

Promotion of Investment for Highly Efficient Coal Power Generation

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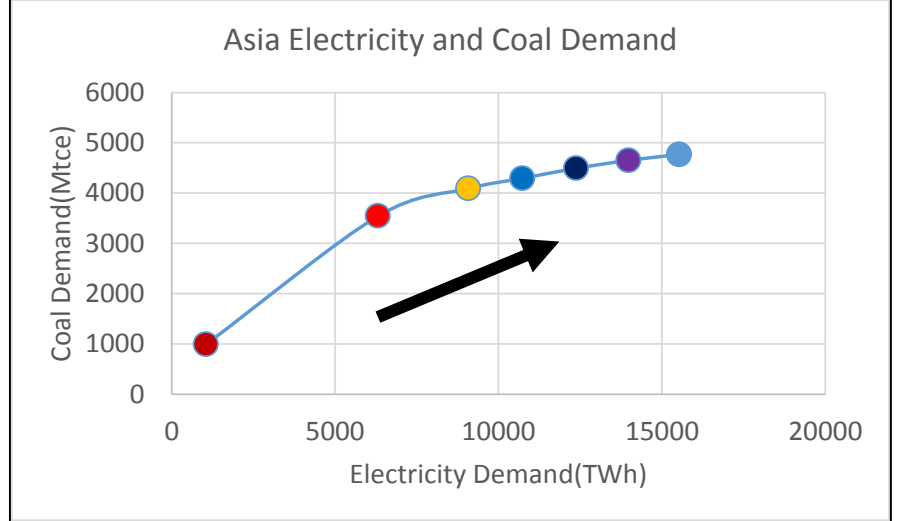
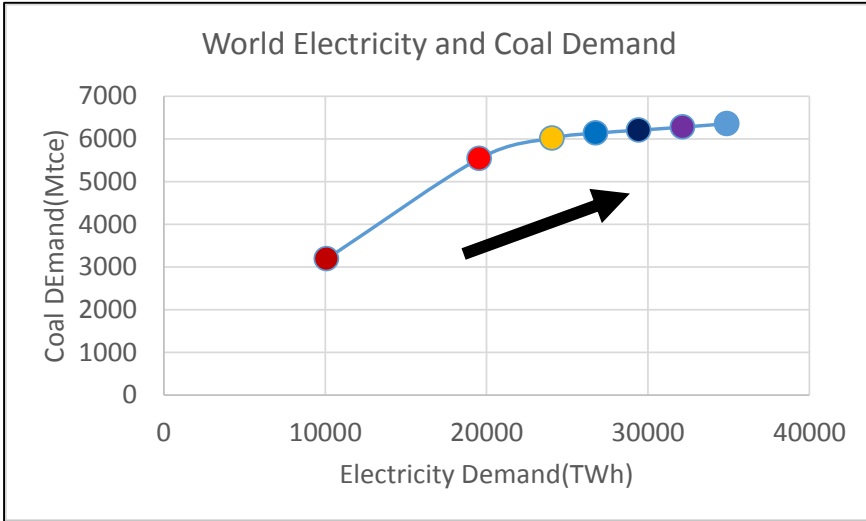
JCOAL



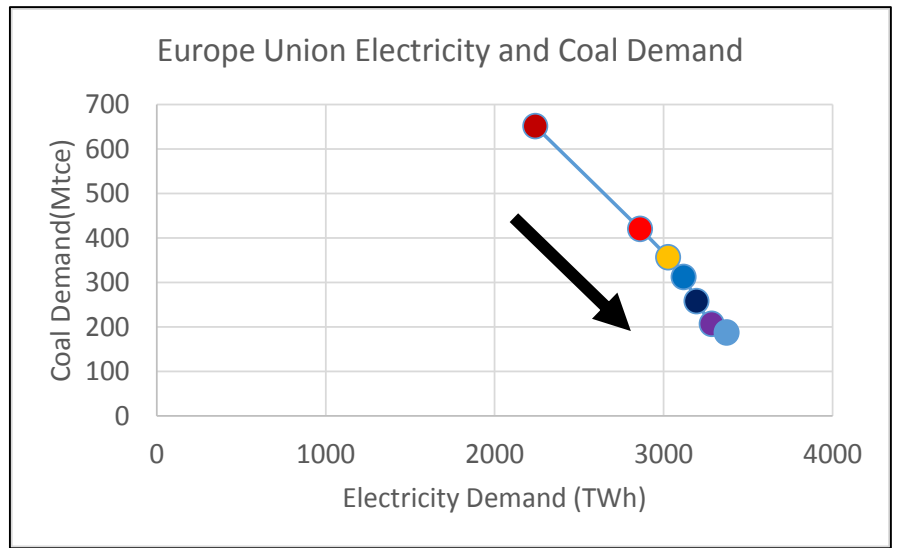
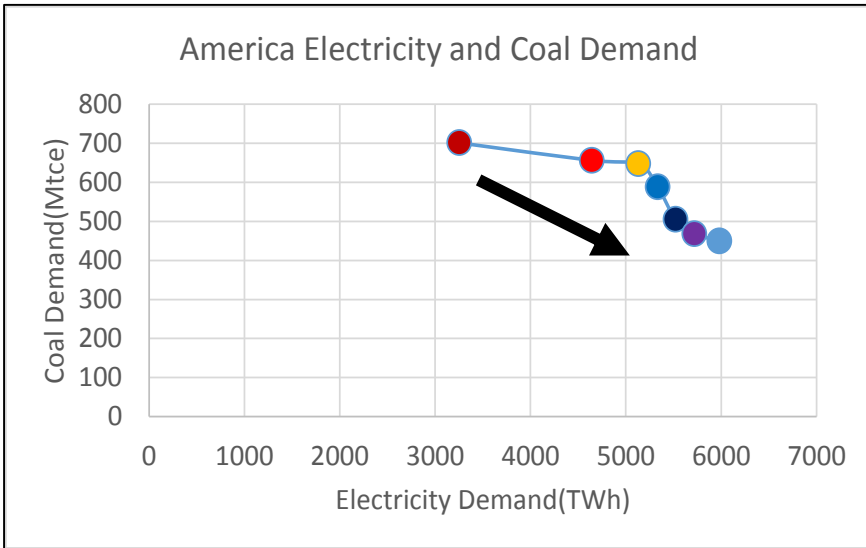
CONTENTS

- 1. Coal and Electricity Demand**
- 2. Clean Coal Technology**
- 3. Expect for Future Coal Power Generation**
- 4. Life Cycle Cost of USC**
- 5. Conclusion**

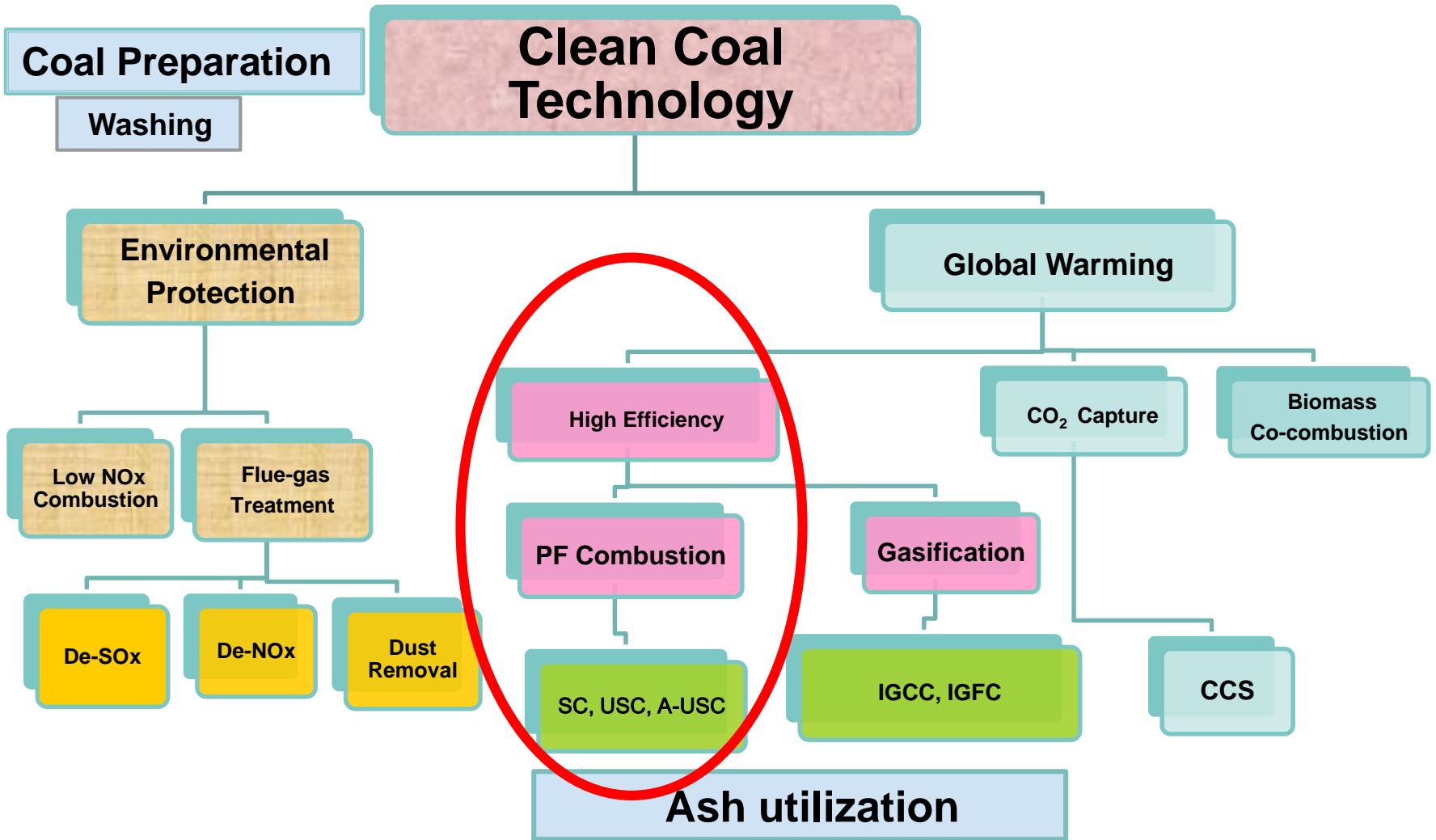
1. Coal and Electricity Demand



Trend for 50 years : 1990, 2012, 2020, 2025, 2030, 2035, 2040

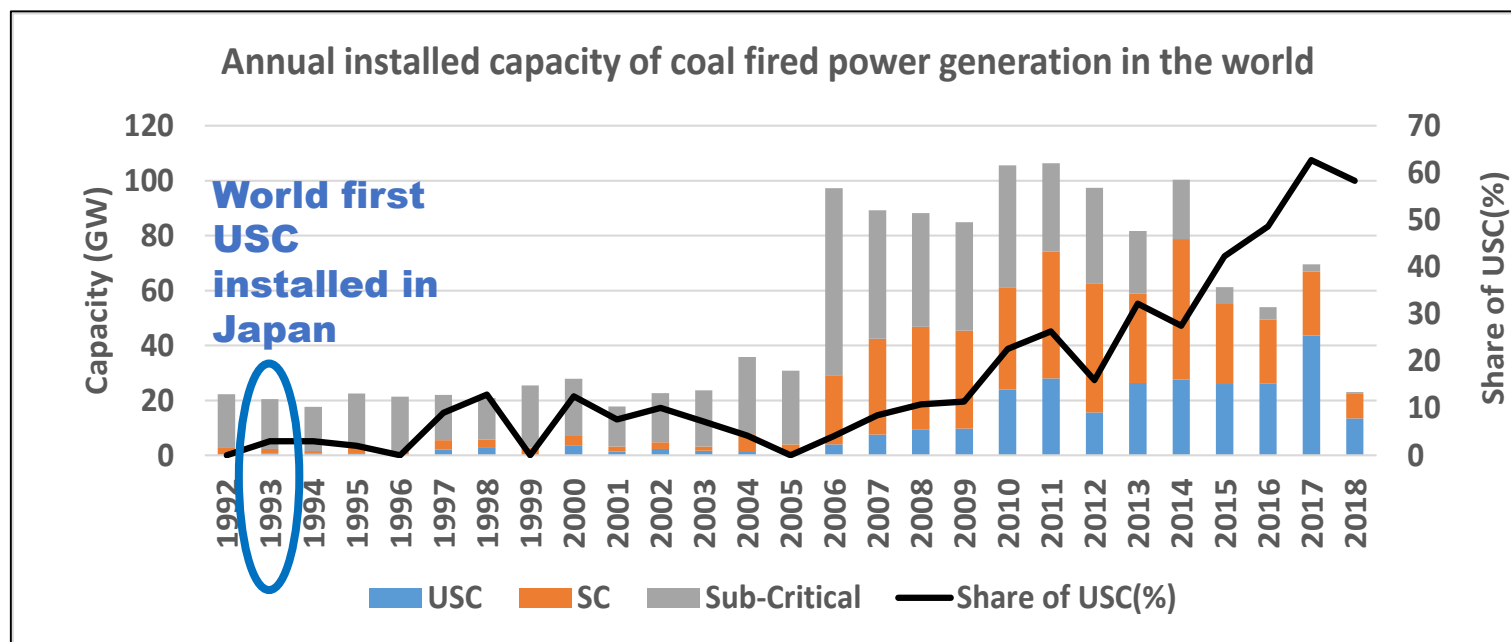


2. Clean Coal Technology

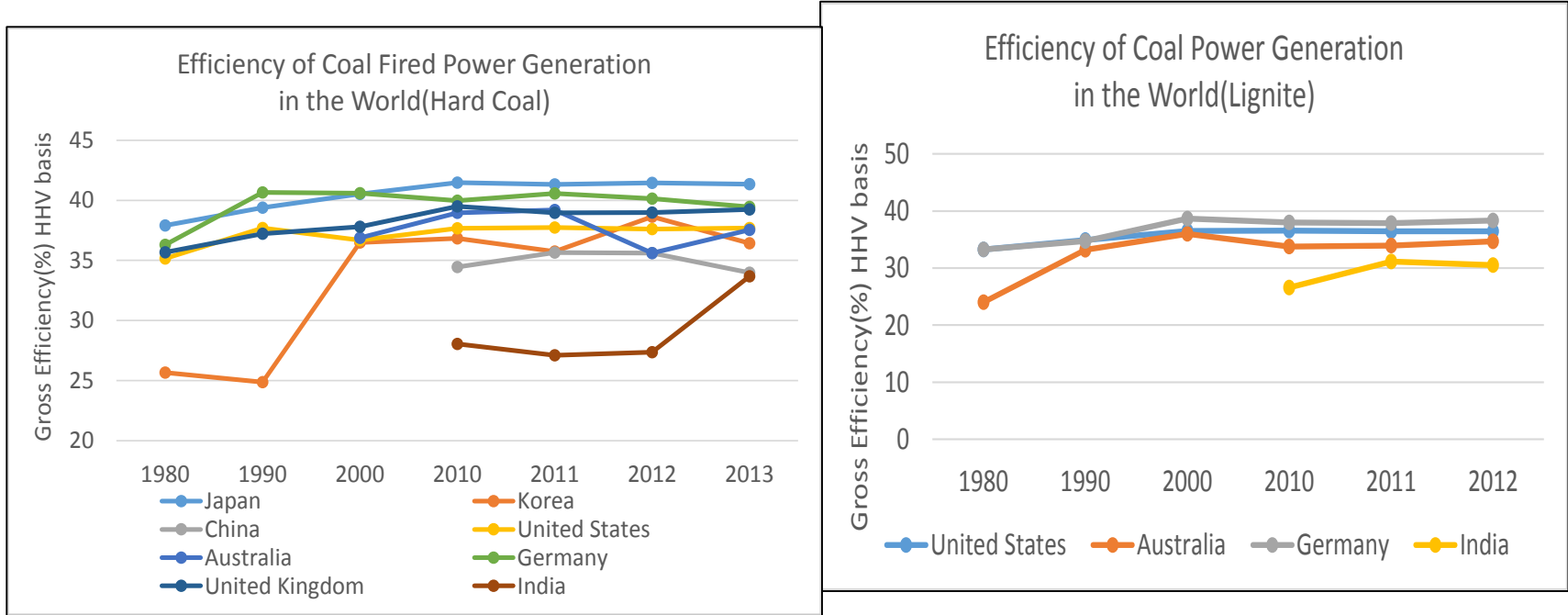


Installation of USC in the World

- **First Ultra Super Critical Unit (USC) was installed in Japan in 1993.**
Since then, USC is increasing RAPIDLY and Super-Critical and Sub-Critical units are decreasing.
- **60% of recent installation is USC in the world.**
SC is less than 10% and Sub-Critical is small number.
- **Countries where USC were already operated:-**
Japan, Germany, Italy, Poland, Czech Republic, Netherland, Slovenia, USA, China, Korea, Taiwan, Malaysia,
- **Countries where USC is planned:-**
Greece, Indonesia, India, Philippines, Morocco, Vietnam



Efficiency of Coal Power Generation in Various Countries (HHV, gross heating value basis)



Hard Coal

Lignite

**IEA Electricity Information 2015 :
Calculated by JCOAL**

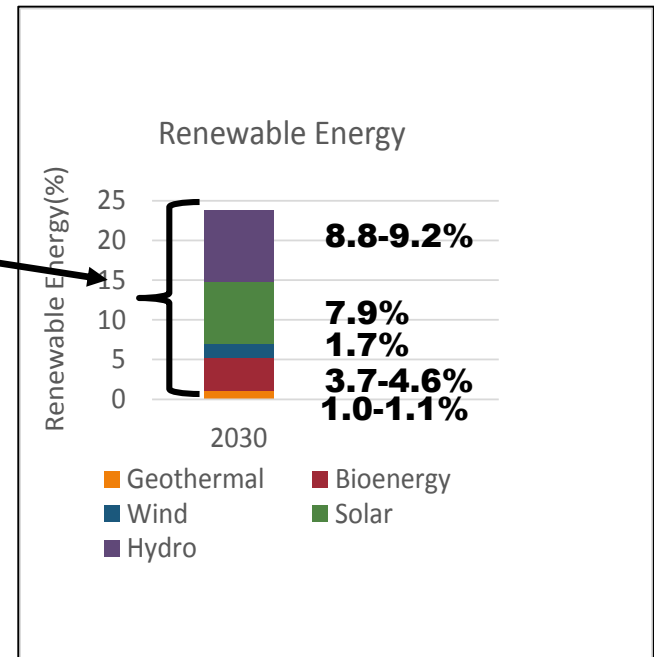
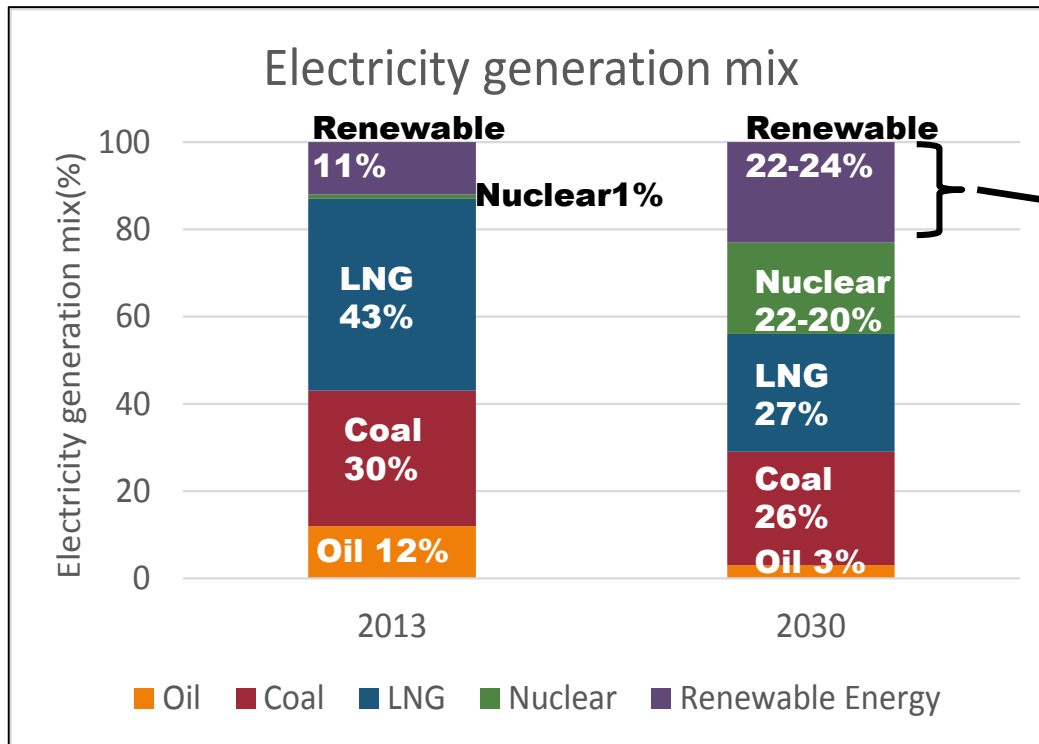
World Highest Efficient Coal fired Power Station ---Isogo No.2 600MW 600/620C USC (Japan)---



Efficiency :
Gross 44%
Net 41%
(HHV Basis)

Electricity Generation Mix of Japan

- July 2015, Japan's New Energy Mix towards 2030 was decided.
- The basic policy of "Energy Mix" is to realize a balanced power source composition, while achieving 3E+S(Safety, Energy Security, Economic efficiency and Environment).
- Coal is positioned as the important energy source to be used while the environmental burden.

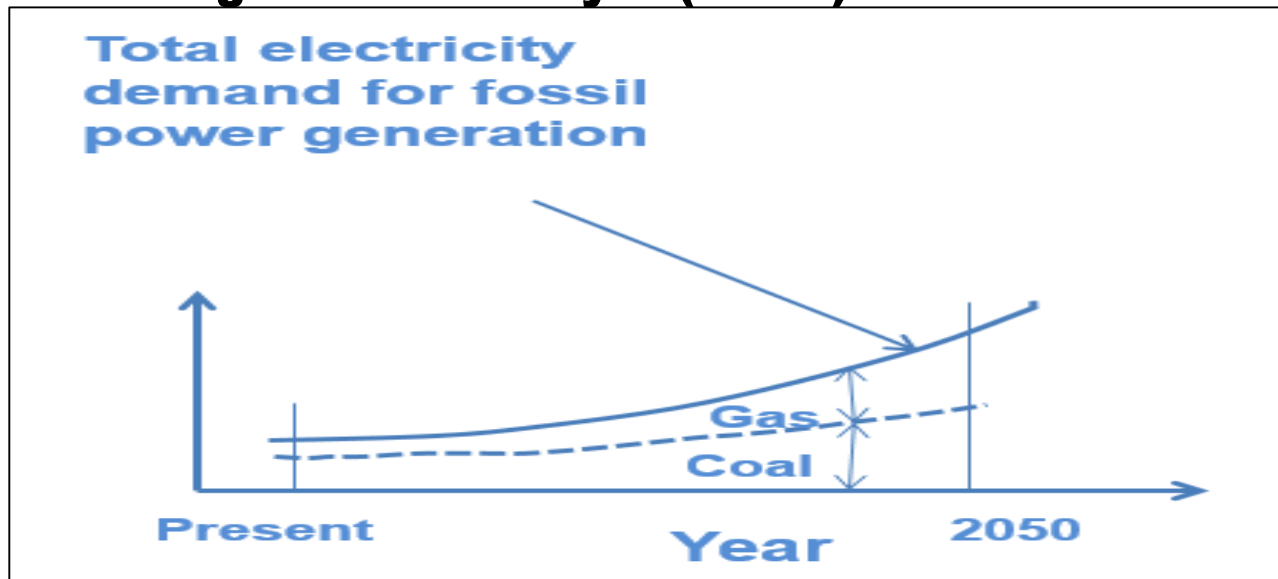


METI Website

3. Expect for Future Coal Power Generation

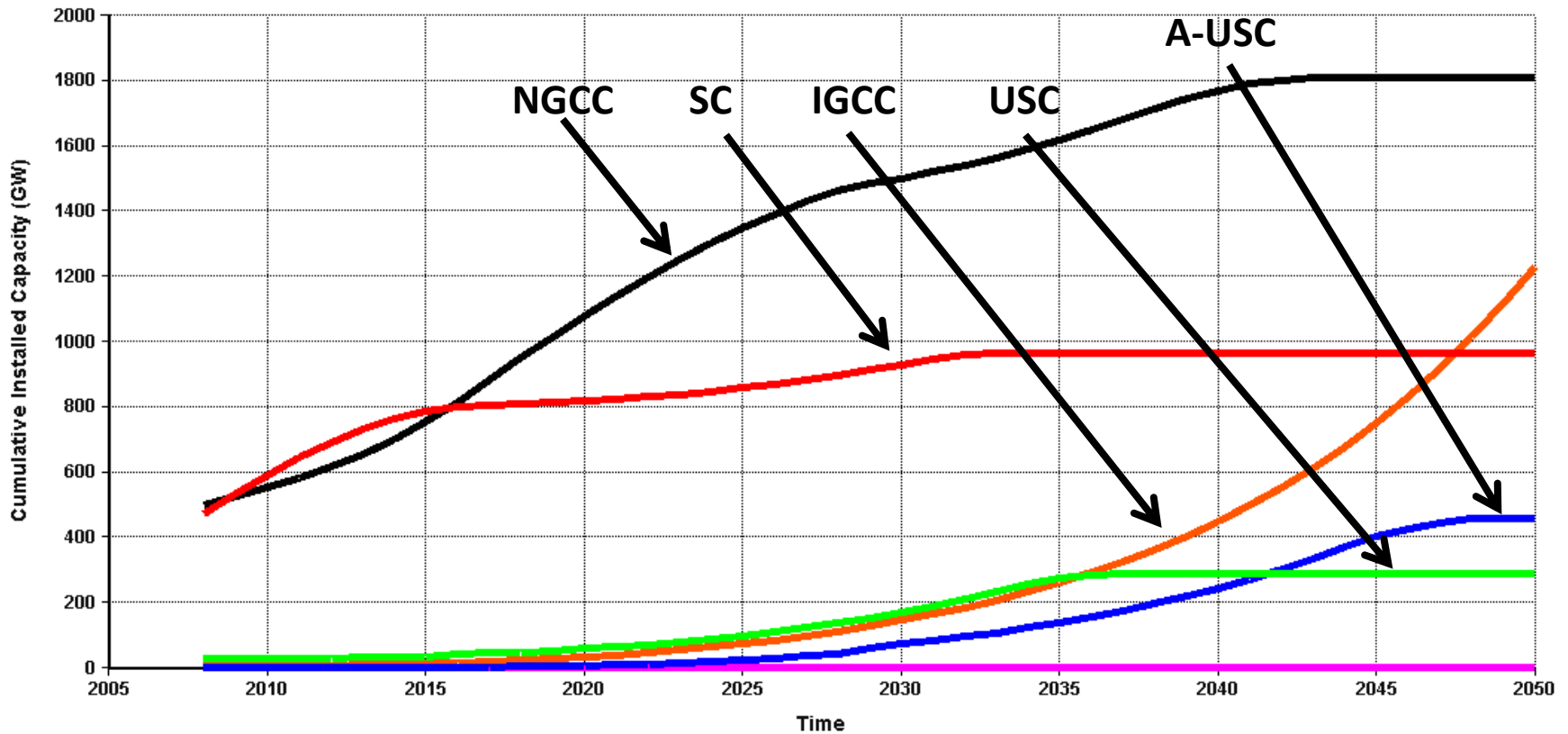
Competing plants are:-

- **Super critical unit(SC)**
- **Ultra supercritical unit(USC)**
- **Advanced ultra supercritical unit(A-USC)**
- **Integrated gasification combined cycle(IGCC)**
- **Natural gas combined cycle(NGCC)**

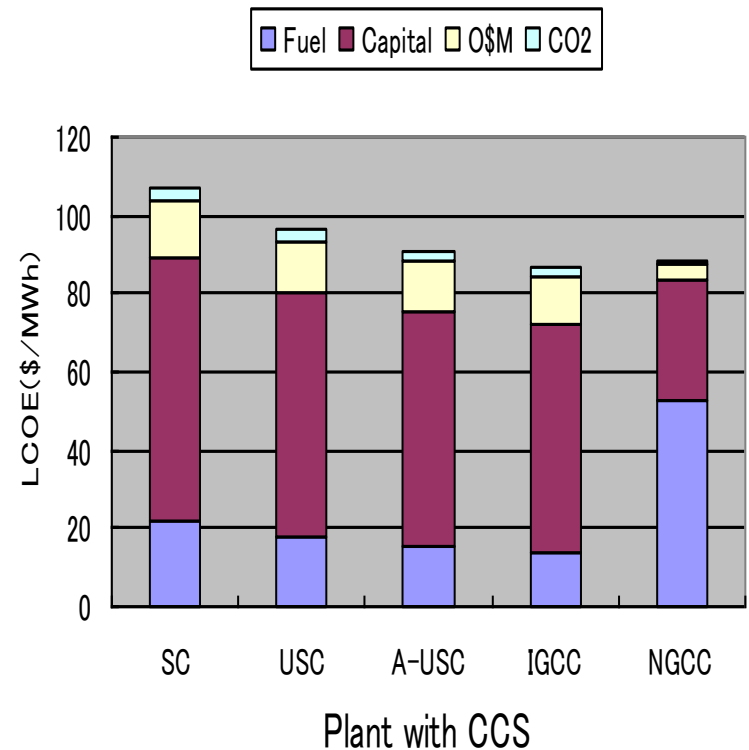
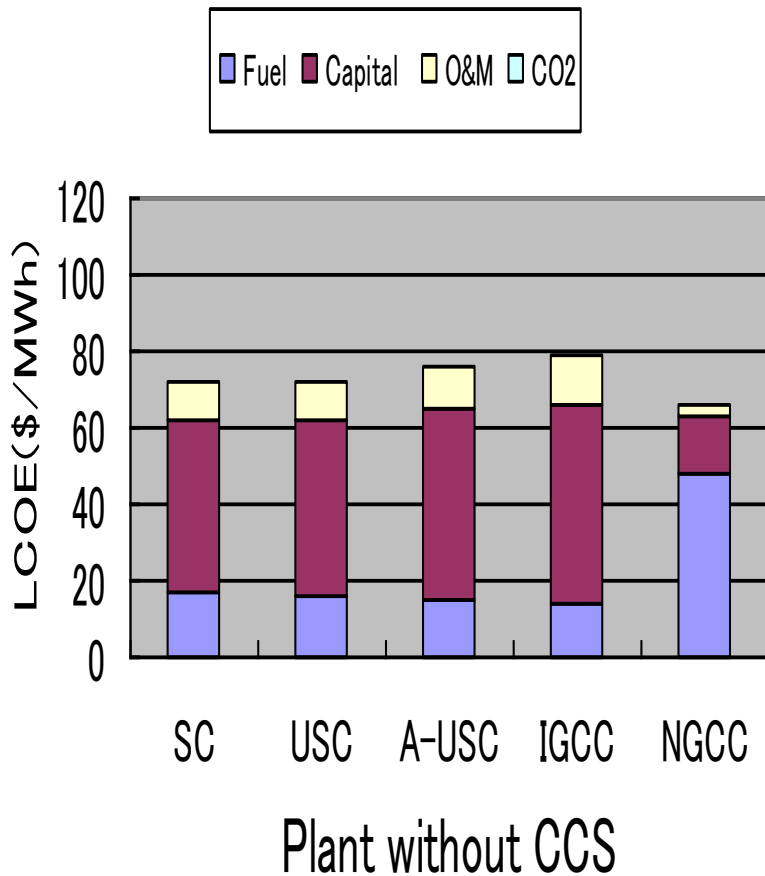


JCOAL Simulation

Cumulative Installed Capacity of Plants when CCS is equipped



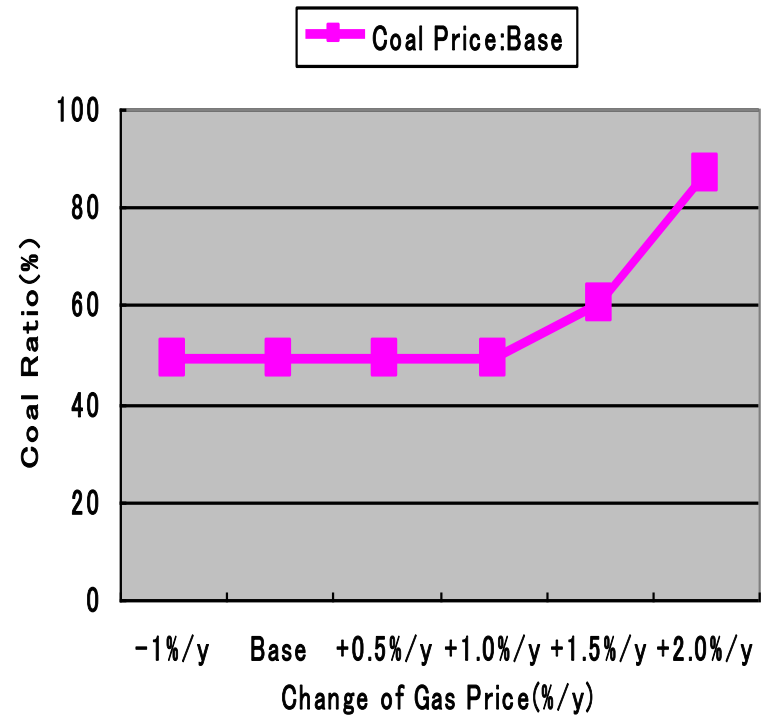
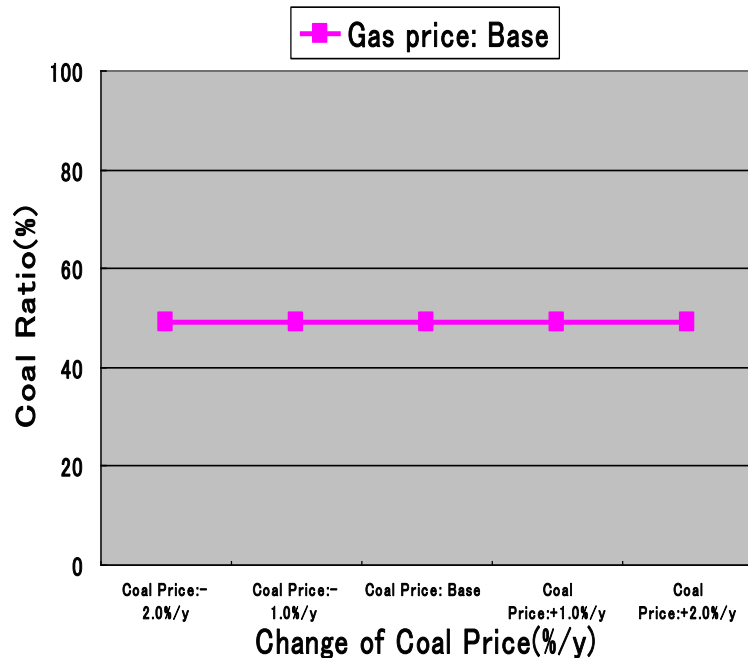
Breakdown of LCOE (Base case at 2030)



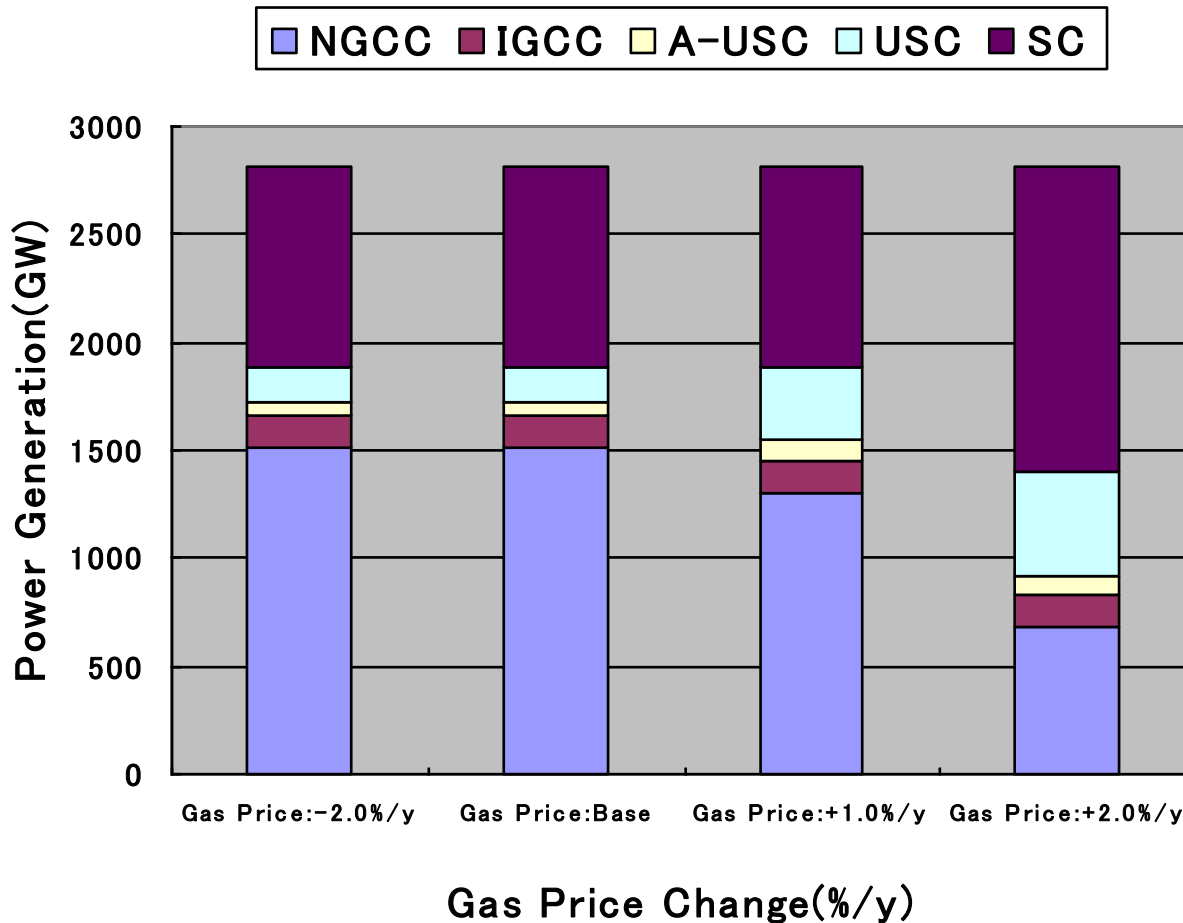
- Capital cost is biggest for coal fired power plants, but fuel cost is biggest for NGCC.
- LCOE of plants with CCS is higher than without CCS case (when carbon tax is not applied).
- LCOE of IGCC is lowest among all the plants when CCS is equipped, but highest without CCS.

Effect of coal and gas price change for the share of coal and gas

Change of Coal Ratio(%) at 2030(without CCS)



Share of plants when CCS is equipped (at 2030) when natural gas price is changed (Coal price is constant)

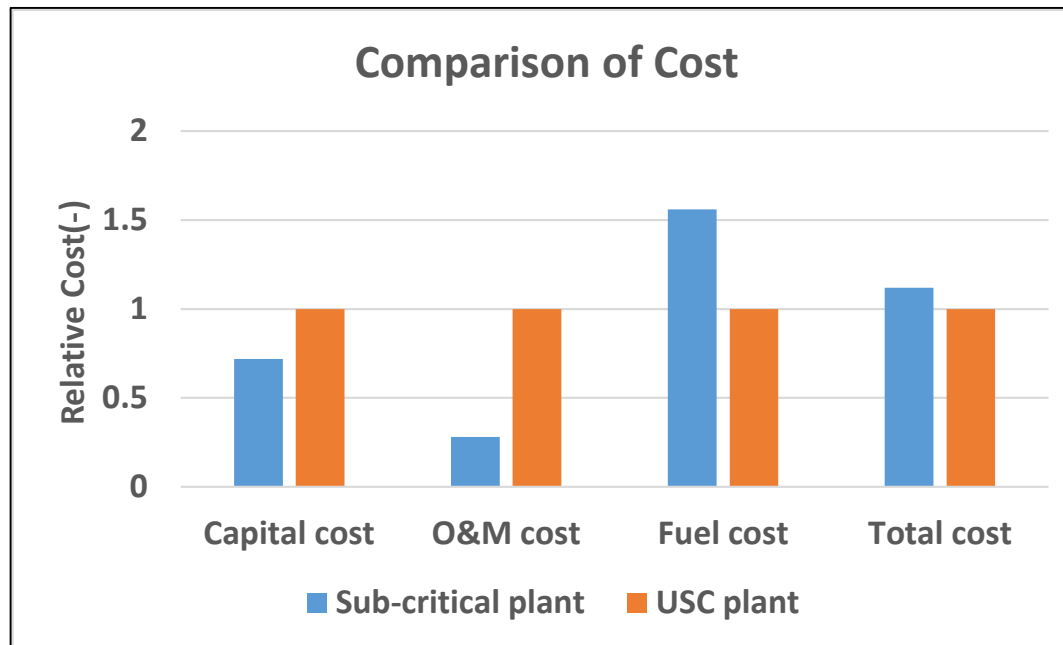


• Share is not changed when gas price goes down, but share is changed much for higher gas price.

4. Life Cycle Cost of USC

- **Total cost of USC is smaller when compared with Sub-Critical unit, when studied about the case in developing country.**
- **Conditions of estimation:-**

	Net thermal efficiency	Load factor	Data source
USC	0.4	0.8	CRIEPI
Sub-Critical	0.26	0.73	ECOFYS 2013



5. Conclusion

- **Coal is the essential fuel in many countries.**
- **However, coal should be used by installing Clean Coal Technologies.**
- **High efficient USC(or HELE) will play a major role for coal power generation.**
- **Life cycle cost of USC is smaller than Sub-critical units. USC is already commercially used widely in the world.**
- **Investment for USC should be considered for the next project.**
- **Japanese government will contribute by USC technology for reducing global warming gas in the world.**