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Financing New Coal-Fired Power Plants

Guidance Note | 2011

- **Coal is likely to be part of the energy mix for the foreseeable future. Therefore, to limit dangerous climate change, coal-fired power generation needs to be substantially decarbonised by 2050.**

- Deployment of the best available technologies for coal-fired power plants (CFPPs) could raise generation efficiency from today's global average of 34%, to over 50%.

- Financial Institutions (FIs) can help accelerate the uptake of the best available CFPP technologies by adopting policies that stipulate emissions intensity ceilings that become progressively lower between now and 2050.

- Improved generation efficiency and cofiring are necessary, but in the longer-term are inadequate to limit dangerous climate change. Carbon Capture and Storage (CCS) is today the only technology with the potential to make the CFPP emission cuts needed[1]. Fully integrated commercial-scale CFPP with CCS remains to be demonstrated and is unviable for private sector finance at current operating costs and carbon prices, but it is important that CFPPs built now are made 'CCS ready'.

- Policies for CFPP finance should recognise that CFPPs built now may only avoid early retirement and resulting financial losses if technologies that enable them to meet future emissions limits become viable quickly enough.

[1] International Energy Agency, Technology Perspectives 2010: Scenarios and Strategies to 2050 (IEA, 2010)

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Background

Global CO_2e emissions must fall radically between now and 2050 to limit dangerous climate change. During the same period additional new power generation capacity will be installed and in many regions coal will remain the fuel of choice due to its economically competitive and energy security advantages. In 2007, CFPPs generated 42% of global power and 73% of power-related CO_2 emissions[2]. Coal-fired generating capacity will rise 149% by 2050[3] under the business-as-usual scenario, so timely mitigation of CFPP emissions is required if atmospheric CO_2e is to be contained at a relatively low-risk concentration of 450ppm.

Recognising the challenge of reducing carbon emissions while also satisfying increasing power demands, the Climate Principles Financial Institutions (CPFIs) identified the need for guidance on financing CFPPs in the absence of regulation. The Climate Group has developed this guidance note with the CPFIs. The CPFI banks are committed to developing their own policies for financing CFPPs in line with this guidance.

Scope

Developments in renewable energy, nuclear power, and other fossil fuels have a great bearing on the outlook both for global power sector greenhouse gas emissions, and for coal-fired generation. This note's scope is, however, limited to opportunities for private sector financial institutions to direct finance to new CFPPs whose CO_2 emissions are consistent with the IEA BLUE map scenario[4] for power sector emissions.

Key aspects of a policy for CFPP finance

1. Performance Standards

To ensure consistent application, policies for CFPP finance should include measurable performance standards. Standards may be framed in terms of the type of technology installed, the efficiency with which primary energy is converted into electricity, or the emissions intensity at which power is generated. Annex I indicates how technology types equate to energy conversion efficiency, and emissions intensity levels.

From 2011 to 2020, the deployment of best available technologies and practices could deliver limited but indispensable reductions in CFPP CO_2 emissions against a business-as-usual scenario. Key technologies (Super- and Ultra Super-critical Steam Cycles, Combined Heat and Power, Integrated Gasification Combined Cycle, and cofiring with biomass and waste) are discussed briefly at Annex II.

CCS is not ready to be deployed commercially in the power generation sector but, with the potential to reduce emissions from fossil fuel plants by over 90%, it is currently the

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[2] Ibid
[3] Ibid
[4] As described in International Energy Agency Energy Technology Perspectives 2010 (IEA 2010)

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best placed technology to achieve the results needed for the BLUE map scenario. It is therefore important that CFPPs built now are made CCS Ready. Annex IV references a number of definitions of 'CCS Ready'.

Table 1 indicates CO_2 emissions intensity ceilings that are achievable with the best CFPP technologies currently available. It is recognised that these technologies are not capable of limiting CFPP CO_2 emissions intensity to the levels that will be needed from 2020 onwards. Policies should reference the long-term goals for emissions reductions and indicate that policies will be revised to reflect future developments in policy and technology. Table 2 indicates the reductions in CFPP CO_2 emissions intensity from now until 2050 that will be necessary if coal-fired generation is to be compatible with the IEA BLUE Map scenario for a 450ppm pathway.

Table 1: Indicative CFPP emissions intensities achievable today (2011)

Option	**2011 emissions intensity ceiling** *(Net CO_2 emissions intensity - gCO_2/kWh[5])*
Excluding the most polluting CFPPs in developing countries with high emissions intensity levels	830[6]
Ultra Super Critical with Pulverised Coal Combustion	770[7]
CHP and co-firing with biomass	550

Table 2: Indicative CFPP emissions intensities from 2011 to 2050

Period	**2011-2020**	**2021-2030**	**2031-2050**
Emissions intensity ceiling *(Net CO_2 emissions intensity - gCO_2/kWh[8])*	550-830[6]	100[8]-550	100[8]

The 830 gCO_2/kWh ceiling immediately rules out providing finance for the most polluting CFPPs in those developing countries where 830gCO_2/kWh represents a significant improvement over business-as-usual. We would expect that policies will specify much more stringent performance standards in all developed countries and in developing countries that have a track-record of lower emissions intensity levels. Ultra Super Critical boilers can achieve better than 770gCO_2/kWh while cofiring with biomass and Combined Heat and Power could reduce emissions intensity to 550gCO_2/kWh. Beyond 2020 new CFPPs should be equipped with CCS or other technology that limits

[5] Based on Higher Heating Value (HHV) – see definitions for full explanation
[6] IEA Energy Technology Perspectives 2008 performance summary for CFPP Super Critical with pulverised coal combustion (830 *gCO2/kWh)*
[7] IEA Energy Technology Perspectives 2008 performance summary for CFPP Ultra Super Critical with pulverised coal combustion (770 *gCO2/kWh*)
[8] Assumes that CCS or other technology that limits emissions to no more than 100gCO_2/kWh is deployed.

emissions to no more than 100gCO_2/kWh. In exceptional conditions where this is not possible, the ceiling should be no higher than that which can be achieved today (550gCO_2/kWh). From 2031 onwards CFPPs should only be built to operate at or below the 100gCO_2/kWh ceiling.

Implementing the 830gCO_2/kWh ceiling will be more challenging for banks financing smaller plants in developing countries. In these instances, achieving the ceiling will be approached on a best efforts basis, ensuring employment of best available appropriate technology.

2. Review of Performance Standards

Table 1 reflects the urgent need to cease financing the most carbon intensive forms of coal-fired generation. Performance standards should be reviewed regularly as financial institutions learn from the practical implementation of their policies, as CFPP technologies become more efficient, as the scenarios developed by the IEA (in particular the BLUE Map scenario) change over time, and as circumstances in individual countries change. In the longer-term, financial institutions' policies will need to be reviewed as the outlook for timely large-scale deployment of CCS, or other equally efficient emissions reduction technology, becomes clearer. CCS readiness is discussed briefly at Annex III and Annex IV.

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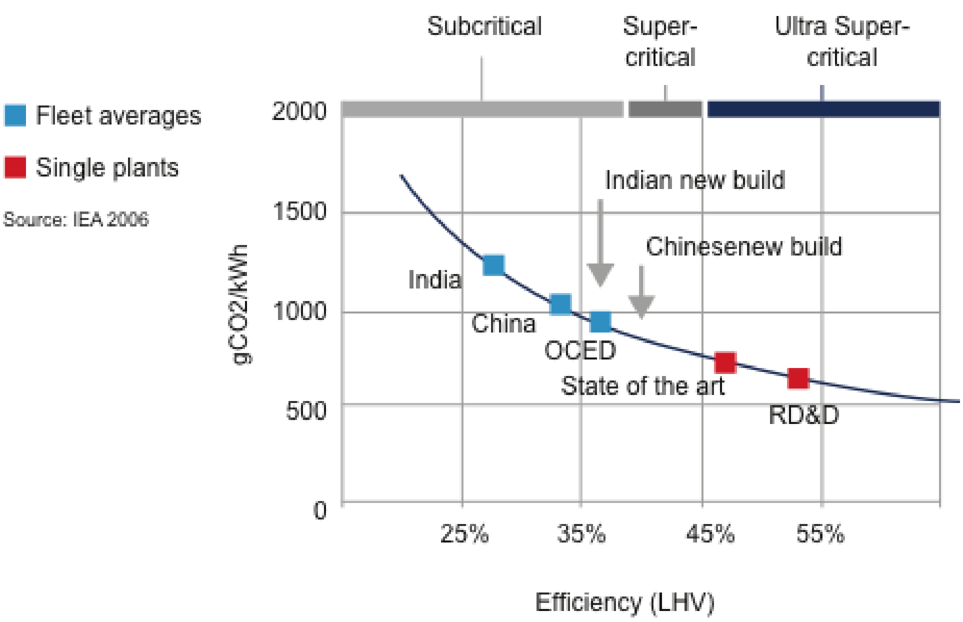
ANNEX I: Technology, Emissions Intensity and Generation Efficiency Equivalents

CFPP CO_2 emissions (from "Coal Meeting the Climate Challenge: Technology to Reduce Greenhouse Gas Emissions", *The World Coal Association*, September, 2007)



Characteristics and Performance of New Coal Fired Power Plants That May be Supported by the IDB (from "Coal Fired Power Plants Guidelines An Approach to Reconciling the Financing of Coal-Fired Power Plants with Climate Change Objectives" *Inter-American Development Bank,* October 2009)

Technology	(PCC) Super-critical	(PCC) Ultra-super-critical	Circulating Fluidized Bed Combustion (CFBC)	Integrated Gasification Combined Cycle (IGCC)
Net Plant Higher Heat Value (HHV) Efficiency (%) (Bituminous coal)	>38.3 [1]	>42.7 [1]	>36.0 [2]	>38.2 [3]
Net CO_2 Emissions Intensity (kg CO_2/net MWh)	<832 [4]	<748 [4]	<890 [4]	<832 [4]

Sources: [1] US EPA, Environmental Footprints and Costs of Coal-Based Integrated Gasification Combined Cycle and Pulverized Coal Technologies, 2006; [2] International Energy Agency, Developments in fluidized bed combustion technology, 2006; [3] US Department of Energy (DoE) - Cost and Performance Comparison Baseline for Fossil Energy Power Plants, 2007; [4] Based on US EPA emissions factors for bituminous coal (93.47 kg CO_2/MMBtu) and minimum net plant efficiency.

ANNEX II: Leading CFPP Technologies

It is essential to deploy the most efficient and least emissions-intensive CFPP technologies summarised below if global power emissions are to plateau by 2020. 80% of projected 2020 emissions from this sector are set to come from existing plants, or plants currently being built.

- **Super critical and ultra super critical** (SC & USC) steam cycles currently enable generation efficiencies of 42% to 47% (improved alloys are likely to raise efficiencies above 50%). SC is a well established technology, now commonly used for new coal-fired plants in many countries. USC boilers are also being commercially deployed. China's plans to meet power generation efficiency and emissions intensity goals through deployment of SC and USC mean that the average efficiency of China's CFPP sector is likely to outstrip average efficiency in the OECD countries[9].

- **Combined heat and power** (CHP) systems are capable of generation efficiencies greater than 90% if adequate demand for heating exists close to the CFPP. 75%-80% conversion rates are common. CHP can be employed both at large and smaller local plants, and is therefore well suited to distributed energy generation, particularly in colder climates.

- **Integrated Gasification Combined Cycle** (IGCC) technology gasifies coal in a process with generation efficiency levels in the range of 45%-50%. However, 97% of the world's coal-fired capacity remains based on pulverised coal combustion and IGCC is a relatively expensive technology which has held back wider uptake.

- **Cofiring** of coal material with biomass or waste is a least-cost option to deliver emissions intensity reductions. Substitution rates of over 50% are possible but in practice reductions in CO_2 emissions of approximately 20% are more typical[10]. While co-firing delivers immediate emissions intensity reductions, it does not improve the generation efficiency gains needed to make CFPPs CCS ready. Deeper, longer-term emissions cuts from co-firing CFPPs would therefore rely on the viability of higher coal-substitution rates.

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[9] Clean Energy Progress Report (IEA 2011)
[10] Cofiring with other fuels (IEA Clean Coal Centre, 2007)

ANNEX III: CCS Readiness

The best technologies available to cut CFPP CO_2e emissions today together account for only a small percentage of the CFPP technology mix in 2050 as envisaged in the IEA's BLUE map scenario. The long term viability of CFPPs that are being built or refitted now may depend on their near-total decarbonisation in the future. CCS is currently the only technology that appears to have a realistic prospect of delivering that depth of emissions cuts.

CCS has the potential to reduce emissions from coal (and other fossil fuel plants) by as much as 97% and is currently the best placed technology to achieve the results needed for the IEA's BLUE Map scenario. The IEA concludes that deployment of 100 large scale CCS projects (in the power-generation and industry sectors) by 2020, and 3,400 by 2050 will be needed to help meet the emission challenge of dangerous climate change.

CFPP CCS remains to be demonstrated at full scale and is unlikely to be available for commercial deployment before 2020-25. Government policy will be critical in determining whether large-scale roll out becomes technically and economically viable.

ANNEX IV: Definitions

Higher Heating Values: Discussed by the IEA in '*Fossil-Fuelled Power Generation: Case Studies of Recently Constructed Coal- and Gas-Fired Power Plants' (2007)* as follows:

The chemical energy available per unit mass of fuel may be quantified using either the higher heating value (HHV) – also known as the gross calorific value – or the lower heating value (LHV) – also known as the net calorific value. The HHV is the released heat measured at constant volume using a bomb calorimeter after all the products from combustion have been cooled to the initial temperature of the fuel and oxygen of 25°C. It includes the heat released when the water vapour in the product gas condenses into water (latent heat).

CCS Ready: various organisations have offered definitions including CTF[11], DECC[12] and GCCSI (see table below). They have in common the requirements that CCS ready CFPP projects should include space for future build of a CCS plant, access to transport and storage, and a process for ensuring that planning and resources are in place so that CCS can be retrofitted as soon as practicable.

[11] Clean Technology Fund Criteria for Financing Low-Carbon Opportunities in Coal and Gas Power Investments (CTF, 2009)
[12] Carbon Capture Readiness (DECC, 2009)

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Proposed International Definition of CCS Ready from 'Defining CCS Ready: An Approach to An International Definition (prepared for The Global Carbon Capture and Storage Institute by ICF International, 2010)

Proposed International Definition of CCS Ready

A CCS Ready plant is one that is Capture Ready, Transport Ready, and Storage Ready.

Capture Ready Plant

A CO_2 Capture Ready plant satisfies all or some of the following criteria:

1) Sited such that transport and storage of captured volumes are technically feasible;
2) Technically capable of being retrofitted for CO_2 capture using one or more reasonable choices of technology at an acceptable economic cost;
3) Adequate space allowance has been made for the future addition of CO_2 capture-related equipment, retrofit construction, and delivery to a CO_2 pipeline or other transportation system;
4) All required environmental, safety, and other approvals have been identified;
5) Public awareness and engagement activities related to potential future capture facilities have been performed;
6) Sources for equipment, materials, and services for future plant retrofit and capture operations have been identified; and
7) Capture Readiness is maintained or improved over time as documented in reports and records.

Transport Ready Plant

A CO_2 Transport Ready plant satisfies all or some of the following criteria:

1) Potential transport methods are technically capable of transporting captured CO_2 from the source(s) to geologic storage ready site(s) at an acceptable economic cost;
2) Transport routes are feasible, rights of way can be obtained, and any conflicting surface and subsurface land uses have been identified and/or resolved;
3) All required environmental, safety, and other approvals for transport have been identified;
4) Public awareness and engagement activities related to potential future transportation have been performed;
5) Sources for equipment, materials, and services for future transport operations have been identified; and
6) Transport Readiness is maintained or improved over time as documented in reports and records.

Storage Ready Plant

A CO_2 Storage Ready plant satisfies all or some of the following criteria:

1) One or more storage sites have been identified that are technically capable of, and commercially accessible for, geological storage of full volumes of captured CO_2, at an acceptable economic cost;
2) Adequate capacity, injectivity, and storage integrity have been shown to exist at the storage site(s);
3) Any conflicting surface and subsurface land uses at the storage site(s) have been identified and/or resolved;
4) All required environmental, safety, and other approvals have been identified;
5) Public awareness and engagement activities related to potential future storage have been performed;
6) Sources for equipment, materials, and services for future injection and storage operations have been identified; and
7) Storage Readiness is maintained or improved over time as documented in reports and records.