Webinar on “Clean Coal Technologies in Japan”

5th June 2019

Questions & Answers

1. What does sub critical, super critical, ultra-super critical exactly mean?

The difference between subcritical, supercritical, and ultra-supercritical versions of pulverized coal combustion technology has to do with the steam pressure within the boiler. In a subcritical plant, steam pressure is below 3200 pounds per square inch and temperature is below 1025 degrees Fahrenheit (550 degrees Celsius). Subcritical units have efficiencies of between 33% and 37%; i.e. between 33% and 37% of the energy in the coal is converted into electricity. (www.sourcewatch.org, 2015).

In contrast to subcritical plants, supercritical (SC) and ultra-supercritical (USC), operate at higher steam cycle conditions, hence they use less coal per unit of electricity produced and emit fewer pollutants. Definitions of supercritical and ultra-supercritical conditions vary. However, the following temperature and steam ranges are used frequently: <22.1 MPa and up to 560°C for subcritical steam conditions; 22.1–25 MPa/540–580°C for supercritical; and >25 MPa/>580°C, for ultra-supercritical units (Nalbandian, 2008). The recent USC plants operate with temperatures of 600°C and above (IEA, 2011).

The following table gives an overview on the efficiency and the CO2 intensity factor of the different systems:

Table 1 **CO_2 intensity factors, average (LHV, net) efficiencies and fuel consumption values as a function of plant steam cycle condition** (modified from IEA, 2012; VGB, 2011; Henderson, 2016)

	CO_2 intensity factor	Efficiency (LHV, net)
A-USC (700°C)† IGCC (1500°C)‡	670–740 g CO_2/kWh	45–50%
Ultrasupercritical	740–800 g CO_2/kWh	up to 45%
Supercritical	800–880 g CO_2/kWh	up to 42%
Subcritical	≥880 g CO_2/kWh	up to 38%

† steam temperature; ‡ turbine inlet temperature

Note: the CO_2 intensity factor is the amount of carbon dioxide emitted per unit of electricity generated from a plant. For example, a CO_2 intensity factor of 800 g CO_2/kWh means that the coal-fired unit emits 800 g of CO_2 for each kWh of electricity generated.

(Source: IEA Clean Coal Centre, 2016)

2. Are there any EU Japan projects going on regarding CCT?

The European *CO2 Care Project* (funded by the European Commission) supported the large scale demonstration of CCS technology by addressing the research requirements of CO2 storage site abandonment (http://www.co2care.org/). Partners from the U.S., Canada, Australia and also Japan are involved: the CO2 Storage Research Group of RITE (Research Institute of Innovative Technology for the Earth) is investigating geological CO2 storage capacity in Japan and is developing technology for the safe injection of CO2, safety assessment methodologies and expertise relevant to the establishment of the regulatory framework for CO2 storage. RITE has supported the large-scale demonstration of CO2 geological storage and conducted follow-up research especially with the view of establishing safety assessment methodologies and suitable technologies for CO2 storage in Japan. Within the CO2 Care Project, RITE contributed their experiences in the Nagaoka storage project (https://www.rite.or.jp/English/lab/geological/overview.html). The project ended in 2013 (Report: https://cordis.europa.eu/project/rcn/96609/reporting/en).

The *EU Research Fund for Coal and Steel (RFCS)* funds project for the development of CCT technologies. But there is no evidence for a participation of Japanese industry or academia: https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/research-fund-coal-and-steel-rfcs_en

The *EU-Japan Science Technology and Innovation Projects* do also not contain any project related to CCT or CCS: http://www.jeupiste.eu/eu-japan-science-technology-and-innovation-projects.

3. How about the evaluation and acceptance of CCT technology in Europe and other Western countries?

In Germany, CCS had not been seen as a real opportunity for making coal carbon-free. At least this was the case until French President Macron started the initiative of France and other EU states to realize a CO2 neutral economy until 2050. Chancellor Merkel stated that that it must be discussed how Germany could reach such a goal given the fact that coal is still contributing to the power supply in Germany with 43.6%. Related to this, she also mentioned CCS as one possibility that should be taken into account again to reduce CO2.

The EU, on the other hand, is actively promoting R&D of CCS technologies. The European Commission roadmaps towards 2030 and 2050 have identified Carbon Capture and Storage (CCS) as a central low-carbon technology to achieve the EU's 2050 Greenhouse Gas (GHG) emission reduction objectives.

Here are some related links:

http://www.zeroemissionsplatform.eu/policy-and-regulation.html

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/programmes/rfcs

http://www.co2care.org/Default.aspx?section=376

4. From the view point of SDGs, and for example Paris Agreement, the eco system using this technology seems to be imperfect as still using CO2. So, if Japan tries to promote this technology, which merit and advantage to seek for?

Japan just confirmed its emphasis on commercializing carbon capture and utilization (CCU) technology by 2023, and carbon capture and storage (CCS) used in coal-fired power generation by 2030, in the recently published plans for realizing a carbon neutral society: https://www.eceee.org/all-news/news/news-2019/japan-sets-carbon-neutral-goal-with-focus-on-capturing-emissions/

It seems that there is a strong belief among government officials that CO2 emissions can be really significantly cut down by the most advanced CCT technologies (such as IGCC or IGFC) and CCS technologies.

On the other hand, there is also an interest of the industry to stick with coal-related technology as an export good as it is believed to provide business opportunities also in the future. This might be the expected economic merit which is connected with the strategy.