EUROPEAN POWER PLANT SUPPLIERS ASSOCIATION

1 October 2006
Version 3

EPPSA Position Paper

on Recommendations for the

7th Framework Programme for R&D

INTRODUCTION

EPPSA, representing European power plant suppliers, both manufacturing supplies for power plants and constructing power stations, enthusiastically supports the European Commission's "Proposal for a Decision of the European Parliament and of the Council concerning the seventh framework programme of the European Community for research, technological development and demonstration activities (2007 to 2013)", particularly for including the priorities CO_2 Capture and Storage Technologies for Zero Emission Power Generation and Clean Coal Technologies under the theme of Energy.

EPPSA commends the European Institutions for the work and progress achieved up to this point and would like to inform the European Institutions, involved in the 7th Framework Programme, of its recommendations to the Specific Programme (related to the recently launched European Technology Platform on Zero Emission Fossil Power Generation).

In the power generation sector, EPPSA members are actively engaged throughout the European Union. EPPSA welcomes the opportunity to provide industry feedback as well as to offer their expertise in a constructive dialogue with the institutions concerned.

EPPSA hopes that the European Institutions will continue to ensure suitable transparency and consultation with industry in the future. With this in mind, EPPSA urges the European Institutions to seriously consider the detailed recommendations that are provided on the following pages.

These recommendations take into account the presentations and comments made at the ENERFOS 2010+ Workshop, co-financed by DG TREN, on 16 June 2005. As EPPSA members' expertise are in the construction of power plants, which includes CO_2 separation and capture, EPPSA has not made specific recommendations on complementary Research, Development and Demonstration relating to the storage of CO_2. Compared to Version 1 (19 July 2005), new sections on NGCC and Instrumentation Control and Electrical Systems have been added. Section 1 has been updated.

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1. IMPERATIVES BEHIND EPPSA RECOMMENDATIONS FOR THE SPECIFIC RESEARCH, DEVELOPMENT AND DEMONSTRATION PROGRAMME

- Need to ensure security of electricity power supplies as gas and oil resources dwindle and prices of these fuels rise.

- Need to reduce emissions of harmful pollutants, including carbon dioxide.

- Follow the twin track/two trajectory approach to reducing CO_2, i.e. efficiency improvement in the short and medium term accompanied by carbon dioxide capture and storage (CCS) in the medium and longer term.

- Recognise the global markets for these technologies and the related environmental and business benefits through exports from Europe.

- Technologies are needed for new power plant, for replacement power plant and for retrofitting of existing plant.

- Clean fossil power and CCS will be required to operate in a mixed generation portfolio alongside nuclear and renewables and must therefore be available for both base-load and load-following operation.

- An early priority will be the development of designs of "capture-ready" plant – i.e., plants of the highest efficiency currently practical which are suitable for the later addition of CO_2 capture equipment.

- For both Europe and for global markets, technologies need to be developed and proven for the full range of fossil fuel specifications and types.

- In order to maximise the possibilities and speed of deployment, the programme of R, D and Demonstration must be industry-led and take into account economic realities. Nevertheless, it should encourage ongoing/underpinning R+D that will help to build capacity and capabilities and provide suitably qualified engineers in the relevant disciplines.

- Demonstration projects are a vital stage in the commercialisation chain and should be encouraged at all scales (including small scale component demonstrations through slip stream demonstrations to full scale demonstrations – retrofit and new build).

- The primary clean fossil technologies for electricity generation that will be deployed in the next ten years are high efficiency supercritical boiler/steam turbine and natural-gas fired gas combined cycle power systems. Most coal-fired units will be pulverised coal type but a significant number will be circulating fluidised bed. Integrated Gasification Combined Cycle will be needed for specific applications, including hydrogen and chemical polly-generation production from coal. All these technologies will be required to achieve "Zero Emission" status if global security of supplies and environmental targets are to be met.

2. TOPICS FOR SPECIFIC RESEARCH, DEVELOPMENT AND DEMONSTRATION PROGRAMME

Key to Symbols:

r = Continuing need to underpinning University research at a level of around 10% of the total budget. Industry input to planning via ETP.

R = Industry-led Research aiming to lead to the Demonstration stage in 3 to 6 years.

D = Industry-led R+D "basic development" aiming to lead to the Demonstration stage in 3 years. May include engineering feasibility studies.

Demo = Demonstration of innovative technologies at full-scale (or, where appropriate, near to full-scale).

(Note: In the terms of EU contracts, r = basic research 100% funded, R+D = pre-competitive collaborative research 50% funded, Demo = collaborative demonstration with <35% funding of innovative portion).

A. PULVERISED COAL	Underpinning Research	2007 – 2010	2010 – 2013
A1: Ultrasupercritical Power Plant Materials, components, manufacturing and inspection methods underpinning technologies for capture-ready 700°C ultra supercritical steam power plant (building on AD700 experience)			
• Materials and structure development for maximum process parameters 700/720°C, 375 bar (high-temperature corrosion-resistant materials, verification of strength characteristics, weld joints for nickel-base materials and mixed joints, realistic testing, NDT and monitoring))	r	R, D, Demo	R, D, Demo
• Pre-drying of lignite with low-temperature heat (optimised grinding process, demonstration of drying concept, dry lignite boiler design, plant integration)	r	R, D, Demo	R, D, Demo
• Modelling of slagging and fouling processes (coal burn-up and mineral conversion reactions / transportation, deposition and interaction mechanisms)	r	R	R
• Overall process optimisation and heat management	r	R, D	R, D
Full-scale demonstrations of ultra supercritical steam power plant (incl. AD700) on hard coal and lignite		D, Demo	Demo

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A. PULVERISED COAL (Cont'd)	Underpinning Research	2007 – 2010	2010 – 2013
A2: Carbon dioxide capture			
Materials, components and underpinning technologies for carbon dioxide capture:			
• Amine scrubbing	r	R, D	Demo
○ Improved integration	r	R, D	Demo
○ Improved amines	r	R, D	R, D, Demo
• Oxyfuel firing	r	R, D	R, D, Demo
○ Combustion system	r	R, D	R, D
○ Heat transfer	r	R, D	R, D, Demo
○ Effects of CO_2 gas streams on boiler corrosion, fouling, slagging	r	R, D	R, D, Demo
• Alternative CO_2 removal systems (adsorption, anti-sublimation, ammonia/chiller technology)			
Carbon dioxide capture demonstrations on hard coal and lignite:			
• Amine scrubbing		Demo	Demo
• Oxyfuel firing		Demo	Demo
A3: Clean pulverised coal technologies (AQCT)			
Clean pulverised coal technologies (AQCT) for full-range of coals:			
• Multi-pollutant	r	R, D, Demo	Demo
• Mercury	r	R, D, Demo	Demo
• Volatile Organic Compounds	r	R, D, Demo	Demo
A4: Advanced biomass and municipal waste cofiring	r	R, D, Demo	
Advanced biomass and municipal waste co-firing (max %, fuel flexibility)			

B. CIRCULATING FLUIDISED BEDS	Underpinning Research	2007 – 2010	2010 – 2013
B1: High efficiency once through CFB boilers			Demo
• Materials – Supercritical conditions	r	R, D	
• Match heat duties vs. heat exchangers	r	R, D	
• CFB – once through steam cycle integration, steady state/dynamic performance	r	R, D	
B2: Carbon dioxide capture			
Oxyfuel combustion, performance and design basis		Demo	
• Combustion	r	R, D	
• Heat transfer and temperature profiles	r	R, D	
• Effects on bed material, particle size distribution	r	R, D	
• Corrosion, fouling, bed agglomeration	r	R, D	
Concept/design development		Demo	
• Optimisation of O_2/CO_2 ratio		R, D	
• Heat exchanger configurations – maintain uniform temperature profiles		R, D	
• Advanced boiler and heat exchanger designs		R, D	
Oxyfuel CFB Technology for carbon dioxide capture			
• Oxy-CFB development (30-50MWe)	r	D, Demo	
• Oxy-CFB demonstration (250MWe)	r	R, D	Demo
B3: Emissions			
• Performance vs. criteria in integrated system		Demo	
• Sulphur – absorption mechanisms and rates in O_2/CO_2 environment	r		
• NOx, CO_2	r		
• Other emissions	r		
B4: Advanced Biomass			
• Combustion, performance and design basis	r	R, D	
• High efficiency	r		

C. **IGCC**	Underpinning Research	2007 – 2010	2010 – 2013
Components and plant integration of highly efficient and competitive integrated gasification combined cycle (IGCC) technology including an optional CO_2 removal			
• Fuel flexible gasification: for gasification with either coal (incl. low rank coals), biomass or waste fuels.	r	R, D	Demo
• Gasifier: durability of refractory, reliability, robustness of auxiliary systems, fouling, materials, I&C.	r	R, D	Demo
• Hot gas cleanup: syngas cooling, pollutant removal from higher temperature gas streams, filter robustness and durability, Hg and carbonyls removal.	r	R, D	Demo
• Water-gas shift reaction and CO_2 removal from syngas (high pressure scrubbing)	r	R, D	Demo
• Gas turbines: efficiency, reliability, fuel diversification, H_2 combustion.	r	R, D	Demo
• Solid handling: fouling of mixed fuels, slag and fly ash removal.	r	R, D	Demo
• Plant integration, optimisation, load following, availability and cost reduction.	r	R, D, Demo	
(Note: Demonstrations of improvements should be trialled on existing plants)			

D. **NGCC**	Underpinning Research	2007 – 2010	2010 – 2013
Natural gas combined cycle gas turbine component and plant integration of highly efficient and competitive technology including extensive fuel flexibility and an optional CO_2 removal by pre-combustion or post combustion methodologies.			
• Fuel flexible high efficiency gas turbine systems needed to mitigate cost penalties associated with CO_2 removal	r	R, D	Demo
• Pre-combustion CO_2 removal from natural gas and H_2 combustion turbine	r	R, D	Demo
• Post-combustion CO_2 removal including exhaust gas recirculation and high pressure CO2 separation	r	R, D	Demo

E. STEAM TURBINES	Underpinning Research	2007 – 2010	2010 – 2013
High performance steam turbines for ultra supercritical steam power plants with low or even zero emissions:			
• Increasing steam parameters to >300 bar and >700°C with adequate, partially cooled designs, 3D high temperature blading and matching mechanical integrity	r	R, D, Demo	R, D, Demo
• Increasing turbine efficiencies by high performance blading including diffusor optimisation, minimisation of losses (steam moisture, leakage flows, sealings) and innovative bearings	r	R, D, Demo	R, D, Demo
• Improvement of operation and part load behaviour, optimisation of lifetime and component designs	r	R, D, Demo	R, D, Demo

F. COOLING SYSTEMS	Underpinning Research	2007 – 2010	2010 – 2013
F1: High performance power plants:			
• Modification on cooling fills (packing?)		R, D	Demo
• Modification of fin tubes in dry cooling systems		R, D	Demo
• Arrangement of Direct Air Cooled Condenser (ACC) heat exchangers in natural draught cooling towers		D	Demo
• Combination of wet and dry technology in hybrid cooling towers		D	Demo
F2: Carbon dioxide capture plants:			
• Impact of CO2-free flue gas (incl. rejection in cooling tower, emission spreading, plume dispersion, mixing in the plume)		R, D	Demo
• Corrosion/materials issues			

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G. GENERAL	Underpinning Research	2007 – 2010	2010 – 2013
G1: Mathematical Modelling (steady state and dynamic) of plant performance:			
• Pulverised fuels (incl. oxyfuel combustion)	r	R, D	R, D
• Circulating fluidised beds (incl. chemical looping combustion)	r	R, D	R, D
• IGCC (incl. hydrogen production)	r	R, D	R, D
• Total plant integration / efficiency optimisation	r	R, D	R, D
• Dynamic modelling	r	R, D	R, D
G2: Life Cycle Management (incl. impact of load following [balancing versus intermittent renewables], lifing studies, creep, fatigue. availability modelling)	r	R, D, Demo	R, D, Demo
G3: Alternative gas and air separation unit (ASU) solutions incl. Membranes (CO_2/N_2, O_2/N_2, CO_2/H_2)	r	R, D, Demo	R, D, Demo
G4: Retrofit technologies (Multipollutant, CO_2 abatement, improved load following, co-firing)	r	R, D, Demo	R, D, Demo

H. INSTRUMENTATION, CONTROL AND ELECTRICAL SYSTEMS	Underpinning Research	2007 – 2010	2010 – 2013
• New field instruments	r	R, D	R, D
• Improved controls	r	R, D	R, D
• Electrical balance of plants	r	R, D	R, D

3. USE OF EU INSTRUMENTS FOR COLLABORATIVE PROJECTS

EPPSA recommends that a mixture of Integrated Projects, Specific Targeted Projects and a limited number of Networks of Excellence be undertaken.

EPPSA encourages the EU Institutions and especially the Commission to accommodate medium-sized projects that take advantage of retrofit opportunities to introduce innovations matching the Programme needs.

EPPSA also advises that Joint Technology Initiatives should be established for some of the larger key projects which may be funded from a combination of sources (EU, other public and private). New forms of "support instruments" (including the guarantee of financial compensation for technical risk, extended commissioning, or plant under-performance) may be more cost effective than normal contract support.

EPPSA recommends that the EU institutions take note of the extensive financial support for R&D and the wide range of risk reduction strategies associated with "first of type" commercial deployment of power generation in the United States.

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The European Power Plant Suppliers Association (EPPSA) is the voice, at a European level, of companies both manufacturing components for power plants and constructing them. EPPSA's members, throughout Europe, represent a leading branch of technology with more than 100 000 employees and an annual turnover of over €20 billion. It actively promotes projects aimed at increasing efficient and environmentally friendly improvements in power generation, particularly zero or near zero emission power generation. EPPSA believes increased investment in Research, Development and Demonstration is a key factor in driving EU competitiveness as well as assuring a power supply for European consumers.

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