Chapter 4

The Development of Technological Potential Map for CCT Dissemination in the EAS Region

Study on the Strategic Usage of Coal in the EAS Region Working Group

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CHAPTER 4

The Development of Technological Potential Map for CCT Dissemination in the EAS Region

1. Importance of the Technological Potential Map

Table 4-1 gives an overview of regulations related to coal-fired power stations in various countries in the EAS region, as well as the EU and United States as a reference. Environmental regulations on emissions from coal-fired power stations are already in place in most countries. The main difference is the stringency of the emission regulations, with developing countries often having less stringent regulations compared to regulations in developed countries.

On the contrary, regulations on the thermal efficiency of coal-fired power generators generally have not been implemented in developing countries as well as developed countries. In liberalized markets such as in Europe (and US to some extent, depending on state), the economic rationale for efficient technologies is set in the market, and therefore, the most efficient and economical technologies are usually deployed. In Asia, most markets remain regulated, and coordination of policies is necessary to promote the deployment of more advanced generation technologies.

Table 4-1:Coal-fired power station regulations

	Australia	China	India	Indonesia	Japan	Korea	Thailand	Viet Nam	EU	US
Unit capacity regulation			None	None					None	None
Efficiency regulation			None	None						
CO2 Regulation	Carbon tax AUD25$				Oil and coal Tax				CO2 certificate	Proposed
NOx and SOx regulation		(mg/m3) NOx 100 W-type, CFB 200 SOx New 100 Existing 200 Key region 50	None	(mg/m3) NOx 750 SOx 750		(ppm) NOx 80 SOx 80	(ppm) NOx 350 SOx >500MW 320 300-500MW 450 <300MW 640	(mg/m3) Cmax=C x Kp x Kv C: NOx >VM10% 650 <VM0% 1000 SOx :500 Kp(Scale factor) <300 MW : 1 300-1200MW: 0.85 >1200MW:0.7 Kv(Reginal factor): 0.6 ~1.4	(mg/m3) NOx 500 until 2015 then 200 SOx New 200 Old 400	(mg/m3) NOx New 117 NOx and SOx 160 (1997-2005) 640 (before '96)
Particulate matter regulation (mg/m3)		30 Key region 20	>210MW 150 <210MW 350	100		>500MW 20 <500MW 30	120	C: 200	50	22.5
Mercury regulation		0.03	None			None			0.03 (Germany)	0.001 0.002

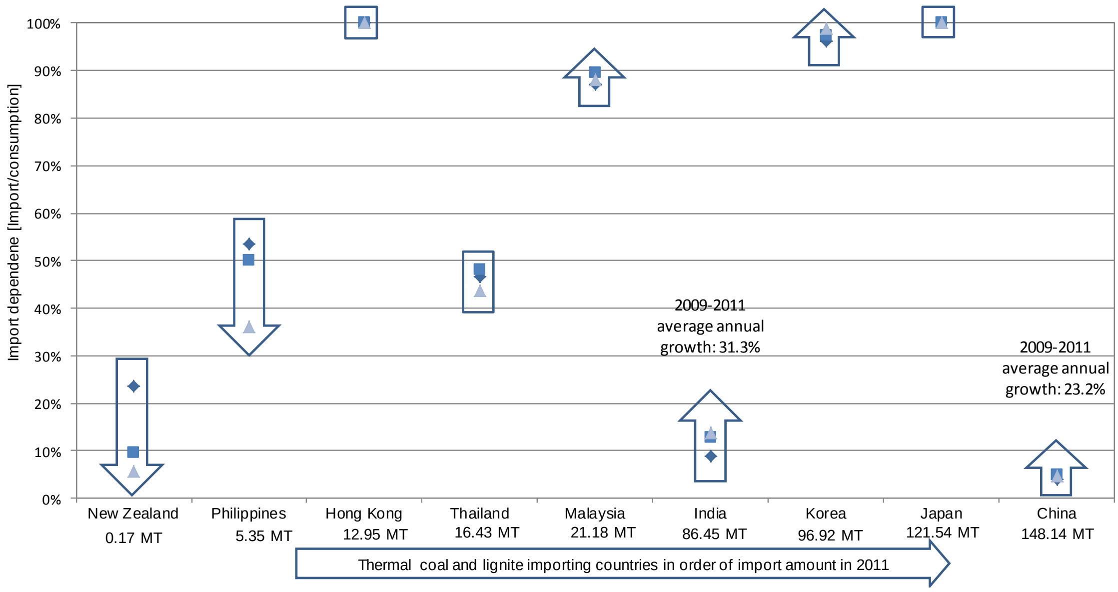
Efficiency regulation not in place

Source: From various sources.

The thermal efficiency of power stations can have a severe impact on coal imports. Figure 4-1 shows the coal import dependency of the major importing countries in the EAS region. For Hong Kong, Thailand, and Japan, import dependence remained unchanged at 100%, and Korea's import dependence is nearing the 100% mark, at 98.8% in 2011. These countries require highly efficient technologies in order to minimize imports.

Although China and India still have access to domestic coal resources, import dependence has been increasing from 2009 to 2011 (China from 4% to 5%, and India from 9% to 15%). As China's and India's coal demand is large in absolute terms, and as imports are increasing, more advanced coal-fired power stations are necessary.

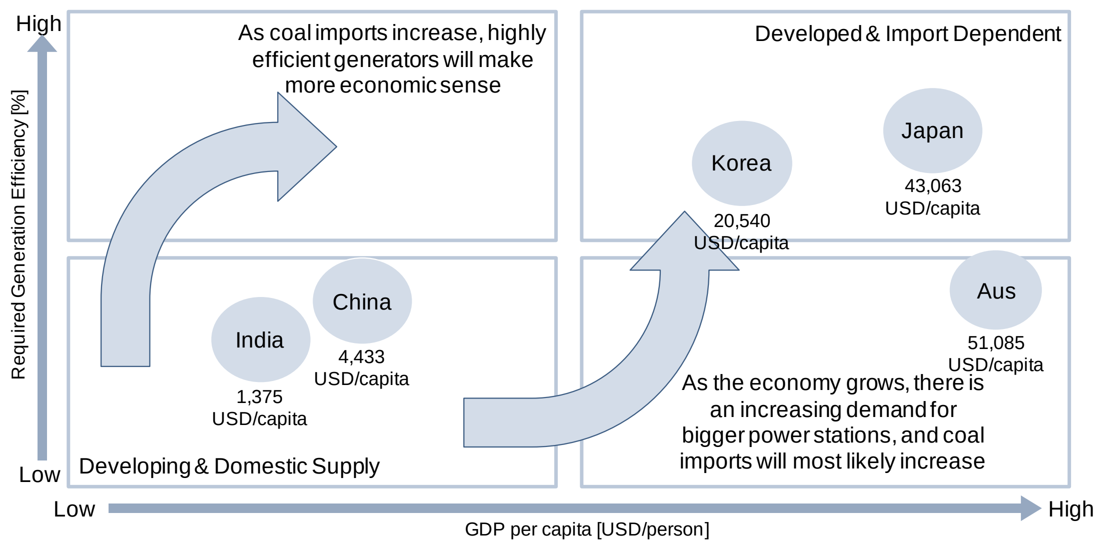
Figure 4-1:Coal import dependency



Source: Compiled from IEA Coal Information 2012

Figure 4-2 shows the need for different policies in different countries according to their respective stage of economic development. Developed countries are usually highly dependent on thermal coal imports, and therefore technologies deployed in these countries have to be as efficient as possible. For emerging countries in Asia, thermal coal imports are expected. The policy guidelines should be set at feasible levels according to the stage of economic development. As the economy develops, it is highly recommended to increase investment in efficient technologies.

Figure 4-2: Countries' status and required policy levels



Source: World Bank data.

In order to stimulate investments in highly advanced generation technologies appropriately, several technological potential maps need to be formulated, respecting the different stages of economic development across the EAS member countries. Figure 4-3 shows the necessary guidelines which need to be included in the technological potential map. By providing the technological potential map, which defines feasible efficiency levels, as well as environmental performance and maintenance criteria of CCT, EAS member countries are able to select and introduce the best CCT appropriate for their current stage of development.

Upon the completion of this research, a "practical" technological potential map including the above mentioned items will be developed.

Figure 4-3: Image of the technological potential map

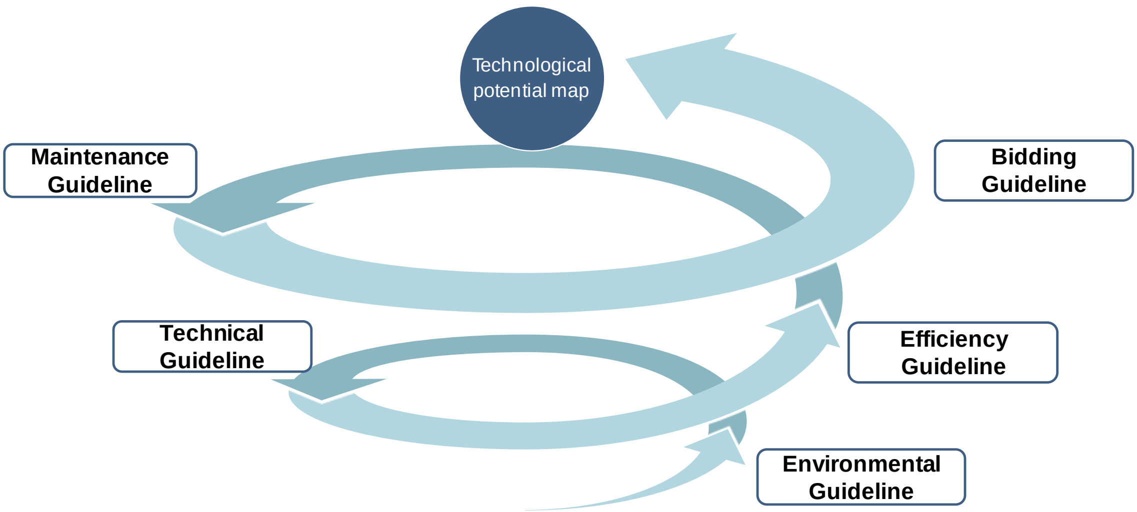


Table 4-2 gives an example of a technological potential map, in which thermal efficiency, investment costs, maintenance costs, fuel consumption and CO_2 emissions are compared for Ultra Super Critical (USC), Super Critical (SC) and Sub-critical (C) boiler types. In this case, policy makers can choose which new technology is appropriate for their country. The technological potential map will be updated based on data submitted by the Working Group members in next year's study.

Table 4-2: Technological potential map example

	Boiler Type		
	Ultra Super Critical (USC)	Super Critical (SC)	Sub-critical (C)
Thermal Efficiency	41.5% ~ 45.0%	40.1% ~ 42.7%	37.4% ~ 40.7%
Initial Cost	1,298 mln USD	991 ~ 1,240 mln USD	867 ~ 991 mln USD
Fuel Consumption	2,229,000 tons/year (100%)	2,275,000 tons/year (+2.1%)	2,413,000 tons/year (+8.3%)
CO2 Emission (ton/year)	5,126,000 tons/year (100%)	5,231,000 tons/year (+2.11%)	5,549.000 tons/year (8.3%)
O&M Cost	3.42 mln USD/year	4.1 mln USD/year	5.0 mln USD/year
Generation Cost at USD 100/ton (USD cent/kWh)	4.03 cent/kWh (100%)	4.19 cent/kWh (+3.9%)	4.44 cent/kWh (+10.2%)
Examples	✓ "Isogo" J-POWER ✓ "Tachibanawan" J-POWER ✓ "Nordjylland", Denmark ✓ Xinchang, China	✓ "Takehara" J-POWER ✓ "Matsushima" J-POWER	✓ Taichung Power Plant ✓ Thai Binh 2

Note: Operation is assumed at 75%. Thermal efficiency is LHV. API 6 Newcastle FOB coal = 6,000 kcal/kg. CO_2 emission = 2.30 kg-CO_2/kg.

Figure 4-4 shows the generation cost of USC, SC and C type boilers compared with fuel purchase costs, based on the costs and thermal efficiency values from Table 4-2. Power plants equipped with the latest technology become more economically viable with increasing prices. In the simulation, the generation cost of USC is lower than SC and C type boilers once coal prices are higher than USD 30/ton.

Figure 4-4:Generation cost compared with fuel purchase costs