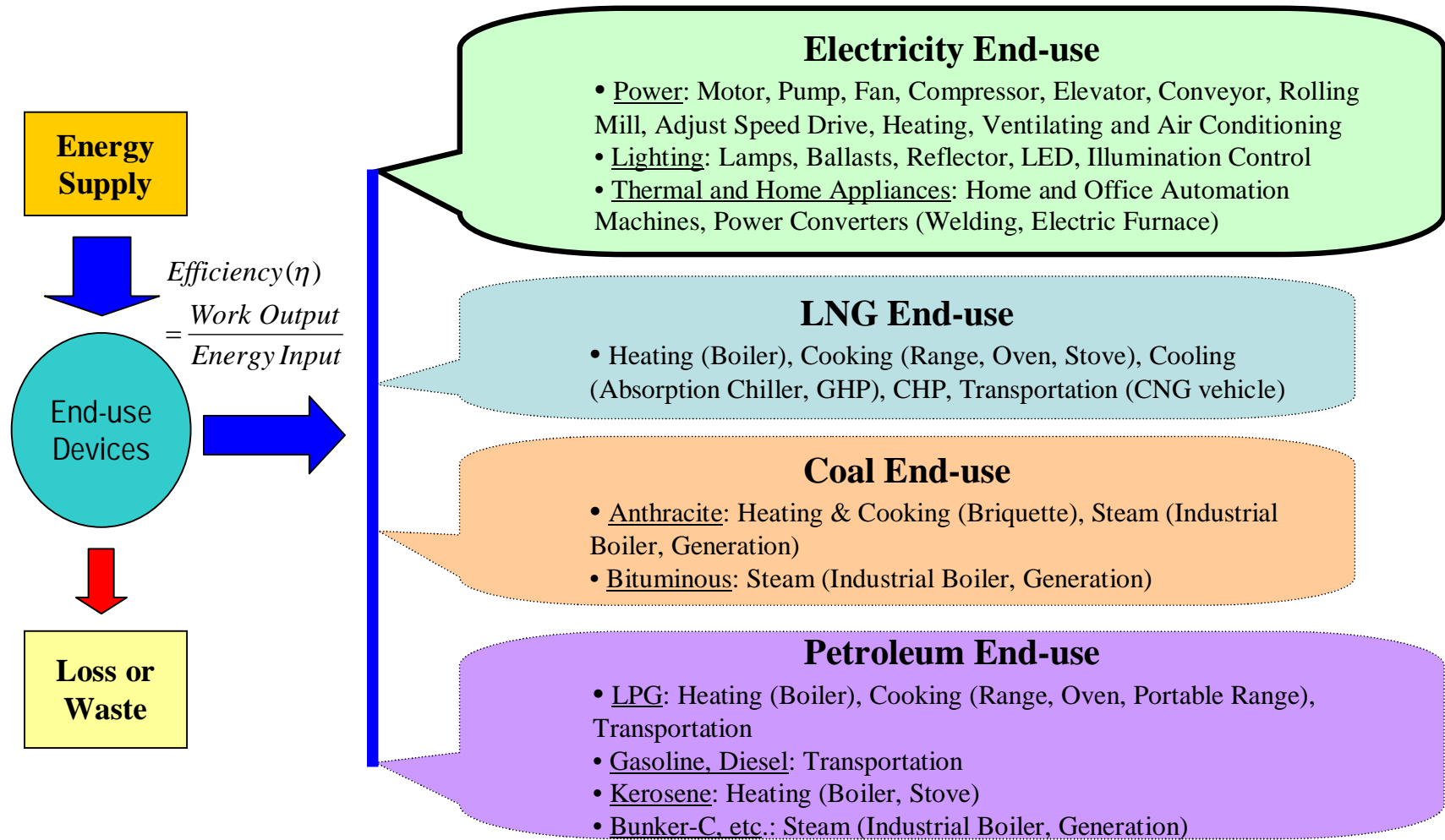


Commercial Customer



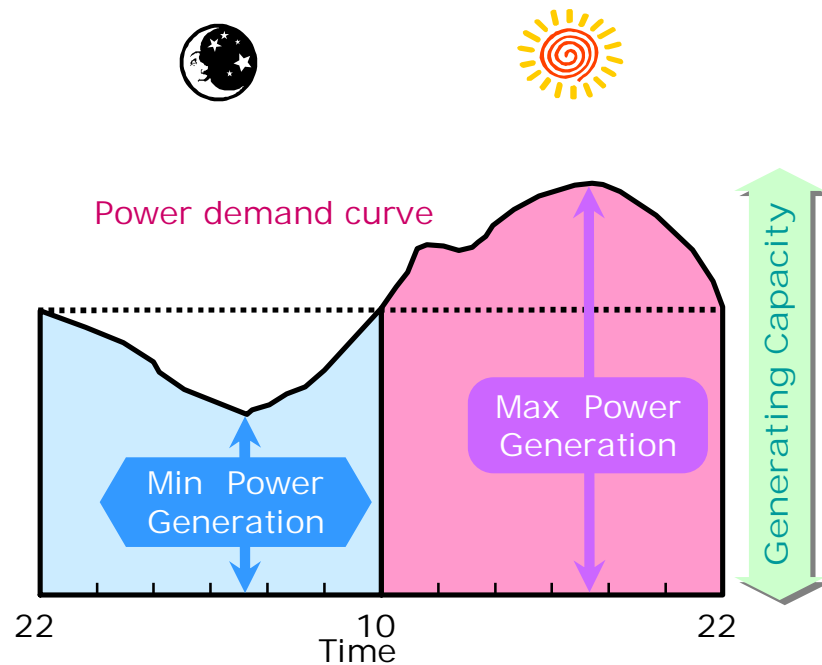
Residential Customer

End-Use Energy Efficiency

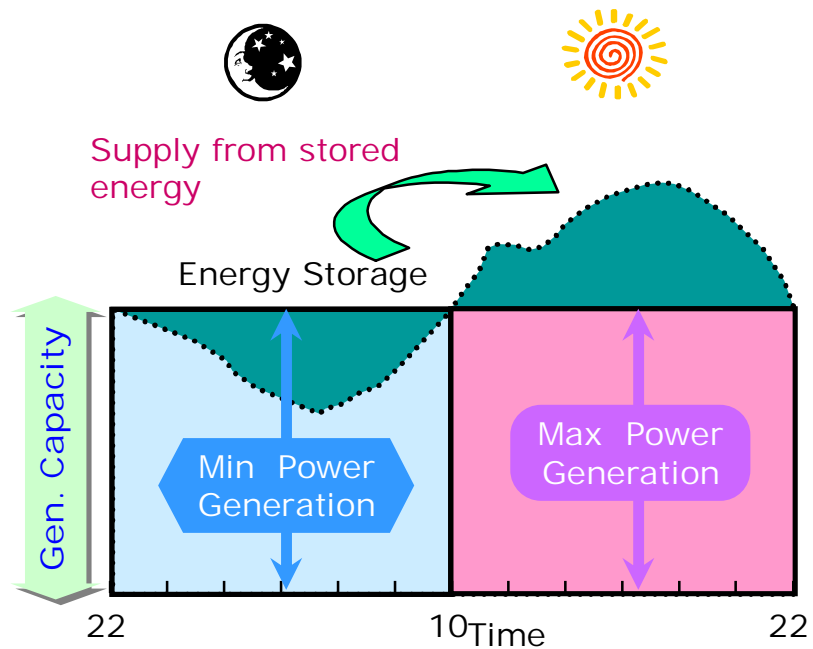


Utilization of Energy Storage

Typical Load Curves



With Load Leveling



- Pumped Hydro, Thermal Accumulators, Ice Storage System
- Battery ES, Flywheel ES, Superconductive Magnetic ES
- Compressed Air ES

II

Descriptions of Korea Profile

Policies, driving forces for DG, RES, DSM/DR

DG (CHP)

- ▶ Policy drives are vague except the Community Energy Business Act

Renewables

- ▶ The 2nd Renewable Energy Development and Dissemination Plan (2003~2012)

DSM/DR

- ▶ The 3rd basic plan for Electric Power Supply and Demand (2006~2020)

Energy Efficiency

- ▶ The 3rd basic plan for Rational Energy Utilization (2004~2008)

Energy storage

- ▶ Not commercially focused except pumped hydro
- ▶ Battery storage widely used for UPS, smart grid is introductory R&D stage

Checksum on Market Potentials

❏ CHP

- ▶ Some researches on the potential estimations of CHP, but until now there was no publicly informed or agreed opinions on the diffusion goals on DG resources.

❏ Renewables

- ▶ NRE Center affiliated in KEMCO estimated the economic potentials for adopting renewables as from 3.1% to 5.0% of TPES in 2012.
- ▶ But, the governmental target was eagerly set to 5.6% in 2012.

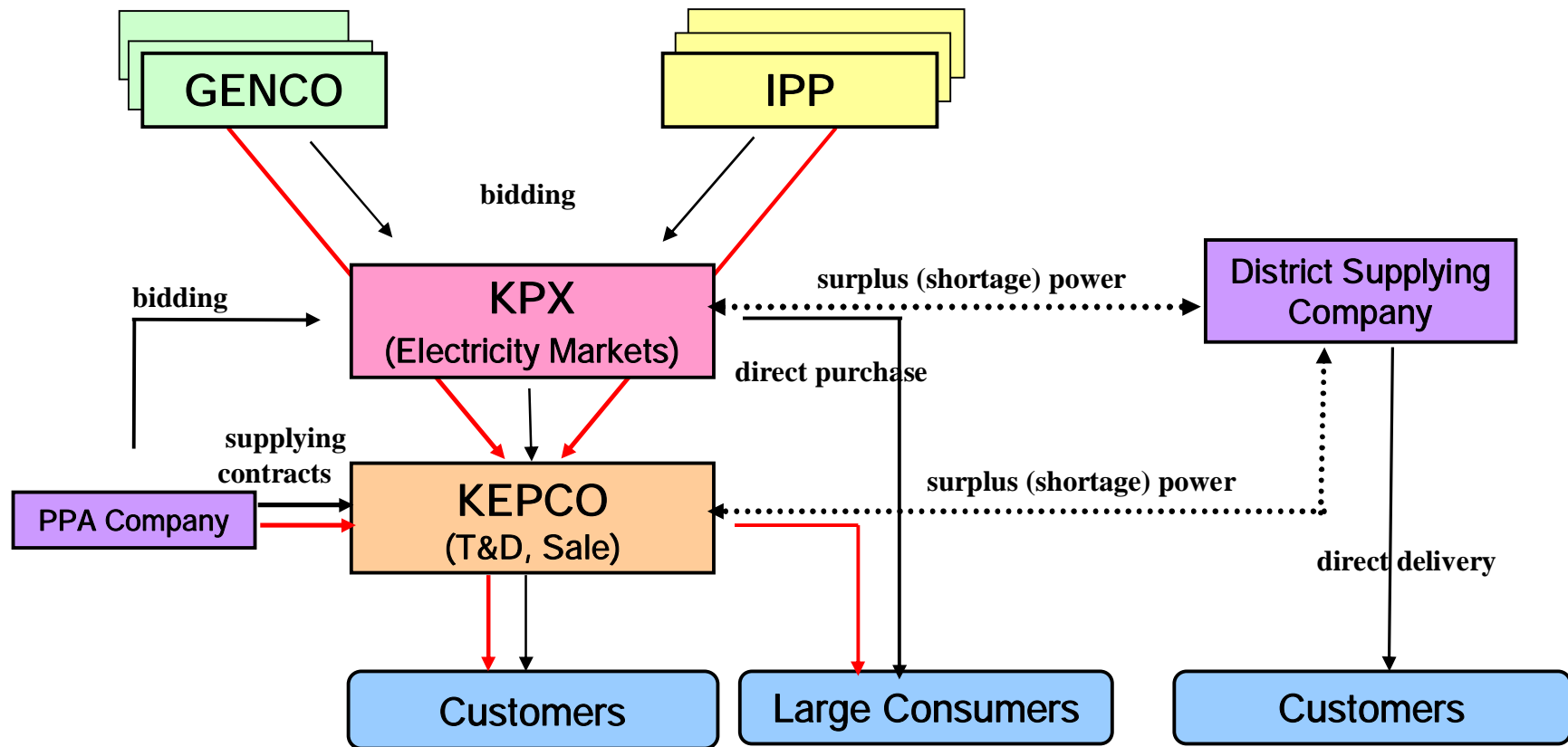
❏ DR

- ▶ Market potential has not been studied yet.

❏ Energy efficiency market potentials, from 7% to 15% of TPES per annum

- ▶ Domestic market potential of energy efficiency has been studied by KEMCO through the industrial energy audits and the ESCO programs.
- ▶ But specific energy efficiency potentials by energy sources such as, electricity, natural gas, petroleum, etc. are not comprehensively assessed until now
- ▶ Despite the energy efficiency goals of national concerns are set up, the targets of efficiency by individual energy resources are not specifically linked to the national levels.

Korean Electric Market Structure



※ PPA : Power Purchase Agreement

→ Electricity Flow → Sale

KOREA ENERGY MANAGEMENT CORPORATION

Characteristics of Korea Electricity Markets

Mandatory Pool

- ▶ Power transaction only through KPX

CBP (Cost-Based Pool)

- ▶ Price formation by short-run marginal cost

Only Spot Market

- ▶ No forward market and contract

Division of market

- ▶ Base-load and non base-load
- ▶ Profit allocation between KEPCO and Gencos

Price Structure of Korea Electricity Market

Price Structure

- ▶ Non base-load : $SMP + CP$
- ▶ Base-load : $BLMP + \text{Base-load } CP$

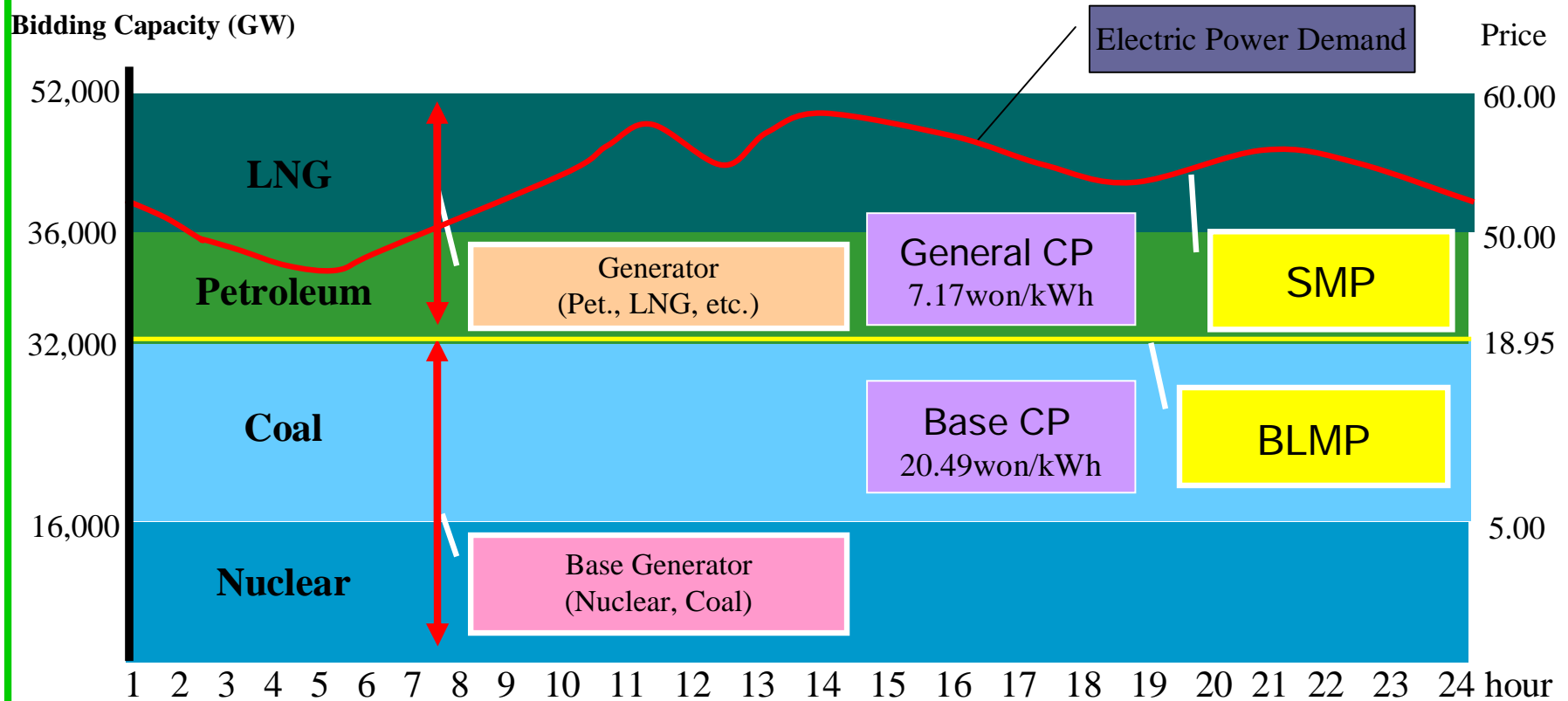
SMP(System Marginal Price) / BLMP(Base Load Mrginal Price)

- ▶ Short-run marginal variable cost

CP(Capacity Price)

- ▶ Based on fixed cost of reference marginal plant
- ▶ Non base-load : gas turbine
- ▶ Base-load : standard coal plant (500MW)

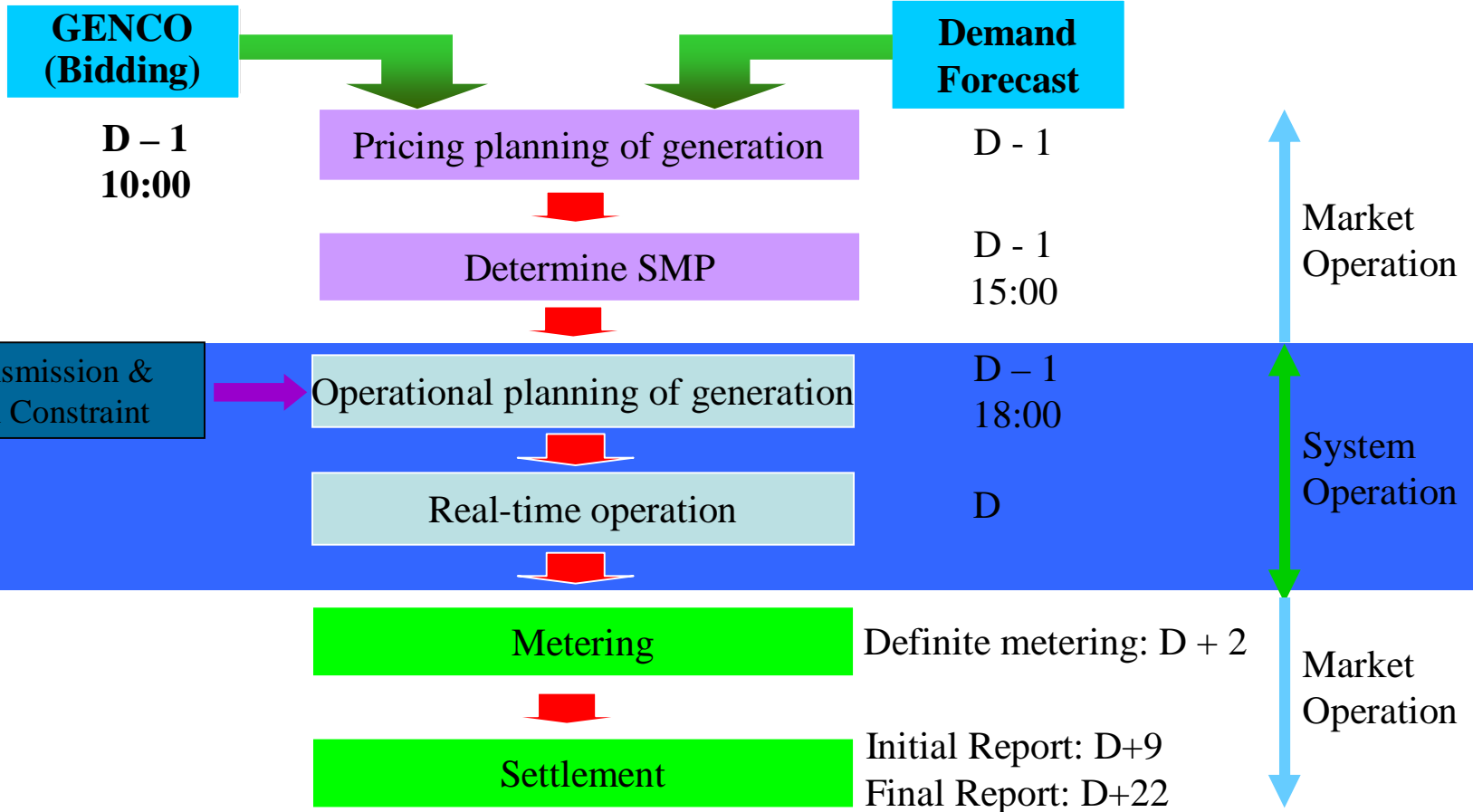
Marginal Price of Electricity



※ 2005(average) : SMP 62.13 KRW/kWh, BLMP 19.28 KRW/kWh

Electricity Market Operation

[Korea Power eXchange]



Status and Targets for DG, RES, DSM/DR

CHP for district heating and industrial cogeneration

- ▶ (2006) district heating 1.3GW, industrial cogen 2.2GW, small cogen 0.5GW
 - 4.9% of total gen capacity(70.4GW) and 4.3% of total generation(404.7TWh)
- ▶ In the national levels, diffusion targets of CHP or dispersed generation excluding renewables are not specifically set up.
 - Recently CHP has deployed in the forms of local community energy systems (25 sites under construction).

Renewables

- ▶ (2006) 5.3 million toe(2.24% of TPES), 3.9TWh(1.02% of total electricity generation)
- ▶ Long-term targets of renewables is set up to 5.6% of Total Primary Energy Supply in 2012 and to 9.0% of TPES in 2030 by the National Energy Fundamental Plan.

DSM/DR

- ▶ DSM goals of electricity, together with load management and energy efficiency, are reduce about 14% of peak demand on the basis of BAU scenario in 2020. (energy efficiency takes up 4% of peak demand reduction)
 - Reserve margin targets of power systems: 10% in long-term perspectives and 6% reserves(near 4GW levels) in normal operations

Major Electricity DSM Programs

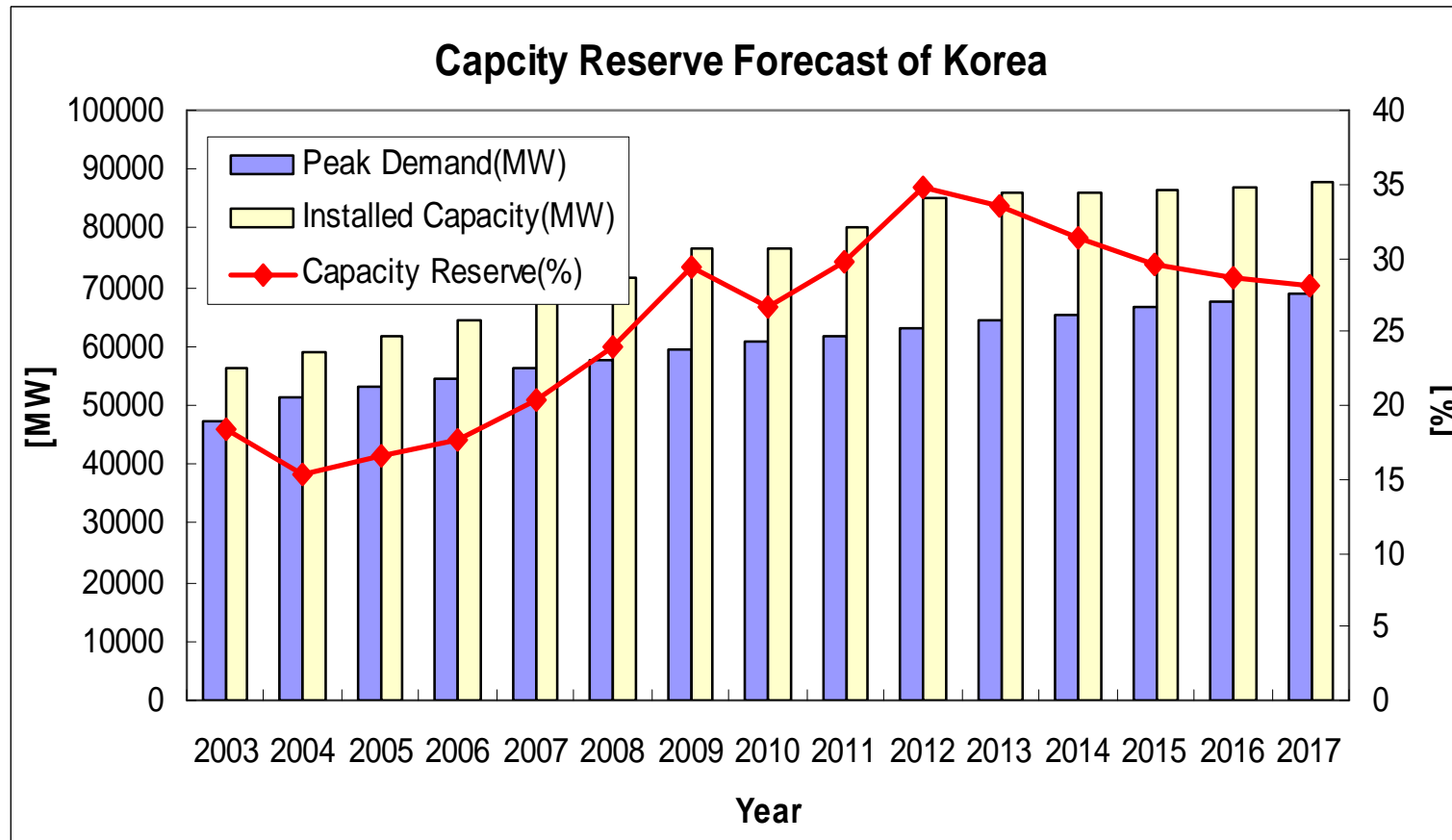
Load Management Programs

- ▶ Demanding charges according to the maximum demand during previous 12 months
- ▶ Seasonal pricing, TOU rate, midnight power service, subsidies for installing ice storage cooling system, rebate for requested load adjustment
- ▶ Direct load control program, rebate for peak demand controller

Energy Efficiency Rebate Programs (for High Efficiency Certified Products)

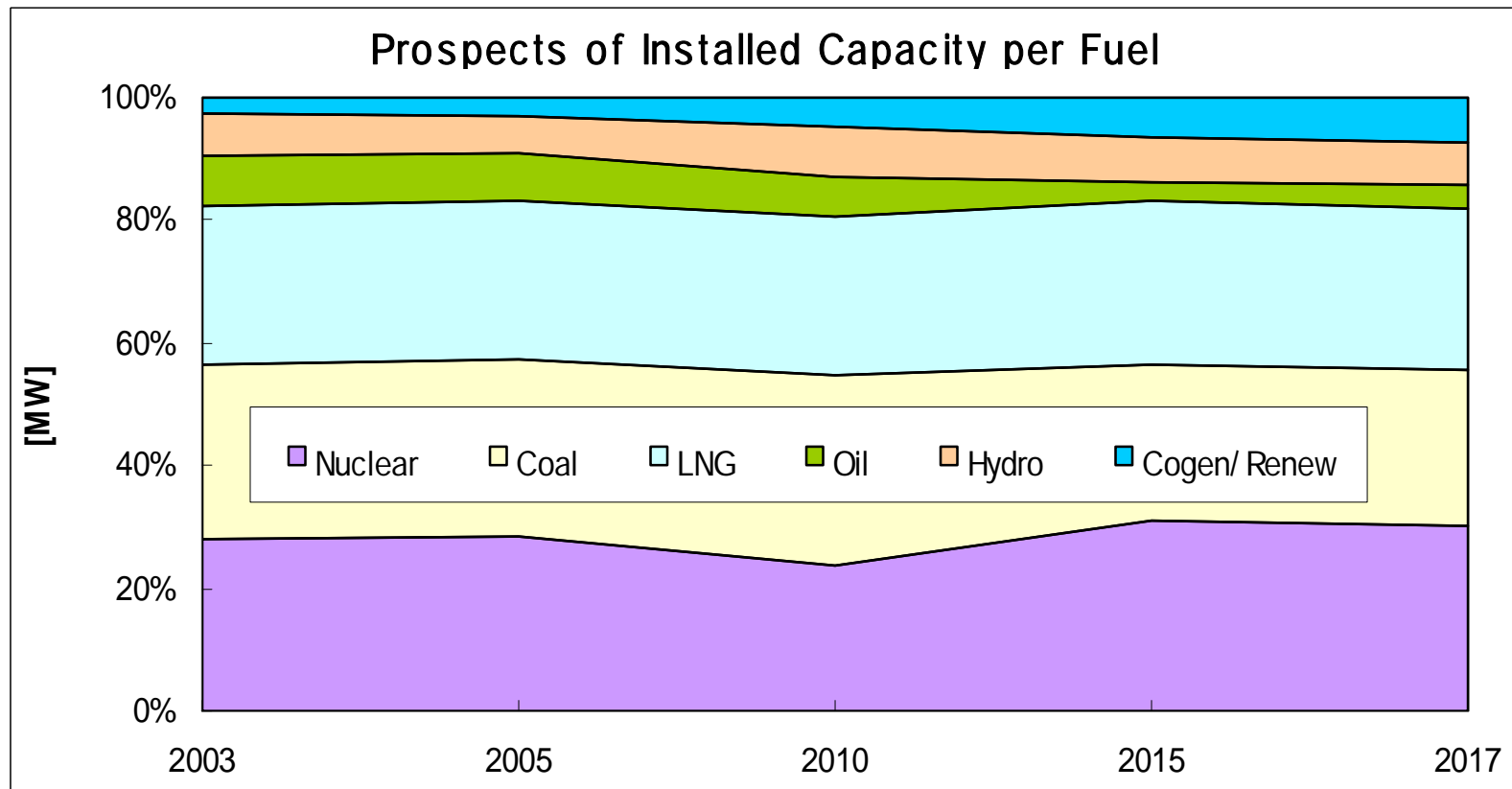
- ▶ Lighting: electronic ballasts for 16mm(T-5), LED, CFL
- ▶ Electric motor: 3 phase induction below 600V rating
- ▶ Inverter: more than 3.7kW rating
- ▶ Vending machine: set the operation time of built-in compressor
- ▶ Transformer: 1 phase 30~100kVA and 3 phase 100~1,250kVA with amorphous core or in molded shape
- ▶ Centrifugal pump: rating of 0.03~15.0 m³/min

Long-term Generation Expansion Plan



- Demand growth rate : 2.7% annually
- Reserve margine : 15.3%~33.5%

Power Mix Prediction



- Nuclear, Cogen / Renewables will grow gradually
- Coal share will decline a little
- LNG share will be similar to current status

Problems in Capacity Adequacy

Supply Side

- ▶ **Uncertainties in Plant Construction**
 - Absence of risk hedge instrument
 - Uncertainty resulting from market situation
- ▶ **Uncertainty of Market Structure**
 - Current Capacity Based Pool is temporary
 - Absence of road map for future market
- ▶ **Retirement Delay of Inefficient Plants**
 - Sufficient compensation by current CP system

Demand Side

- ▶ **Inaccuracy of Demand Prediction**
 - Mismatch of prediction of economy, Change in demand pattern
 - Possible Substitution between Resources , Distorted energy price system by use
- ▶ **Uncertainty of Demand Side Management**

Power Quality Issues

Adequate power quality in KEPCO systems

▶ System Frequency

- Maintaining monthly standard freq. criteria of $60\text{Hz}\pm 0.1$ with 99.9% in 2007

▶ System Voltage

- High voltage regulation ratio resulted in nearly perfect
- Average transmitted voltage(2007): 159kV (in 154kV line), 352kV (345kV line)
- Voltage maintaining criteria of 154kV line: light loads(156 ± 4 kV), load fluctuation (157 ± 4 kV), heavy loads(160 ± 4 kV)
- Voltage maintaining criteria of 345kV line: 353kV(336~360kV)

 Special issues of power quality in demand side have not raised yet.

Market Access of DER

❏ Mandatory market pools for electricity transactions

- ▶ Generators above 200kW which want sales should register to KPX
- ▶ Only KEPCO purchases all the electricity from the pool
- ▶ DG/renewables is treated as the one of market participation entities.

❏ Compensate the market participation renewables with feed-in tariffs

- ▶ The government compensates eligible renewable generators for any shortfall between the pool price and feed-in tariffs.
 - Renewable standard prices(KRW/kWh, in 2007): PV(700), Fuel Cell(283), Wind(107), Small Hydro(95)

< Registered Generation Capacity to the Korean Electricity Markets (unit: GW, as of 2008) >

	Hydro*	Coal	Oil	LNG	Nuclear	CHP	Renewables	Sum
Capacity	5.5	20.5	5.4	17.9	17.7	0.9	0.4	68.3
Share(%)	8.0	30.0	7.9	26.3	25.9	1.3	0.5	100

* Hydro(5,492MW): Large(1,528MW), Small(64.0MW), Pumped Storage(3,900MW)



감사합니다.

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