

## **EGCFE Projects Responding to the EWG Strategic Plan and APEC Leaders' Goals**

The APEC Energy Working Group's Expert Group on Clean Fossil Energy (EGCFE) has focused its work during the past decade on the following principal areas of activity:

- Improving the efficiency and performance of electricity generation from fossil fuels, as a means of mitigating future CO<sub>2</sub> emissions from generation technologies.
- Technical, economic and regulatory/permitting issues related to introduction of carbon capture, utilization and storage (CCS/CCUS) for coal-based power plant projects in developing APEC economies.
- Increasing the knowledge and awareness of carbon capture and storage technologies in developing APEC economies, including preparation of training materials related to the potential future introduction of CCS in these economies.
- Issues related to natural gas, LNG and unconventional gas exploitation as a means of reducing future growth of coal-fired generation and thereby reducing the growth of CO<sub>2</sub> emissions.

Throughout the past decade, the EGCFE's project planning has been consistently based on directions prescribed and Declarations made by APEC Leaders and Energy Ministers during their regular meetings.

Taken as a whole, the EGCFE program over the past decade has made very significant contributions to the transfer of knowledge and information among APEC economies, aimed at building capacity in developing economies to handle mitigation of global climate change through significant reductions in the projected future growth of CO<sub>2</sub> emissions from production and use of fossil fuels.

The following summarizes the principal results of a number of representative EGCFE projects active during the period 2008-2015. They prescribe the tools for significant contributions to potential global climate mitigation via reductions in the future growth of CO<sub>2</sub> emissions. EWG members should be able to point to benefits arising from application of the results of EGCFE projects in their economies.

### **EWG 01 2008a: Planning and Cost Assessment Guidelines for Making New Coal-Fired Power Generation Plants in Developing APEC Economies CO<sub>2</sub> Capture Ready**

This project reviewed the current status of international discussions on the definition of "capture-ready" for coal-fired power plants, identified some suitable power plant projects in the early siting, planning, and design stages to serve as case studies, developed conceptual designs for plants to be built in developing APEC economies, and worked with appropriate experts to carry out the case studies and synthesize the results. A 2 x 600-MW configuration was selected for a *typical* coal-fired plant project for the region.

The final report developed a set of general planning and cost assessment guidelines for making new plants in developing APEC economies CO<sub>2</sub> capture-ready, and identified additional detailed engineering and economic analyses necessary.

### **EWG 07 2009A: Case Studies of Public Education and Information Campaigns in APEC economies, and Development of Best Practice Guidelines (LNG)**

Public concern about the safety of ships, terminals, and storage facilities for liquefied natural gas (LNG) surfaces any time a new project is considered anywhere in the world. The concern is legitimate and requires an adequate response in the form of public information, consultation, and education. Engaging the public is critical to the successful development and operation of LNG projects and to the growth of LNG trade in the APEC region.

The objectives of this project were to:

- Provide information on and examine in greater depth a number of case studies of LNG public education, consultation, and information campaigns held in APEC member economies;

- Develop best practice guidelines for such campaigns that will assist developing APEC economies in their communications with stakeholders and the public; and
- Build capacity in developing APEC economies in the area of LNG public information, education, and consultation.

The most important and useful findings from the analysis of the case studies consist of identification of the following ten best practices to achieve success of an LNG project:

- Integrate public outreach into the project management plan.
- Establish a strong public outreach team.
- Identify the project stakeholders.
- Conduct and apply social characterization.
- Develop an outreach strategy and communication plan.
- Develop key project-specific messages.
- Develop communication materials tailored to intended audiences.
- Actively manage the public outreach program over the project life.
- Monitor the performance of the public outreach program and changes in public perceptions and concerns.
- Be flexible – refine the public outreach program as warranted.

The project report provided illustrations of how and why each of these best practices contributed to the success of LNG projects.

#### **EWG 05 2010A: Increasing the Knowledge and Awareness of Carbon Capture and Storage: CCS Capacity Building in the APEC Region (Phase V)**

The objective of this project - the fifth in a series aimed at capacity-building in the CCS area - was to increase the knowledge and awareness of carbon capture and storage (CCS) technologies in three developing APEC economies through workshops in each economy. Altogether, more than 800 participants attended the series of CCS capacity building workshops.

Responses to evaluation questionnaires circulated at the end of each of the workshops were highly favorable, and provided useful inputs for planning the succeeding workshop. The relevant EGCFE reports are available at <http://www.egcfe.ewg.apec.org/projects.htm>.

#### **EWG 04 2010: Permitting issues related to carbon capture and storage for coal-based power plant projects in developing APEC economies**

The objectives of this project were to review the work in progress in the region and around the world on relevant legal, regulatory, and permitting issues and frameworks, identify issues likely to arise if they were to be applied to future CCS projects in Developing APEC economies, and make recommendations on how best to handle these issues.

The project examined permitting regimes in nine developing APEC economies (China, Chinese Taipei, Indonesia, Malaysia, Mexico, Philippines, Republic of Korea, Thailand and Viet Nam). It identified six categories of substantive issues that should be addressed in CCS regulation: environmental impact; capture; transportation; storage; legal and financial, and public engagement. Public engagement efforts should reflect best practices in public education and outreach, and provide the public with a role in shaping CCS project developments. Finally, regulation and collaborative efforts should support a commercial path for CCS that foster innovation in delivering lower cost technology and benefits through CO<sub>2</sub> utilization wherever possible.

The final report, which is posted on the EGCFE website, identified the essential elements of a permitting process for CCS projects in these economies, as well as additional mechanisms and structures that might need to be put in place to support the CCS permitting process and monitoring of CCS projects.

## **EWG 12 2011: APEC Unconventional Gas Census: Evaluating the Potential for Unconventional Gas Resources to Increase Gas Production and Contribute to Reduced CO<sub>2</sub> Emissions.**

The objectives of this project were:

- To share experiences and exchange information on surveys of unconventional gas resources completed, underway, or planned for different APEC economies, and on relevant activities by other international fora.
- To develop a report to the Energy Working Group containing:
  - Estimates of potential amounts of each type of unconventional gas that could be practically and economically produced in each economy throughout the APEC region, including a timeframe for their availability;
  - Suggested framework, scope and content of an APEC unconventional natural gas census, and relationship to other relevant international and national activities.
  - Recommendations for a follow-on, more detailed APEC unconventional natural gas census, addressing scope, content, timing, etc.

The report produces a framework for of an APEC Unconventional Gas Census, including scope, content, timing and management responsibility. This provides a structure and motivation for a more complete tabulation of unconventional gas resources that would provide a better understanding of the important and growing potential of increasing use of natural gas by APEC.

A separate project EWG 16 2011 (APEC Unconventional Gas Workshop) organized an expert workshop on this topic in China. This is described below.

## **EWG 16 2011: APEC Unconventional Gas Workshop**

The workshop objectives were to obtain feedback from government and industry experts on the findings of the EWG12/2011 project on an unconventional gas census; exchange information on the status of surveys of unconventional gas resources completed, underway, or planned for different APEC economies, and on relevant activities by other international fora; and to recommend future work, including capacity building on technologies, the economics of unconventional gas, public acceptance issues, and needed policy/regulatory structures, such as best practice regulatory and policy approaches to support the development of unconventional gas.

The workshop took the form of a 1-day Experts' Meeting on Unconventional Gas held in Beijing, China, on September 27, 2013. Attendance at the event totaled about 30 with most of the representatives being from China, along with experts from Australia, Japan, Korea, and Vietnam.

The main outcome was to recommend setting up an APEC Unconventional Gas Expert Team, that would visit and assist government ministries in key APEC economies which have significant unconventional gas resource potential but which require technical assistance to initiate or accelerate the process. The Expert Team should include specialists in the following key areas: geologic assessment and development of geologic and well data bases; technology and knowledge transfer from the unconventional gas industries of mature economies (Australia, the US, Canada); and fiscal policies to promote unconventional gas investment and development.

## **EWG 02 2013A: An APEC Initiative for Deploying Advanced Clean Coal Technologies**

This project builds on a multi-year Expert Group on Clean Fossil Energy (EGCFE) program aimed at both new and existing coal-fired power generation. The overall objective of the program is to accelerate the uptake of clean coal technologies (CCT) for new plants, particularly in developing APEC economies where coal use is on a rapid growth path; and to improve the performance of existing plants, including reduced emissions, through power plant upgrading and refurbishment and better environmental monitoring.

The specific objectives of the Fukui CCT Deployment Initiative were to:

- Assess plans for new coal-based energy facilities in several developing APEC economies,
- Identify and assess technical, economic and institutional challenges limiting near-term adoption of clean and efficient coal technologies in each economy, and
- Highlight government policies and incentives needed to support acceleration of CCT deployment in each economy, to disseminate best practices for application of CCTs to new and existing power plants, to recommend capacity building measures in this area in the selected economies, and to identify APEC efforts needed to promote CCT deployment.

This project was the first phase of the Initiative. It assessed the status of cleaner coal technologies, related policies, and technical, economic, and institutional challenges slowing cleaner coal technologies deployment in two selected developing APEC economies. The assessment included:

- CCT-related policies in each economy, including technical, economic and institutional challenges facing their deployment.
- Technology options for CCS including carbon capture, utilization and storage (CCUS), and issues related to early demonstration and adoption of these options.
- Dissemination of best practices for applying CCT technologies to new and existing power plants.

The developing APEC economies targeted in this phase were Thailand and Indonesia. Topics included policy, what types of CCTs are of interest, environmental issues (legislation, limits), investment needs, international cooperation requirements, and statistics (e.g. coal and power sector information).

The visits included consultations and assessments by a team of experts, including engineers, technologists, policy and regulatory analysts, and financial advisors. The purpose was to gain insight into factors influencing the deployment of clean coal technologies in the target economies.

The project final report provides recommendations regarding how APEC could support the achievement of the objectives of the two target economies. The main findings of the visits were the following:

- Indonesia has a Roadmap to deploy clean coal technologies. According to its plan, from 2017 to 2025, ultra supercritical (USC) technology will be applied for the larger power plants mainly in Java, and after 2025 IGCC technology will be applied for commercialized power plants. They expect IGCC to have been successfully implemented by developed economies. Since there are many small islands with poor transmission networks, they consider deploying the comparatively higher efficiency plants, such as circulating fluidized bed (CFB) for the medium and small coal-fired power plants, as well as supercritical plants.
- Thailand does not have a roadmap for cleaner coal technologies, but has a Power Development Plan (PDP 2014) that considers energy diversification. It is anticipated that the use of coal will increase in the coming decades due to the goal of achieving energy security by reducing dependence on gas consumption, the uncertainty of successfully deploying new and renewable energy to the planned level, and concern over the public acceptance of nuclear power plants.

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This project is the first step in the APEC CCT Deployment Initiative. One approach may be to repeat the activity for other APEC target economies. Another project could be devised to provide advice and assistance to developing APEC economies in their efforts to measure aggregate CO<sub>2</sub> emissions per unit of GDP.

### **EWG 15 2013A: APEC Expert Workshops on Carbon Capture and Storage for Enhanced Oil Recovery (CCUS-EOR)**

The first workshop was held in Beijing during September 2014, hosted by the Peoples University of China. It was a 2-day event with some 30-40 participants. It took the form of roundtable discussions on selected topics:

- CCUS-EOR Basics and Overview of the EOR Process
- Advanced CO<sub>2</sub>-EOR Technologies
- EOR Economics and CCUS Investment Models
- Legal and Regulatory Aspects of CCUS-EOR
- GHG Compliance and CCUS-EOR / MRV Approaches
- CCUS-EOR Opportunities in China
- CO<sub>2</sub>-EOR vs. Saline Storage/Monitoring.

The second workshop was hosted by Southern Company and Mississippi Power on February 2-3, 2015 and held in the Kemper County Energy Facility, which is a state-of-the-art 582-MW integrated gasification combined cycle (IGCC) plant with the capability to capture about 65% of the CO<sub>2</sub> generated. There were 42 participants from Australia, China, Mexico and the United States.

### **EWG 17 2013A: CCS Capacity Building in Mexico**

The project was approved by APEC in January 2014. The original timetable called for three workshops. The first workshop - an Advanced Storage Workshop involving 40 participants - was held in August 2014 in Mexico City. The second workshop, aimed at engineering teachers and students, was held in October, also in Mexico City. There were 240 participants. The third workshop, CCUS Workshop for CO<sub>2</sub> Storage, was held in the University of Sonora in Hermosillo, Mexico, on 22-23 January 2015. It covered the basics of geologic storage, CO<sub>2</sub> storage capacity assessment, monitoring, measurement and assessment, EOR and storage case studies, CCS risk assessment, and various aspects of CCS in Mexico. There were over 200 participants.

### **EWG 19 2013A: APEC Expert Workshop on Innovative Systemic Approaches to Enhancing Coal-Fired Power Generation Efficiency**

This 3-day workshop was to share proven results of various innovative technologies and best practices to enhance coal-power power generation efficiency, reducing coal consumption and CO<sub>2</sub> emissions, as well as ensuring a safer and more secure power grid in emergency supply disruptions. It will include low-cost measures that are applicable to nearly every coal-fired power plant, to enhance power generation efficiency, reducing coal consumption and CO<sub>2</sub> emissions. This is of particular relevance to regions where the energy-mix is dominated by coal.

The event, entitled "APEC Forum on Innovative Technologies to Enhance Coal-Fired Power Generation Efficiency", was held in Shanghai on March 26-27, 2015. There were 137 participants.

Topics included:

- Information on state-of-the-art technology demonstrations and deployments aimed at lower-emission power generation through efficiency enhancement.
- Applicability and transferability of these technologies to existing and future coal-fired power plants in regions where the energy-mix is dominated by coal.
- Systemic and holistic approaches to enhance coal-fired power generation efficiency through innovations in optimizing operating procedures and residual thermal resource recycling.
- Input to provide to the finalization of the EWG 02 2013A project on advanced CCT deployment.

The event featured a site visit to Shanghai Waigaoqiao Phase III (2 x 1000 MW) ultra-supercritical power station to showcase technologies and best practices to improve the performance of coal-power generation.