EXPERT GROUP ON CLEAN FOSSIL ENERGY (EGCFE) PROGRESS REPORT TO THE 55th MEETING OF THE APEC ENERGY WORKING GROUP (EWG 55)

A summary of administrative and project activities undertaken by the EGCFE since the 54th EWG Meeting is provided by the EGCFE Chair, Mr. Scott Smouse (USA).

ADMINISTRATIVE

EGCFE Vice Chair

Mr. Masaomi KOYAMA (Director, Overseas Energy Infrastructure Office, ANRE, METI, Japan) was nominated and confirmed as EGCFE Vice Chair. He will focus on oil- and gas-related activities, while the EGCFE Chair Scott Smouse will focus on coal-related activities as part of his Chair's responsibilities.

Terms of Reference

The EGCFE's Terms of Reference (TOR) were revised include the required sunset clause.

EGCFE Website

The EGCFE's website has been revamped by a USDOE contractor (Energetics). We welcome any comments from EWG members on the website.

EGCFE Secretariat

The EGCFE Secretariat for coal-related activities is provided by the Japan Coal Energy Center (JCOAL) by Ms. Toshiko Fujita. Other Secretariat activities are provided by the EGCFE Chair.

Support Contractor

Technical and some administrarive support is provided by Dr. Ian Torrens (USA) through a USDOE support contract, including preparation of project concept notes, full project proposals, project monitoring and completion reports, progress reports to the EWG, development of technical programs for EGCFE seminars and workshops, and other ad hoc tasks as required.

EGCFE Meeting

Historically, EGCFE meetings were held in conjunction with the annual Clean Fossil Energy Technology and Policy Seminar. However, the annual EGCFE seminar, and thus the associated meeting, has not been held in recent years owing to the lack of financial sponsorship and competing conferences in the region. However, Japan hosted an EGCFE meeting focused on coal in Tokyo on 8 September 2017following their International Clean Coal Day Conference. Subsquently, Japan also hosted an EGCFE meeting focused on oil and gas in Tokyo on 9 March 2018 following the 4th Oil and Gas Security Network Forum meeting Both EGCFE meetings were viewed as successful in discussing priorities in each area and reviewing relevant ongoing projects along with discussing and prioritizing potential new work.

PROJECT STATUS

COMPLETED PROJECTS

APEC Water-Energy Nexus Expert Workshop (EWG 07 2015A)

The first follow-up to the water-energy nexus project was the EGCFE project **APEC Water-Energy Nexus Expert Workshop (**EWG 07 2015A)**,** to share the results of this project with APEC member economies (see below). The contractor organizing the workshop was Washington CORE, selected via RFP from two bids received.

This expert workshop built on information generated and lessons learned in the EWG 08 2014A water-energy nexus project described above. The objectives were to:

- Discuss and evaluate the priorities identified in EWG 08 2014A project findings, and to share up-to-date knowledge and experience.

- Discuss future work in this area and develop recommendations, including capacity building needed on technologies, on the economics of measures addressing water-energy nexus issues, and on needed policy/regulatory structures.

The workshop was held in Atlanta, GA, United States, on 30 November – 1 December 2017. Broad support was voiced for the EGCFE to consider the following next steps in dealing with the water-energy nexus issue in the context of fossil energy:

- Develop a decision support tool to help key decision-makers to assess the impact of water conservation as well as to potentially identify suitable technology solutions.
- Hold a regular meeting or workshop to continue knowledge sharing with a wide group of stakeholders, especially concerning experiences with water management technology implementation.
- Further study technology solution feasibility for extracting water vapor from flue gas, dry cooling, and reducing energy consumption and costs of wastewater treatment
- Establish a cross-cutting steering committee or task force to set priorities for further discussion, policy measures and research.
- Promote industry collaboration on reducing costs of technology development and seek funding for a technology development competition prize to accelerate commercialization of new technologies.
- Create a knowledge sharing database with information from APEC member and other economies on local water costs, volume of water used by energy sector, and water conservation technology acquisition and implementation costs and performance.
- Develop guidelines for water conservation efforts at coal-fired power plants to optimize efforts. These can provide APEC economies with the general concepts and strategies to address water-energy issues.

Thirty-four experts attended the workshop, including speakers and participants from eight APEC economies, split equally between developing and developed members (Canada, Indonesia, Japan, Korea, Malaysia, the Philippines, the United States, and Vietnam). Research Institutes and academia involved in R&D activities for water conservation technologies, and economic and policy analysis relating to the water-energy nexus were represented, includiing the Electric Power Research Institute (EPRI), Carnegie Mellon University (CMU), Gas Technology Institute (GTI), and USDOE's National Energy Technology laboratory (DOE/NETL). Also represented were relevant industry sectors with interests in the topic, such as Duke Energy Corporation, Southern Company, Tenaga Nasional Berhad (Malaysia), and Electricity of Vietnam. In addition, the International Energy Agency's Clean Coal Centre (IEACCC) participated and supported the workshop development, by sharing infomraiton on several recently completed relevant studies.

The speakers and audience included:

- Key government officials from the United States, Indonesia, Malaysia, and the Philippines, at the policy level, with relevant technical and economic expertise, which are involved in decision-making on freshwater resources management (production, transportation, and distribution), particularly with regard to the use of water for fossil energy-based industry; and on the environmental and regulatory issues specific to the water-energy nexus.
- Institutes and academia involved in economic and policy analysis in this area, such as the Electric Power Research Institute, the International Energy Agency Clean Coal Centre, the Gas Technology Institute, Carnegie Mellon University, Lehigh University, the U.S. Department of Energy's National Energy Technology Laboratory (NETL), Japan's New Energy and Industrial Technology Development Organization (NEDO), Southern Research Institute, University of North Dakota, and Western Research Institute.

  The workshop structure, content, and selection of speakers reflect a special focus on the needs of developing economies, including speakers from Indonesia, Malaysia, and Viet Nam. The workshop featured presentations on:

- Overview of the Global Coal Utilisation-Water Nexus
- Water-Energy Nexus Research findings
- Water conservation technologies for coal-fired power plants: User perspective and R&D activity
- Policy making, implementation and International cooperation on water-energy nexus.

In addition, breakout group discussions were held so that all attendees could share experiences, and a concluding panel discussion was held to review preliminary findings and suggest possible future directions for EGCFE. The workshop also included a field trip to the nearby Water Research Center, so that attendees could observe research being conducted on the latest water technology solutions at a coal-fired power plant.

The publication **APEC Water-Energy Nexus Expert Workshop**, containing the Proceedings and Synthesis Report for the Workshop, includes presentations and other relevant information, was published by APEC in December 2017.[1] The report contains suggestions, including input from the workshop participants, for follow-on work on water-energy nexus issues.

Close coordination between this project and the EWG 08 2014A water-energy nexus project helped to identify invited speakers who were not only knowledgeable in this field of activity, but also capable of identifying critical future directions of research and analyses needed within the APEC region on the water-energy nexus field of activities from technology through policy to regulations.

Roadmap to Promote Transfer and Dissemination of Clean Coal Technologies in APEC Region (EWG 08 2015A)

Fossil fuels, especially coal, will continue to play significant roles in the energy mix of Asia-Pacific region in long term. This project responds to APEC Energy Ministers' instruction for the EWG (through their 2014 Beijing Declaration) to promote clean coal technologies (CCTs), so as to enhance cooperation in developing and applying CCTs and to ensure sustainable energy development in APEC region.

The project focused on transfer and dissemination of CCTs, including clean and efficient coal-fired power, CO_2 capture, conversion and storage, and clean and efficient coal utilization such as coal gasification and liquefaction. In a more broad sense, it also includes the efficient and clean coal-based technological advances (e.g., utilization of coal-based syngas, water saving and recycling) in chemical industry.

The objectives were to:

- Create a platform for all APEC economies to participate in the activities of CCTs, and to build a CCTs database providing a technology category list and priority technical review.
- Develop and provide recommendations on promoting technology transfer and dissemination of CCTs.
- Emphasize to select partner beneficiaries clear the significance and prospects of CCTs and to enhance common understanding among APEC economies on development of Low Carbon Technology.

The project includes a CCTs database, built through information collection and field survey work, providing a technology category list and priority technical review. Periodical seminars enable experts to share their up-to-date information and best practices on CCTs, and provide recommendations on promoting technology transfer and dissemination.

A clean coal technologies website[2] has been built. The IEA Clean Coal Centre's 1st workshop on high efficiency, low emissions coal plant (HELE2016), held on 23-25 May 2016, provided a unique showcase of the current and emerging technologies, pushing coal plant efficiencies to 50% and beyond and reducing their environmental impact. Program highlights included:

- State-of-the-art in flexible, ultrasupercritical plant for integration with renewables
- High temperature metals for advanced USC plant
- Developments in IGCC and IGFC in China and Japan
- Beyond steam: Advanced power cycles such as the supercritical CO2 cycle
- Advanced pollutant control technologies and upgrading existing power plant
- HELE policy in China, Japan, and Europe

[1] https://www.apec.org/Publications/2017/12/APEC-Water-Energy-Nexus-Expert-Workshop-Report

[2] http://www.apec-cct.com/CCTS/ABOUTCCTS.html?data=1)

The website consists of the items in the following table:

CCTs	Brief introduction of clean coal technologies, such as IGCC, USC, CCUS and utilization of syngas, along with the latest developments in this field
EVENTS	News or notices of some relevant upcoming events and past events
REPORT	Collection of workshop documents; ”Database” collects the data for CO_2 emissions, coal consumption, CO and CO_2 utilization technologies, and emission standards of economies within the APEC grouping
ABOUT US	Introduction, objectives, work plan and project overseers
CONTACT US	Provides several ways in which to contact the project

Using this website, experts, designers, policy-makers, entrepreneurs and the public can have access to consult the survey report and development plan. Also, brochures, media release documents, newsletters, draft network creation as well as development plans will be delivered for review.

ONGOING PROJECTS

PREP – Peer Review on Efficient Power (EWG 12 2017A)

Coal will continue to meet much of the APEC region’s electricity demand for many years. Deploying high-efficiency coal-fired electricity technologies benefits APEC economies by reducing fuel costs and pollutants, while contributing towards a reduction of carbon dioxide (CO_2) emissions. However, maintaining efficient operations is often difficult for some developing economies as their coal-fired power plants age, owing to a lack of knowledge and resources. This results in increased fuel consumption and emissions and higher operating costs. Thus, aPeer Review on Efficient Power (PREP) initiative for coal power generation was proposed, wherein power sector experts from developed APEC economies will review current coal power generation practices in APEC developing economies. This project aims to begin addressing the knowledge gap that exists in these economies, which will provide a basis for delineating needed resources and considering means to secure these resources.

Modelled after the APEC PREE initiative, PREP Peer Review Teams from developed member economies will visit two volunteer economies in this first phase to collect information from government ministries and regulators, power utilities, industry associations, and other relevant stakeholders. This will include formalized and informal guidance, procedures and methodologies, and seek to identify the highest payback opportunities for each economy. A report on findings, including summaries of current coal power plant management practices to assure optimum reliable performance, will be prepared for each volunteer economy, and will contain recommendations on how to improve plant performance.

Two PREP Peer Review Teams from developed APEC member economies, each possibly consisting of 3-6 experts, will visit the two volunteer developing economies in the first phase to collect information from government ministries and regulators, power utilities, industry associations, and other relevant stakeholders.

Objectives of the project are:

- To develop a report for each volunteer economy on their findings, including summaries of current coal power plant management practices, along with recommendations to improve coal power plant performance through broader sharing of best practices in each economy, and among various APEC economies. This is expected to include identification and prioritization of low-cost improvement opportunities with quick paybacks along with higher cost opportunities with longer execution times for each volunteer economy.
- To provide lessons learned for subsequent PREP visits to other APEC developing economies that could improve the information collection process.
- To provide recommendations for a future APEC expert workshop on improving the efficiency of existing coal power plants, which could be proposed to APEC for funding consideration.

This information will be shared with governments and utilities in the APEC region to assist in their planning and decision processes related to maintaining efficient coal power generation in their economies.

In the planning stage, the Project Overseer, in consultation with a representative of each PREP Peer Review Team, will lay out a structure for the visits by the PREP Teams to the two volunteer developing APEC economies, and for their reports on the outcome of their visits. Following their visits to the two developing economies, the PREP Teams will each detail the information obtained and conclusions drawn from their visits. The Project Overseer aided by the Project Steering Committee (PSC) will consolidate the results obtained by the PREP teams into a final report for the project.

The outputs from this project will help to put APEC developing economies with rapidly growing use of coal for electricity generation into a position to apply more effective and efficient power generation technologies for new or upgraded generating plants; to enhance their operational capabilities for improving the performance of existing plants; and to build the professional capabilities and capacity for achieving these objectives efficiently. The resulting efficiency improvements will contribute to reductions in the growth of local environmental emissions and impacts due to coal-fired power generation. Over the longer term they will contribute to international efforts aimed at reducing the growth of greenhouse gas emissions and the resulting impacts of global climate change.

International Workshop on Best Practice Guidance of Effective Coalbed Methane Recovery Technologies for APEC Developing Economies (EWG 17 2016A)

The project objectives are to:

- Summarize the successful experience and mature technologies of Coal Bed Methane (CBM) development in United States, China, Australia and Canada
- Accelerate in-depth and broad exchange of experiences and information on CBM recovery technologies among APEC economies;
- Establish best practice guidance of CBM recovery technologies for APEC economies;
- Work out policies and suggestions for relevant government departments on the difficulties during the development and promotion of the CBM recovery.

The workshop, organized by the China Coal Information Institute (CCII), is scheduled for May 30-31 2018 in Beijing. It will be a 1.5-day event that will serve as a platform for CBM technology sharing, expert networking and business cooperation within the APEC region. It will disseminate the results and raise the awareness of CBM recovery technologies, and will provide valuable guidance on recovery technology selection for APEC developing economies.

The workshop consists of a one-day meeting and half-day technical on-site visit. A specific discussion section on the first day will give active participants more opportunities to communicate with experts. During the following morning the active participants funded by APEC are invited to visit the key CBM laboratory in Beijing to see well-drilling and fracturing experimental devices. This technical on-site visit can help to accelerate in-depth and broad exchange of research experiences, technologies and information on CBM recovery technologies among APEC economies.

Target audiences of this project are APEC Member Economies' organizations such as CBM companies, government agencies, suppliers of technology and equipment for CBM development, research institutes and international organizations. As appropriate, economies may wish to consider the nomination of representatives from CBM project implementers and research institutes of the CBM industry. Economies are strongly encouraged to consider qualified female participants in their nominations.

The presentations and other documents from the Workshop will be collated by the by the Project Overseer (or their delegate) who will send them to the APEC Secretariat within 2 weeks of the event.

PROPOSED PROJECTS

High-Efficiency Low-Emissions (HELE) Coal-Fired Power Generation and Cogeneration

Fossil fuels, including coal, will continue to meet much of the Asia-Pacific region's growing electricity demand. More efficient, state-of-the-art coal power plant designs and operation can supply electricity

cost-effectively and reliably while reducing coal consumption and lowering pollutant and greenhouse gas emissions. The global status of state-of-the-art technologies and best designs globally for efficient coal-fired power generation will be assessed through case studies of existing and planned power plants. Case studies will include information on plant and equipment design, emissions control technologies deployed, coal types being utilized, and summaries of management best practices to assure optimum reliable performance. The state-of-the-art in coal utilization for efficient power generation and cogeneration will be explained for decision makers in the region to aid them in making informed decisions for new plants.

The objectives of this project are to:

- Identify and describe the most efficient existing and planned high-efficiency coal-fired electricity generation and cogeneration units in APEC economies and around the world, including their operating and management practices.
- Share this information with governments and utilities to assist them in their planning and decision processes related to approving and building new coal-based plants, by clearly expressing the relative efficiencies of the plants in the case studies.
- Recommend follow-on work on high-efficiency coal power generation. This could include organization of an expert workshop on power plant efficiency improvement and advanced coal power generation and cogeneration technologies.

Higher efficiency coal-fired electricity generation benefits APEC economies by reducing fuel costs and pollutants, while contributing towards reduction of carbon dioxide (CO_2) emissions. This applies to all APEC economies that use coal to meet their generation needs. Technology advances have enabled coal-fired power plants deploying ultra-supercritical steam (USC) cycles with full environmental controls to achieve up to 45% (with a resulting average coal consumption of about 280 g/kWh). If the global average net efficiency of coal-fired power generation can improve to 45%, CO_2 emissions can be reduced by 36%.

New plant designs using advanced USC steam conditions can exceed 49% net efficiency, with even greater CO_2 emission reductions. Furthermore, coal-based cogeneration of power and steam (for industrial use or district heating) provides the opportunity to raise overall energy efficiency to over 80%.

Through detailed case studies of existing and planned high-efficiency coal power, this project will describe recent global advances towards the goal of 50% generating efficiency, and cogeneration plants. Earlier EGCFE work in this area will be reviewed and recent advances in technologies and best practices highlighted, showcasing plants in operation or planned in the APEC region and around the world.

Candidate power generation plants in the APEC region for the case studies include Isogo Unit 2 in Japan and Waigaoqiao No. 3 Unit in the People's Republic of China. Those outside the APEC region include Nordjylland Unit 3 in Denmark and Lünen in Germany. Information developed will help APEC member economies to select the most efficient technology available, especially developing economies where most new coal-based plants in the region are being planned. Owing to a high operating penalty associated with current carbon capture, utilization, and storage (CCUS), it is critical that all new coal power plants be as efficient as possible to allow CCUS to be deployed in the future. CCUS is the best option for substantial CO_2 emissions reduction from coal power generation, and may be needed in order to achieve some member economies' climate commitments. High-efficiency coal-based plants have sustained benefits, both energy and environmental, for all economies that bring them into use, in addition to global environmental benefits arising from reduced greenhouse gas emissions.

The project will be conducted by a consultant team, including engineers, technologists, policy analysts, and financial advisors, under the guidance of an APEC project steering committee composed of EGCFE experts, as well as government and industry representatives from member economies:

- March - April 2018: Develop a detailed work plan to complete the project, and for the structure and content of the final report, including timetables. Identify and describe existing and planned high-efficiency electricity generating and cogeneration plants in APEC economies and around the world for the case studies.
- May 2018 - November 2018: Consultant team visits the identified plants, plant operators, technology manufacturers, and consultants to collect information and data for the case studies. Draft report preparation initiated.

- December 2018 - January 2019: Draft final report prepared.
- February 2019: Draft final report submitted for review by the Project Steering Committee.
- March 2019: Project report finalized for publication by APEC. The report will contain recommendations for follow-on work.

APEC Regional Workshop on Coal Plant Efficiency
The United States plans to propose and convene a self-funded regional technical workshop on enhancing efficiency for coal-fired electricity generation and cogeneration units, and demonstrating the benefits of carbon capture, utilization, and storage (CCUS).

The objectives of this workshop are to:
- Share information on best practices and technologies for improving and maintaining existing power plant performance (efficiency and emissions), including possibility for retrofitting CCUS.
- Share information on the most efficient existing and planned high-efficiency, low-emission (HELE) coal-fired electricity generation and cogeneration units in APEC economies and around the world, including their operating and management practices. This information will be collected in the form of case studies of best plants around the world through a U.S. self-funded project led by the Office of Fossil Energy through the National Energy Technology Laboratory (NETL). Case studies on the two operating commercial coal-fired plants with CCUS will be included (Petra Nova in the United States and Boundary Dam in Canada).
- Share information from the first phase of the APEC-funded FE-led PREP (Peer Review in Efficient Power) project, where peer reviews of utility and coal-fired power plant practices in two developing APEC economies will be performed.
- Organize and hold an APEC regional coal plant efficiency expert workshop to share this information with governments, utilities, and other interested stakeholders to assist them in their planning and decision processes for both improving the operation of existing coal-fired plants and designing and building new plants.
- Recommend follow-on work on coal plant efficiency, including technologies and best practices.

This project responds to a recent APEC Energy Ministers instruction to the EWG:
- We reaffirm the importance of clean and efficient use of fossil fuel. We encourage member economies to enhance cooperation in developing and applying clean coal technologies, such as highly efficient coal-fired power generation and cogeneration plants.

The workshop will be implemented by the Office of Fossil Energy with support from the National Energy Technology Laboratory (NETL) and their support contractors.
- May - June 2018: Develop a detailed work plan for the workshop, including draft agenda structure. Identify workshop location and possible APEC co-sponsors.
- September 2018: Finalize workshop agenda, including speakers and session chairs. Finalize workshop location, venue, and logistics.
- September - November 2018: Secure all speakers and session chairs. Finalize workshop details.
- November - December 2018: APEC Regional Workshop on Coal Plant Efficiency held in TBD location.
- December 2018: Draft final report prepared, with workshop presentations and recommendations.

APEC Study on Small-Scale Shallow Draft LNG Carriers and Floating Storage Regasification Units

Existing LNG infrastructure is insufficient to meet the increasing LNG demand in the region. This project proposes a study on the optimal use of small-scale shallow draft LNG carriers and Floating Storage Regasification Units (FSRUs). Small-scale shallow draft carriers are efficient for regional island-to-island, shallow coastal, and river LNG transport. FSRUs are moveable to meet demand needs,and can be optimized in hub-and-spoke scenarios with large-scale LNG imports.

By developing recommendations for enhancing LNG imports, this will support the APEC Leaders' 2017 priorities "to facilitate energy-related trade and investment, enhance access to affordable and reliable energy, and promote sustainable, efficient, and clean energy sources."

The project will assess the practicality of small-scale shallow draft LNG carriers and FSRUs in the APEC region and demonstrate their efficiency for regional island-to-island, shallow coastal, and river LNG transport. It will develop recommendations, build capacity and provide guidance on the optimal use of small-scale shallow draft LNG carriers and FSRUs to enhance LNG imports.

Among APEC economies, especially in South and Southeast Asia, there is a growing list of FSRU proposals, which, if they came to fruition, could substantially boost APEC economies' use of FSRUs above the region's current global rate of approximately 20 percent.

The project, curretly in the form of an APEC Concept Note, aims to begin in November 2018, with RFP issuance and selection of consultant in December-January. Work on developing a full LNG value chain analysis, with the primary focus being the optimal use of small-scale shallow draft LNG carriers and FSRUs in the APEC region, is scheduled to take place during February-August 2019. The report should be completed during September 2019, reviewed by the EWG during October, and submitted to the Secretariat for publication in November.