산업통상자원부
Ministry of Trade,
Industry and Energy

Energy Transition in Korea

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Chairman of Korean Electricity Regulatory Committee (KOREC)

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Basic Plan for Electricity Demand & Supply (Dec. 29, 2017)

➢ Reflects the Energy Transition Philosophy

Major Considerations

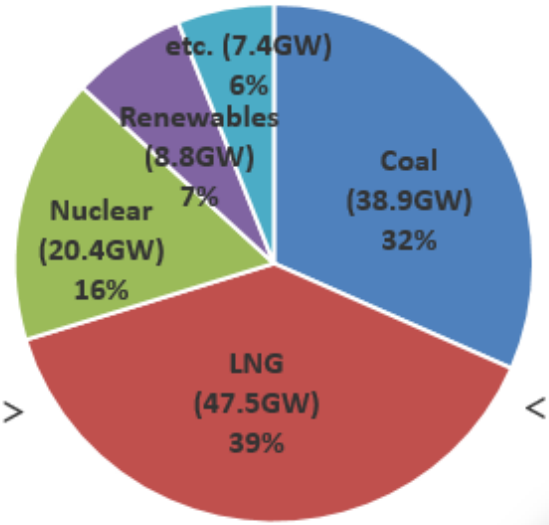
	7th Basic Plan (2015)	8th Basic Plan (2017)
Peak Demand Forecast	127.3 GW	114.0 GW
Energy Consumption	766.1 TWh (2029)	580.4 TWh (2031)
Demand Side Management	15.3GW	13.2GW
Reserve Rate	22% (15% reliability + 7% forecasting error)	22% (13% reliability + 9% forecasting error)

Target year of 7th : ~ 2029
Target year of 8th : ~ 2031

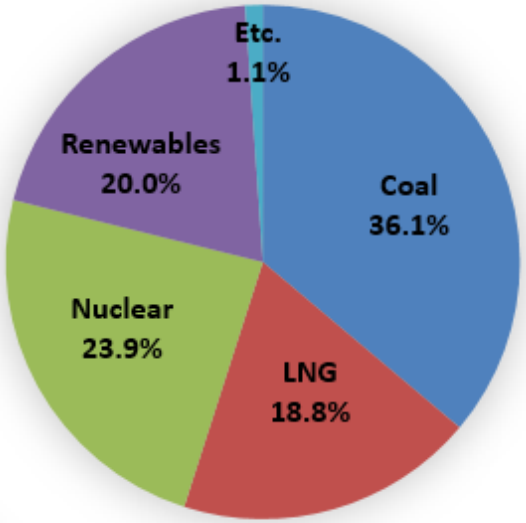
Basic Plan for Electricity Demand & Supply (Dec. 29, 2017)

➢ Changes in Fuel Mix & Generation

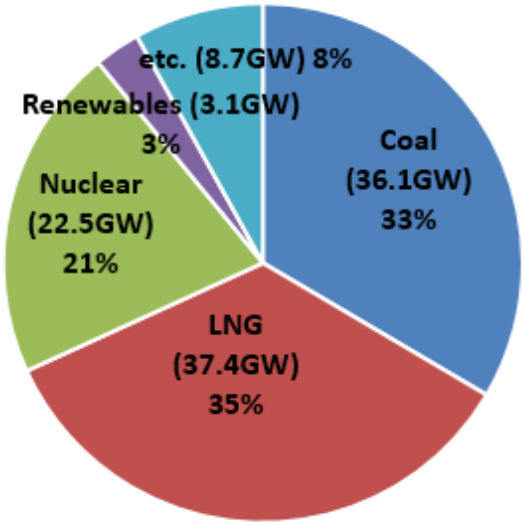
< Effective Capacity by 2030 >



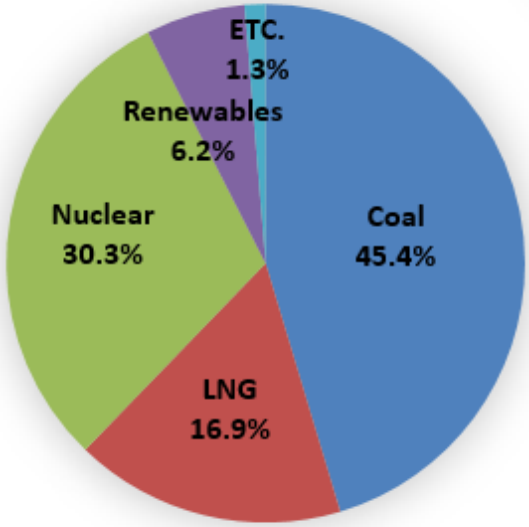
< Generation in 2030>



<Effective Capacity by 2017>



<Generation in 2017>



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Energy Transition Roadmap (Oct. 24, 2017)

➢ Gradual Phase-out of Nuclear reactors for next 20 years

- Suspensions of reactor construction(2) : Resume & Complete
- New Reactors Construction Plan(6) : Cancel
- Aged Reactors(11) : No Life Extension
- Reactor in extended Operation(1) : Early Decommission

	2017	2022	2031	2038
Number of Reactors	24	28	18	14
(change)		+5, -1	-10	-4
Capacity	22.5GW	28.9GW	20.4GW	16.4GW

Source: MOTIE, 'Energy Transition Roadmap' (2017.10.24)

Renewable 3020 Action Plan (Dec. 20, 2017)

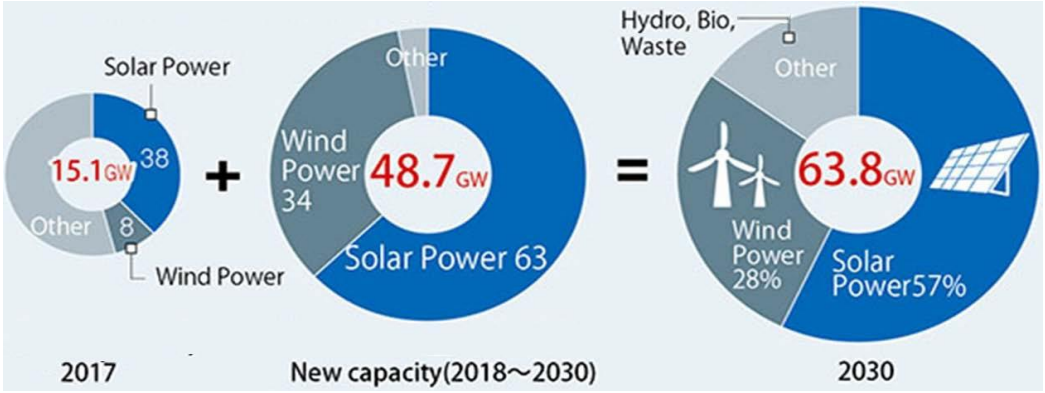
➢ Renewable Target of 20% of the total generation by 2030

– Provide 48.7GW of new installation of the renewable capacity

– Develop more PV and wind projects, which will account for over 95% of the newly install renewable capacity

– Reduce current high reliance on the waste and bio energy in the renewables

< Renewable capacity additions by 2030 >



Source: MOTIE, 'Renewables 3020 Action Plan' ('17.12.20)

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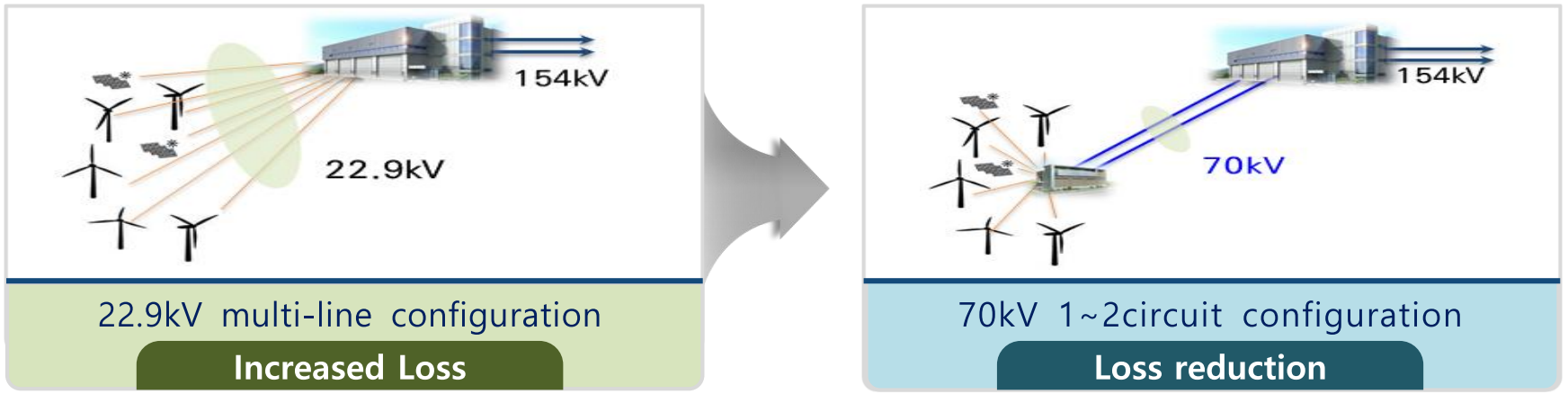
Renewable 3020 Action Plan (Dec. 20, 2017)

➢ 70kV Application & HVDC Plan for Renewables

– For the Renewable Generation connection (40~100MW scale)

– Improvement of 22.9kV multi-lines connection → 70kV 1~2circuits



– 35kV distribution voltage is also under consideration

– Several HVDC Projects are potentially expected for accepting offshore wind power

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Renewable 3020 Action Plan (Dec. 20, 2017)

➢ "Northeast Asia Supergrid" Concept

– Joint development and utilization of renewable energy

– Joint strategy for global climate change & environmental pollution

– Overcoming the geographical limit of 'Isolated system' by sharing reserve power with neighboring countries

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Reform Direction in Market & Regulation

- Rationalization of electricity market
  - Bilateral contract market
  - Improved spot market, real-time market & ancillary service market
  - System flexibility
- Interaction of wholesale and retail market
  - Time-varying electricity pricing
- Liberalization of retail market
  - Opening the retail electricity market

Reform Direction in Market & Regulation

➢ Promotion of new energy business

– 8 Business Models in New Energy Industry (April, 2015) : ESS, EV, Solar Energy Rental, Zero-Energy Buildings, Eco Energy Towns, Energy Independent Islands, Exchange Market of Demand Resource, etc.

– Strategy for boosting new energy industry (Nov. 23, 2015) : Energy Prosumer, Low- Carbon Power Generation, Electric Vehicle, Pro-Environmental Manufacturing Process.

– Small-sized distributed resource market : aggregators

Reform Direction in Market & Regulation

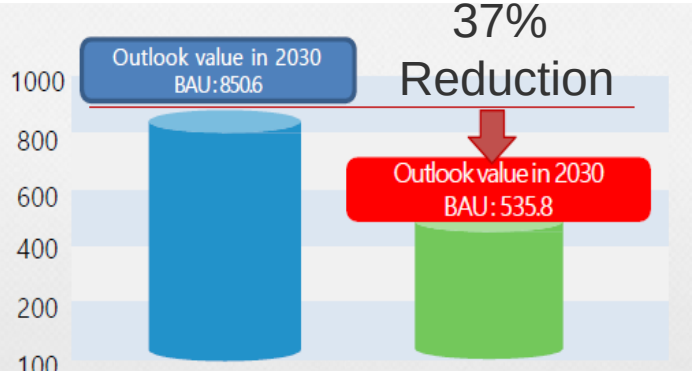
➢ Mandatory environmental dispatch by law (March, 2017)

– Greenhouse Gas in generation sector

- 258 million tons (7th)
- 237 million tons (8th)

– Fine Dust : Reduction of 62% by 2030

- Early retirement of 10-aged coal-fired generators
- Seasonal shutdown of coal-fired generators aged over 30 years in spring
- Converting fuel from coal to LNG



[CO_2 Reduction Target until 2030]

Year	2017	2030	
		7th Plan	8th Plan
Fine Dust (PM2.5)	34	30 (12%▼)	13 (62%▼)
Pollutants	174	162 (7%▼)	65 (62%▼)

[Outlook on fine dust and Pollutant Emissions (Unit: 1,000 t)]

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Illustrative Impact of Tentative Market Renewal in Korea

	Scheduling	Ancillary Services	Trades a day	Settlement
Current Market	• A Constrained schedule determines dispatch (MW). • An Unconstrained schedule sets the market clearing price.	Pre-allocation of MW for reserves and administratively set prices	Once a day before a delivery day	Single settlement w.r.t. day-ahead market prices
Market Renewal	Single Schedule System	Joint provision and pricing of reserves and energy	Multiple adjustments (intraday markets and real-time markets)	Two or more settlements w.r.t. day-ahead and real-time market prices

Illustrative Impact of Tentative Market Renewal in Korea

➢ The generation cost can be reduced by **joint provision and adjustment of energy and reserves, not by sequential provision.**

Comparison of generation cost during Jan. 2017 (Million USD)

	Current market (Sequential provision)		Joint provision of energy & reserves	Difference
	Actual*	Simulation	Simulation	
Generation cost	* Based on the market report	1,857	1,811	-45 (▼2.4%)
Start-up & shutdown cost		3.68	3.63	+0.05 (▲1.4%)
Reserve shortage cost (Penalty = USD 1,000/MWh)		-	0.07	
Total cost	1,821	1,860	1,815	-45 (▼2.4%)

Source: Wook Kim et al., A Study on the co-optimization of energy and reserve market : a Korean case study, PNU Working paper, 2018

➢ Best use of **existing** flexible resources by market renewal will reduce the overall system cost.

Illustrative Impact of Tentative Market Renewal in Korea

➢ **We expect the followings from Tentative Market Renewal:**

- **Adjustments by intraday market** will help to **respond to uncertainty of renewables** as well as existing demand uncertainty & failure of power plants.
- **Joint provision of energy and balancing services** will reduce **system cost** and make best use of **existing** resources.
- Joint provision of power across **multiple hours** will reduce **system cost**.
- Participation of **demand side** in intraday and balancing markets will give **more flexibility** to the power system.

Thank You

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Appendix: Korean Statistics

Source : CIA World FactBook(2017), IEA(2016), MOGAHA, KPX, KOSTAT

14 : Economy (GDP : $ 1,929 billion)

8 : CO2 Emission

28 : Population (51 million)

8 : Petroleum Import

10: Power Consumption (495 TWh)

97% Oversea Energy Dependency

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Appendix: Korea Power System Overview

☐ Generation Capacity

- 107.1 GW in Feb. 2017

☐ Peak Load

- 85.2 GW summer peak in Aug. 2016

☐ Total Consumption

- 497.0TWh in 2016
- Industry 56.1%, Commercial 21.9%, Residential 13.7%, etc. 8.3%

☐ Load Factor

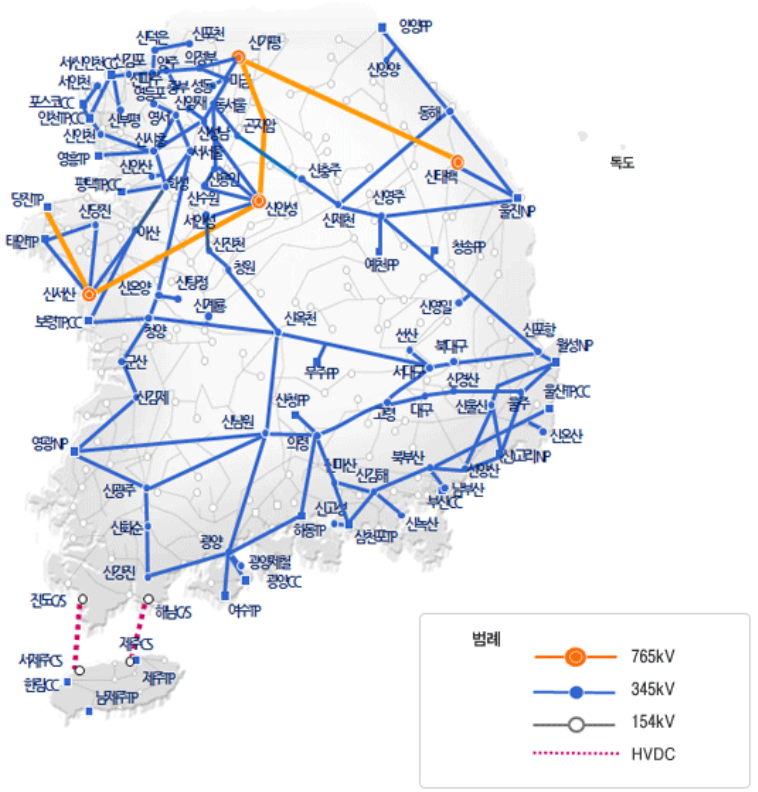
- 70.7 in 2016

☐ Transmission Systems

- 765kV, 345kV, 154kV
- HVDC from the main land to Jeju Island(100km)

#1 HVDC : 300 MW(150MW×2, ±180kV,
#2 HVDC : 400 MW(200MW×2, ±250kV)

Transmission Systems



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