CSLF Bulletin

A Summary Report of the Ministerial Conference of the 6th Carbon Sequestration Leadership Forum (CSLF)

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SUMMARY OF THE CARBON SEQUESTRATION LEADERSHIP FORUM (CSLF) MINISTERIAL CONFERENCE AND FIELD TRIP: 4-5 NOVEMBER 2015

The Ministerial Conference of the Sixth Carbon Sequestration Leadership Forum (CSLF) was held on Wednesday, 4 November 2015, at the Kingdom Center in Riyadh, Saudi Arabia. Taking place as part of the week-long CSLF Ministerial Meeting, the conference followed meetings of CSLF's Projects Interaction and Review Team, Technical Group and Policy Group from 1-3 November, and a parallel Stakeholders Meeting.

Over 100 participants, including 26 government ministers and other high-level officials, participated in the Ministerial Conference. Participants heard opening remarks by CSLF Ministerial Co-Chairs Ernest Moniz, United States Secretary of Energy, and Ali bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, Saudi Arabia, followed by presentations on the role of carbon capture and storage (CCS) globally and in the Middle East region.

Participants heard a presentation by UN Under-Secretary-General Christian Friis Bach on the history of the Conference of Parties (COP) to the UN Framework Convention on Climate Change (UNFCCC), and the opportunity presented by the upcoming 21st session of the COP (COP 21). Two roundtable discussions were held, on steps to complete and move beyond the first wave of CCS demonstrations, and on national and international policies to accelerate the deployment of CCS. Participants also heard key perspectives from the Technical and Policy Groups, as well as from stakeholders, and discussed country experiences, opportunities, key policies and potential actions needed for CCS deployment, after which a Ministerial Communiqué was issued.

On Thursday, 5 November 2015, heads of delegations travelled to Dhahran, Saudi Arabia, where they visited the headquarters of Saudi Aramco, heard presentations on CCS-related developments in Saudi Arabia and toured operational and research facilities. They then attended a luncheon hosted by Saudi Aramco CEO Amin H. Nasser.

This report summarizes the presentations and discussions held during the Ministerial Conference on 4 November and the site visit on 5 November.

BRIEF HISTORY

The CSLF was established in 2003 for the purpose of fostering cooperation to facilitate the development of cost-effective technologies for the capture and safe long-term storage of carbon dioxide (CO2), and make these technologies available internationally. The Forum currently has 25 members, made up of 24 countries and the European Commission, representing approximately 60% of the global population.

Ali bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, Saudi Arabia, and CSLF Ministerial Co-Chair, during the opening plenary session

The CSLF comprises a Policy Group and a Technical Group which meet regularly at times and places determined by appointed representatives. The Policy Group is responsible for the review of legal, regulatory, financial and other issues as needed. The Technical Group: identifies technical, economic, environmental and other issues related to improvement in technological capacity; proposes potential areas of multilateral collaboration on carbon capture, transport and storage technologies; and fosters collaborative research, development and demonstration projects reflecting Members' priorities. The schedule of meetings has evolved since the first Meeting of the Policy and Technical Groups in 2004, but both groups have met at least once annually since that time.

IN THIS ISSUE

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Numerous other workshops and task forces have contributed to the work of the CSLF, meeting as needed to allow Members to review the progress of CSLF-endorsed CCS projects, identify promising directions for further research, and collaborate with the international research community, including industry, academia, government and non-government organizations, with regard to advancing CCS technology and policy. The CSLF Projects Interaction and Review Team (PIRT) was also established in 2006 and has met 14 times.

The CSLF's highest decision-making body is the Ministerial Meeting, which convenes as needed to provide policy and technical direction for the organization. The Ministerial Meeting convened its inaugural meeting in Tyson's Corner, Virginia, US, in 2003. Participants discussed emerging CCS issues, the current situation and challenges for CCS, challenges and goals, and active sequestration projects. The Ministerial Meeting has been held four more times, with the fifth and most recent taking place in Washington, DC, US, in 2013. During this meeting, participants endorsed CCS as a critical low-carbon technology option which can significantly reduce CO2 emissions from coal and gas-fired power plants and industrial processes, including refineries, the chemical sector, and cement and steel manufacturing.

REPORT OF THE MEETING

OPENING PLENARY SESSION: MOVING BEYOND THE FIRST WAVE OF CCS DEMONSTRATIONS

WELCOME: Ernest Moniz, US Secretary of Energy and Ministerial Co-Chair of the Carbon Sequestration Leadership Forum (CSLF), opened the meeting on Wednesday morning, 4 November, welcoming participants. He noted that the CSLF was established to facilitate the development and deployment of improved cost-effective technologies for carbon capture and storage (CCS). He commented that achieving a low-carbon world requires reduced demand as well as a suite of low-carbon technologies in the power sector, including renewables, nuclear and CCS.

Moniz said this forum provides a platform for top-level dialogue before the upcoming International Energy Agency (IEA) ministerial meeting and 21st session of the Conference of the Parties (COP 21) to the UN Framework Convention on Climate Change (UNFCCC). He called for full attention to CCS in any strategy adopted at COP 21. Noting that CSLF membership now includes 24 countries and the European Commission, he welcomed Romania and Serbia as the newest members.

Ernest Moniz, US Secretary of Energy and Ministerial CSLF Co-Chair

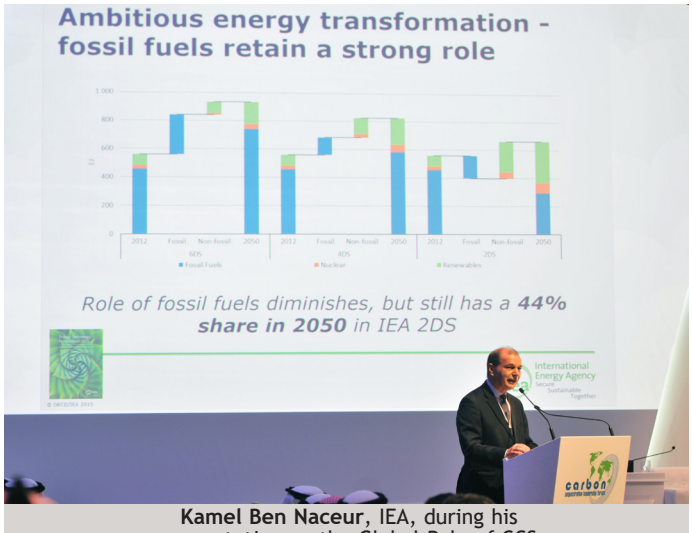
HOST COUNTRY ADDRESS: Ali bin Ibrahim Al-Naimi, Minister of Petroleum and Mineral Resources, Saudi Arabia, and CSLF Ministerial Co-Chair welcomed participants to Riyadh. He stated that natural resources such as fossil fuels have powered global economic growth and progress for centuries, and expressed hope that developing nations would benefit from these resources while technology and innovation mitigate side effects.

Calling climate change a challenge that can be overcome by human ingenuity, research and technological advances, he noted that the global energy mix is changing, with nuclear, solar and wind increasingly complementing fossil fuels, but said all forms of energy will be required to meet the needs of future generations. Highlighting the importance of the CSLF, Al-Naimi noted nations' agreement that reducing emissions and combating climate change are global priorities and stressed that CCS is a critical part of the global quest to reduce emissions. He praised ongoing efforts and projects worldwide and the CSLF's role in catalyzing these efforts, calling on governments to continue committing manpower, brainpower, investment and research.

SCENE-SETTING PRESENTATIONS: Global Role of CCS: Kamel Ben Naceur, Director, Sustainable Energy Policy and Technology, IEA, spoke on three themes. On the need for CCS, he said many analyses show that CCS is necessary to cost-effectively achieve the 2°C scenario (2DS) advocated as the necessary trajectory for sustainability. He noted that by 2050, two-thirds of carbon dioxide (CO2) capture will come from countries that are non-members of the Organisation of Economic Co-operation and Development (OECD).

On progress in CCS, Naceur said the energy required to separate one tonne of CO2 has decreased by 50% over 25 years, and the amount of CO2 captured and stored globally is projected to double from 30 Mt CO2 in 2015 to 60 Mt CO2 by 2020, but an increase to 500 Mt CO2 is needed for achieving the 2DS. He commended Norway's pioneering work on CCS, including on criteria for achieving certainty of fossil fuel value, understanding of local geology, market opportunity, and low-risk political and social environments.

On progress needed, Naceur called on governments to provide financial support mechanisms, policies encouraging innovation, and supportive international regulation; and for industry and the innovation sector to push for pilots and research. He said collaboration with the financial sector is also needed, particularly with multilateral financing agencies.



Kamel Ben Naceur, IEA, during his presentation on the Global Role of CCS

Nadhmi A. Al-Nasr, Executive Vice-President, KAUST, Saudi Arabia, during his presentation on the Role of CCS in the Middle East

Naceur said CCS can become competitive as costs are reduced through innovation and decreases in energy requirements. He noted a worldwide IEA study on the potential of "EOR+", aiming to maximize the quantities of CO2 injected into oil reservoirs in the process of enhanced oil recovery (EOR). He said that a coalition of willing countries is building momentum in pushing the technology forward to reach climate goals without jeopardizing GDP growth. He encouraged participants to pass a powerful statement from this Ministerial to COP 21.

Role of CCS in the Middle East: Nadhmi A. Al-Nasr, Executive Vice President, King Abdullah University of Science and Technology (KAUST), Saudi Arabia, provided an overview of CCS efforts in the Middle East, noting that in the face of growing energy demand, growing population, economic growth, water scarcity, harsh climate and a carbon-intensive infrastructure, the region remains committed to reducing emissions, and as the leading oil-producing region, has a major role to play in the future energy mix.

He described projects in CCS and EOR throughout the region, including Saudi Aramco's Uthmaniyah CCS/EOR project and the Emirates Steel CCS project, each of which has the capacity to store 800,000 tons of CO2 annually, as well as projects at the Saudi Basic Industries Corporation (SABIC) in Saudi Arabia and QAFAC in Qatar to use CO2 in production of methanol and urea.

On CCS research and development in the region, he noted efforts underway at Saudi institutions including the King Abdullah Petroleum Studies and Research Center, Saudi Aramco, KAUST, SABIC, King Fahd University of Petroleum and Minerals, King Saud University, and King Abdulaziz City for Science and Technology.

In closing, Al-Nasr noted that the Middle East has much to offer through its geoscience knowledge and capacity, and its commitment to CCS and EOR. He stressed the importance of collaboration between corporations, universities and research bodies.

HISTORY AND OPPORTUNITY OF THE CONFERENCE OF THE PARTIES (COP) TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC): Christian Friis Bach, UN Under-Secretary-General and Executive Secretary of the UN Economic Commission for Europe (UNECE) spoke on CSLF links to the UN, noting that energy, the focus of the CSLF, is at the core of both the new Sustainable Development Goals (SDGs) and COP 21. He reasoned that fossil fuels will be integral to the global economy for many decades and called for open discussion on how countries relying on

Christian Friis Bach, Under-Secretary-General, UNECE, during his speech on the History and Opportunity of the COP to the UNFCCC

them can be part of both the climate solution and sustainable development, saying the challenge is to convey to the COP, and the whole globe, the fundamental reality that CCS is a critical part of the solution.

Bach called for scaling up efforts to develop and deploy CCS technologies in developed and developing countries, with demonstration projects for low-cost solutions, government support, financial and institutional frameworks, policies to ensure investment, funding mechanisms, and increased monitoring capability. He stressed that for a sustainable energy future, a systems perspective is needed which integrates all technologies, and highlighted that there is no choice between the climate agenda and rational economics, but that markets must compensate producers and consumers for acting sustainably. He said deployment in developing countries is not only essential, it is a good business opportunity.

Bach announced the launch of a new UN tool for classifying energy resources and fossil fuels, and encouraged use of the UN as a convening platform to achieve common climate-energy solutions using all available technologies.

Co-Chair Moniz closed the morning plenary, saying that the meeting's central message is that there is no one low-carbon solution for all countries and that all options must be developed.

ROUNDTABLE SESSION 1: STEPS TO COMPLETE AND MOVE BEYOND THE FIRST WAVE OF CCS DEMOS – HOW FAST IS REASONABLE?: Suhail Mohamed Faraj Al Mazrouei, Minister of Energy, United Arab Emirates, chaired the session. Noting that a megascale CCS project can have the same impact on CO2 emissions as removing 170,000 cars from the road, he asked panelists to describe their projects' budget challenges and commercial feasibility and to comment on the role of government and regulation in making projects viable.

Shell Quest Project in Canada: David Hone, Chief Climate Change Advisor, Shell, described a storage-only CCS project in Scotford, Alberta, Canada, that Shell built with Fluor. Noting that technology, drilling and pipelines are no longer challenges for the industry, he stressed the importance of policy frameworks and carbon pricing for commercial feasibility. He stated that Alberta's provincial carbon price, combined with provincial and federal government support, make the project viable, and that Shell is focusing on price-relevant policy frameworks to drive commercially viable CCS.

The dais during Roundtable Session 1: (L-R) Chair **Suhail Mohamed Faraj Al Mazrouei**, Minister of Energy, UAE; **David Hone**, Global Climate Change Advisor, Shell; **Michael Monea**, President of CCS Initiatives, SaskPower; **Scott McDonald**, Biofuels Development Director, Archer Daniels Midland; **James Briscoe**, Senior Vice-President of Development, Occidental Petroleum; **Khaled A. Al-Buraik**, Vice President, Petroleum Engineering and Development, Saudi Aramco; and **Hans Schoenmakers**, Director Stakeholder Management, Maasvlakte CCS Project C.V.

SaskPower Boundary Dam Project in Canada: Michael Monea, President, CCS Initiatives, SaskPower, described multiple CCS projects. He focused on the company's first commercial-scale plant at the Boundary Dam power station and said it has proven the economic feasibility of CCS, as the utility evaluates how to balance coal and natural gas in its fuel mix. Noting that the experience gained at Boundary Dam will make future plants 30% less expensive to build, he called for knowledge-sharing and collaboration with other panelists and institutions around the world to advance CCS globally.

Illinois Industrial CCS Project in the United States: Scott McDonald, Biofuels Development Director, Archer Daniel Midland, described an industrial CCS project at its ethanol-production facility in Decatur, Illinois, which produces 1 million gallons of ethanol and 3,000 tons of CO2 daily. He highlighted: low capital expenses due to a grant from the US Department of Energy's Industrial CCS Program and partner funding; use of off-the-shelf technologies; low operating expenses due to automation and minimal manpower requirements; and tax credits on the first 750 million tons of CO2 sequestered.

Noting guidance from regulatory framework drivers including underground injection control (UIC) programme rules and the EPA Clean Power Plan, McDonald said new coal-fired plants definitely require CCS. He noted that site geology in the former oil fields of the Illinois Basin makes storing 40-100 billion tons of CO2 possible but includes no monetization, and he preferred reusing CO2 in EOR or in the production of carbonates and other chemicals.

Occidental Petroleum's CO2 Enhanced Oil Recovery Business in the United States: James Briscoe, Senior Vice President of Development, Occidental Petroleum, reported on Occidental's successful CO2-EOR business in the Permian Basin, which began in 1972 and was successfully commercialized. He described the CO2-EOR process, noting that CO2 flooding can increase oil recovery from a particular field by 15-25% of the original amount of oil in the field, substantially increasing the revenue stream from the field, as well as providing significant CO2 sequestration. He said this project demonstrates successful implementation of CO2-EOR in the US, with good reservoir characterization, operational excellence, rigorous surveillance and a culture of safety, and noted that technologies used to manage CO2 flooding can and should be used to measure and verify the quantity of CO2 sequestered during EOR, to be reported to the appropriate authorities.

Uthmaniyah CO2-EOR Project in Saudi Arabia: Khaled A. Al-Buraik, Vice President, Petroleum Engineering and Development, Saudi Aramco, reported on the Uthmaniyah CO2-EOR demonstration project in Saudi Arabia. Noting Saudi Aramco's global leadership in environmental protection solutions such as energy efficiency, reduced gas flaring, zero discharge, renewables, and carbon management, he said this project builds on his company's environmental stewardship by lowering its carbon footprint while supplying energy to the world.

Al-Buraik said the key feature of the Uthmaniyah CO2-EOR is a unique monitoring and surveillance system, which enables deeper views into the reservoir. He explained that the project includes monitoring of sequestered CO2, plume evolution, CO2 migration and oil saturation, noting that: seismic sensors track plume propagation; cross-well electromagnetic surveys track the travel of CO2 plumes between two wells; borehole and surface gravity surveys detect inadvertent CO2 leakage into shallow aquifers; and tracers track CO2 flow path and breakthrough speed.

Al-Buraik cautioned that this project is a test, to continue research into making CCS for EOR economically viable and ensure that best practices are developed for a win-win scenario of recovering more oil and saving the environment by using more CO2. He then showed participants a video describing the project in greater detail.

Rotterdam Storage and Capture Demonstration Project (ROAD) in the Netherlands: J.C.P. (Hans) Schoenmakers, Director Stakeholder Management, Maasvlakte CCS Project C.V., showed participants a video about the City of Rotterdam's Storage and Capture Demonstration Project (ROAD), which aims to make Rotterdam a CO2 hub in northwestern Europe. He noted that the project is still going after six years although developments in the energy market have not favored CCS and the project is not yet operational.

Schoenmakers stressed that CCS must be a general practice of all industries by 2030 so as to win the battle against global warming cost-effectively. He said there is not enough climate funding to achieve this, so the business perspective is crucial, particularly business success stories of reducing costs and adding value. He cautioned, however, that international cooperation is essential for limiting global warming and called the absence of CCS on the official agenda for COP 21 a possible missed opportunity. He urged everyone with an interest in CCS to push for it.

Al Mazrouei then asked panelists to address whether governments need to do more. Hone responded that policy structures are the door to future investment. Monea said funding at the beginning is critical, having provided a tipping point for the SaskPower project for building plants, and noted the lack of carbon value in Canada. Briscoe said the Permian Basin project was enabled by US EOR credits which established the infrastructure. He said the success of future projects will depend on coalitions of projects and government support. Al-Buraik said his project had received a lot of government support. Noting that it will take many years to understand CCS and make it economically viable, he called for government investment in deep research.

Al Mazrouei summarized the panel's view that government support is needed, either through tax credits for carbon or subsidies for projects to continue, but noted that projects' costs drop when technology advances. He called for government and private sector cooperation and investment in research and development in order for CCS projects to be commercialized and CCS to become a viable solution.

ROUNDTABLE SESSION 2: NATIONAL AND INTERNATIONAL POLICIES AND COOPERATION TO ACCELERATE THE DEPLOYMENT OF CCS: Co-Chair Al-Naimi introduced the session. He challenged speakers to address: the role of CCS in the context of national and international greenhouse gas (GHG) policy; the pros and cons of policies and incentives specific to CCS versus broader clean energy policies; which industries are the most promising candidates for technology transfer and capacity development; next steps; and how the CSLF can facilitate knowledge-sharing and collaboration.

Norway's CCS Efforts: Tord Lien, Minister of Petroleum and Energy, Norway, discussed Norway's CCS efforts, noting that CCS is needed to confront the challenges of population growth and the need for economic growth, particularly outside the OECD, in a world that will remain dependent on fossil fuels for decades to come. He called for a price on emissions, saying this would create an incentive to reduce emissions, which will lead to CCS projects.

Tord Lien, Minister of Petroleum and Energy, Norway, reported on Norway's CCS policy.

Henk Kamp, Minister of Economic Affairs, Netherlands, presented the Netherland's CCS efforts.

Lien listed three pillars of Norwegian CCS policy: research, development and demonstration; support for the realization of full-scale demonstration facilities; and promotion of the development of CCS internationally. Noting that Norway's emissions are only 0.1% of the global total, he said Norway's mandate is to promote CCS internationally through various programmes, funds and cooperation.

The Netherlands' CCS Efforts: Henk Kamp, Minister of Economic Affairs, the Netherlands, noted the challenge of developing CCS to be an attractive, cost-effective option for the market and society, and explained that the Netherlands had adopted this as a climate goal in 2013. Noting the Netherlands is focused on saving energy and increasing renewable share, he said large-scale energy intensive industries can use CCS to reduce emissions and that industry can share CCS infrastructure with nearby power plants. Referring to Rotterdam's ROADS project, he called for more international cooperation, and said the current generation must strive to ensure that it does not damage the world for future generations.

U.S. CCS Policy: Ernest Moniz described the Obama Administration's Climate Action Plan, highlighting mitigation, adaptation and international collaboration. Noting the US energy policy includes coal and natural gas, he said CCS contributes to mitigation and was highlighted in the November 2014 joint announcement on climate change by US President Barack Obama and Chinese President Xi Jinping.

Moniz said the US domestic programme supports CCS through three main mechanisms: carrying out research, development and demonstration; providing and enhancing regulatory certainty; and proposing financial incentives and other policy tools. He said much progress has been made but much work remains, noting: the need for more work on carbon storage in deep saline formations; the great distance to the 2020 goal of major operational projects; lack of market conditions necessary for major capital in research and development; and close links with water, and issues of permanence and long-term liability.

During the ensuing discussion, Jeremy Pocklington, UK, described his country's second CCS commercialization competition, saying two projects have been proposed, with final bids expected at the end of the year. Noting that the finance and assurance markets will become more comfortable

Ernest Moniz, Secretary of Energy, US, presented the US CCS Policy Under President Obama's Climate Action Plan.

with CCS as commercial projects come online, he pledged to work more closely with European partners and highlighted contributions to capacity-building funds through the World Bank and Asian Development Bank.

Mohammed bin Saleh Al Sada, Qatar, expressed concern over environmental threats from climate change, saying CCS should be prioritized for new projects that emit CO2. Highlighting Qatar's commitment to environmental protection, he cited its production and export of liquefied natural gas (LNG) as a cleaner fossil fuel. He noted that the Clean Development Mechanism (CDM) was expected to generate financial incentives through trading in carbon credits, but that the carbon market has recently collapsed, with credit prices dropping drastically. He said this harms the prospects for funding CCS projects at the largest scales and called for a new financial mechanism to provide incentives specifically for CCS. He cited domestic projects including a carbonate and carbon storage research center and the use of CO2 to save energy in LNG production.

AFTERNOON SESSION: KEY ACTIONS NEEDED FOR CCS AT THE 2015 UNITED NATIONS CLIMATE CHANGE CONFERENCE (COP 21) TO ENSURE A CLEAN ENERGY FUTURE

KEY CSLF PERSPECTIVES: Stakeholders: Barry Worthington, Executive Director, United States Energy Association (USEA), presented messages to the ministers from the stakeholders' meetings held on 2-3 November. He noted that energy consumption may double by 2050 to meet demand, and that this will be inconsistent with cutting GHGs unless renewables, CCS and as-yet-unheard-of technologies are all put to use. He also stressed carbon capture in emission-intensive industries such as cement and steel.

Worthington noted that CSLF stakeholders do not desire the subsidies that some other technologies receive but want a level playing field. He favored financial and fiscal tools for CCS but said many of these are not available. Noting that financial markets respond to government policy signals, Worthington said if alternatives to CCS are given policy preference, the financial community will lend to them rather than to CCS. He called for financial support for emerging technologies, including incentives for technological innovation and enhanced research, development, demonstration and deployment strategies, particularly for new capture and utilization technologies such as for small operations.

Worthington also called for policy mechanisms to reduce long- and short-term legal liability for CO2 storage, and for: reduction of onerous verification standards; policy support to drive down development costs; and deployment of demonstration projects in developing countries. He said stakeholders and additional CCS advocates need to be involved in communicating the need for and value of carbon storage for reducing GHGs, and thanked the UNECE for their endorsement. He underscored the need for data and knowledge-building on offshore CO2 storage and for special attention to the new CSLF members.

Technical Group: Trygve Riis, Technical Group Chair, Norway, presented the Technical Group's recommendations on evaluations, assessments and collaborative work. He stated that two years after the launch of the 2013 Technology

Barry Worthington, Executive Director, USEA

Trygve Riis, Technical Group Chair, Norway

Christopher Smith, Policy Group Chair, US

Roadmap there are still barriers inhibiting accomplishment of its goals for large-scale deployment of CCS by 2020. He announced a new Technical Group interim report to assess technology readiness, current progress towards commercial implementation and key technological, policy and economic factors affecting implementation.

Riis summarized the Technical Group report, highlighting its messages, including that: first generation technology is ready; economic and policy-related barriers create uncertainty for investment decisions for demonstration projects as well as for research and development; second generation technologies consist of improvements to decrease costs, and increase reliability and operational performance; operational scale and the need for full-scale projects for learning remains an issue; there is only slow to moderate progress toward implementation in ten technology-oriented areas, mainly because of existing policy and economic barriers; and technology readiness in some areas, such as carbon storage, is almost 100%.

Riis gave the Technical Group's recommendations. On technology he called for sharing best practices, encouraging public-private partnerships, and developing more demonstration projects. On economics, he called for governments to work with stakeholders to reduce costs, saying government plays a critical role in incentivizing early projects. On policy, he called for review of institutional barriers, and for regulatory and policy frameworks for meeting goals and removing barriers.

Riis also made specific recommendations, including: clarification of policies and regulatory frameworks for EOR; technical analyses to understand the potential of non-EOR options for CO2; evaluation and assessment of capacity for offshore sub-seabed CO2 storage; financial incentives to speed development and knowledge sharing; continued and sustained support to reduce the costs of CO2 capture, such as through pilot projects for learning; and engagement with emerging economies in capacity building as a precursor to large-scale CCS.

Policy Group: Christopher Smith, Policy Group Chair, US, noted the establishment of a committee in 2013 to explore issues of international cooperation and discussed four recommendations from the committee's working groups in these areas. On communications, he recommended leveling the playing field, ensuring parity for non-power industries such as cement and steel, and creating a new communications expert position to coordinate with the IEA and the Global CCS Institute to deliver one message to bodies such as the UNFCCC.

On global collaboration Smith called for: creating new projects and adding value to existing projects; addressing the need for a large-scale storage network; collaborative testing; and developing a global network of large-scale injection sites. On financing, he recommended that the CSLF initiate a series of business-to-business and government-to-government workshops and discussions in support of CCS, stating that one lesson learned from existing projects is that policy frameworks are crucial.

On second and third generation projects, Smith called for the CSLF to play a role in creating enabling mechanisms, saying the cost of CCS is a significant barrier to its deployment. He noted that a joint Policy Group-Technical Group task force is identifying emerging technologies for carbon capture.

Reporting the Policy Group's recommendations to ministers, Smith called for: enhancing technological efforts and fostering research cooperation; testing emerging technologies and accelerating their commercial adoption; and capacity building to develop the information, tools, expertise and institutions that are required to implement CCS and move rapidly to commercial application, particularly in emerging economies and in academic and research institutions. He ended by noting that the Policy Group has been very productive, attracting the attention of other countries and garnering new CSLF members.

CSLF MINISTERIAL DISCUSSION: OPPORTUNITIES/KEY POLICIES AND ACTIONS NEEDED FOR CCS DEPLOYMENT: Co-Chair Moniz summarized points raised during the day, that: governments should collaborate to help scale up CCS; more work is needed, particularly for commercial viability; the business case for CCS has been made; and an enabling policy environment must be created. Noting differences in national approaches, he nonetheless urged a unified core message from CSLF members, on behalf of their three billion citizens, to the IEA ministerial in mid-November and COP 21 in Paris.

On reaching multi-gigaton rates of carbon capture, Moniz highlighted the need to discuss public confidence and long-term liability. He called for coordinating efforts with international bodies dealing with energy, sharing results to accelerate learning, and exploring transformative processes such as "sunlight+CO2+water=fuel."

In the ensuing discussion, several countries shared viewpoints and experiences. France highlighted a project from Total demonstrating the safety of CCS. Australia described funding for research and development and policies to support CCS. The Czech Republic noted the need for capacity building and expressed hope of becoming a full CSLF member. Canada

Frank Des Rosiers, Assistant Deputy Minister of the Innovation and Energy Technology Sector, Canada

highlighted projects, both ongoing and soon-to-be-launched, and called for considering a ban on coal-fired plants lacking CCS technology.

The US expressed concern over the low number of participants from the oil and gas industries at the CSLF meeting and urged more effort to ensure their collaboration in the future. Turkey expressed interest in becoming a full CSLF member and stressed the need to work with academia to find solutions to problems in carbon storage. Saudi Arabia called for more EOR demonstration projects and detailed technical and economic analysis. Japan discussed its intended nationally determined contribution under the UNFCCC and plans for the period to 2030. Azerbaijan noted that the world is aware of energy as an instrument of development, and its role in climate change.

Prince Abdulaziz bin Salam, Vice Minister, Ministry of Petroleum and Mineral Resources, Saudi Arabia

The Global Carbon Capture Storage Institute underlined the importance of the day's discussions and noted that agencies want to work closely with the CSLF, stressing the possibilities for breakthrough technologies and CO2 utilization schemes over the next 15 years.

Co-Chair Al-Naimi thanked participants and expressed zeal for working together on the challenges ahead. Heads of delegation then convened in a closed meeting to discuss wording of the ministerial communiqué. The meeting was closed at 4:15 pm.

MINISTERIAL COMMUNIQUÉ

In the Communiqué, ministers and heads of delegation expressed their encouragement at progress made in the research, development, demonstration and deployment of CCS, but noted that more needs to be done to bring CCS to the marketplace, and called for accelerating CCS deployment through strong global commitments and supportive government policies. They identified key actions needed, including:

- Asserting and advocating for clean energy policies that support CCS alongside other clean energy technologies, such as renewable energy and efficiency measures;
- Continuing to foster international collaboration aimed at advancing development and deployment of large-scale CCS technology demonstration projects to build government, investor and public confidence;
- Committing to coordinated global efforts to deploy CCS projects and build technical and regulatory capacity around the world;
- Creating opportunities and removing barriers for private sector investment in order to advance CCS and spark innovation;
- Giving CCS fair consideration in clean energy policies and resource commitment, while also supporting development of comprehensive CCS policy frameworks;
- Supporting industrial CCS applications as a pathway to implement substantial, scalable CCS pilot plants;
- Encouraging early stage exploration and development of common user storage and transport infrastructure to significantly de-risk many potential CCS projects; and
- Continuing to explore the potential of CO2 utilization technology to accelerate the deployment and technology maturation of carbon capture and mitigation.

The Communiqué: highlighted the importance of involvement of supportive and engaged stakeholders from industry, society and the academic community; applauded the efforts of stakeholders to advance CCS; and encouraged their continued involvement and input on how to further the goals of the CSLF and implement the key actions.

On next steps, the Communiqué cited the need for CSS to compete on a comparable basis with other clean energy options as nations prepare for implementation of the outcome of COP 21. Ministers and heads of delegation conveyed their support to the International Maritime Organization for steps taken to ensure safe sub-seabed CO2 storage and address transport issues under the London Protocol. To support these steps, the Communiqué tasked the CSLF to work to accelerate CCS deployment by:

- Establishing a global CCS project network to facilitate the sharing of lessons learned;
- Exploring opportunities to collaborate on research, development, and demonstration projects advancing CCS combined with fresh water co-production;
- Promoting appropriate recognition of and crediting for bioenergy plus CCS (BECCS) and enhanced oil recovery plus CCS in regional, national and multinational CO2 accounting mechanisms; and
- Expanding outreach to the academic community to engage the next generation of CCS scientists, engineers and policy makers.

The Communiqué resolved that the CSLF will continue to leverage investments, share knowledge and lead strategic multi-national initiatives, including ongoing capacity building efforts, reinvigorated efforts of the CCS in the Academic Community Task Force, multilateral research and development collaborations, the International Test Centre Network, and the Large-Scale Saline Storage Project Network, to help streamline global collaboration on CCS as a competitive and deployable low-carbon technology, attracting investments and enhancing growth in CCS to help resolve barriers for successful implementation of CCS projects worldwide in a time frame consistent with global climate change mitigation aspirations.

CSLF MINISTERIAL VISIT TO SAUDI ARAMCO, DHAHRAN

On Thursday morning, 5 November, participants travelled to Dharan, Saudi Arabia, for a site visit to Saudi Aramco facilities. During the welcome programme, participants watched a video highlighting the company's work to provide energy and opportunities to a growing world population, while pursuing its goal of increasing efficiency and managing GHG emissions.

Participants were given an overview of the day's events by master of ceremonies, Abdullah A Rabah, Saudi Aramco. Amin Nasser, CEO, Saudi Aramco, then made welcoming remarks, noting Saudi Aramco's cutting-edge work in CCS. He listed advantages the company brings to this work in: innovation, decreasing its CO2 footprint six-fold since 1980; ambition

During the site visit participants watched a video about Saudi Aramco.

and experience in driving change, such as pioneering change in investment from liquid fuel to natural gas which produces fewer emissions; global impact in increasing efficiency because of its size; and research and development for efficiency, such as work on tire performance, mileage, emission reductions and, now, CCS, including deep saline aquifer storage for carbon.

Nasser highlighted Saudi Aramco's work in carbon utilization, including its Uthmaniyah CCS/EOR project, its growing investment in turning CO2 into products such as polythene and cement, and increasing research into technology for commercialization of CO2. Finally, he noted the value that Saudi Aramco places on collaborative work, such as its partnership with other oil and gas companies in the Oil and Gas Climate Initiative to undertake collaborative research to reduce their carbon footprint. He highlighted the need for global energy policies to enable solutions.

Amin H. Nasser, President and CEO, Saudi Aramco

Sarah Tamimi, Saudi Aramco Corporate Affairs, gave an overview of Saudi Aramco's contributions in energizing the world economy, people and ideas across the value chain. She noted that Saudi Aramco provides one in every eight barrels of oil used in the world and pointed to its nomination for a UNESCO environmental responsibility award for its work in protecting habitat surrounding its offshore oil operations.

Ahmad Al Khowaiter, Chief Technology Officer, provided an overview of Saudi Aramco's work in carbon management technology. Khowaiter noted that demand for energy is highest in developing countries and is increasing in parallel with CO2 emissions. He presented a timeline of Saudi Aramco's work in transforming this challenge into an opportunity, beginning with its pioneering investments in capturing and utilizing methane since the 1970s. He listed chronological developments including: an energy management programme, addition of cogeneration capacity, reductions in flaring, and increases in energy efficiency since 2000; the launch of a Carbon Management Technology roadmap in 2006, leading to the first mobile carbon capture demonstration in 2011 and the Uthmaniya CCS/EOR project; and research and development in accelerated transformation since 2010.

Al Khowaiter noted that the company's experience in fluid separation, fluid transport, chemical conversion, and subsurface work can all be applied to carbon management, and gave numerous examples of the company's work in CCS and CUS, including onboard CO2 capture, sub-surface sequestration, and use of CO2 in polymers, EOR, production materials, oxy-combustion, and fracking. He stressed the importance of partnerships across the world for realizing solutions.

Participants then watched a video presentation of initiatives being undertaken by SABIC and heard a presentation by Awadh Al Maker, Executive Vice President, Technology and Innovation, SABIC, on its operations. He described SABIC's work to create value out of sustainability, given the key role of sustainability in its 2025 Strategy, and highlighted the four dimensions of SABIC's CO2 work: low-carbon technology, operational excellence, CO2 utilization and CO2 avoidance.

During their visit, energy ministers and other heads of delegation posed for a photo at the Saudi Aramco Oil Supply Planning and Scheduling (OSPAS) Center

Participants learned about Saudi Aramco's mobile CO2 capture activities.

After the morning's presentations, participants were given a tour of some of Saudi Aramco's Dhahran facilities, including the Oil Supply Planning & Scheduling center, the Upstream Professional Development Center and the GeoSteering department at the Exploration & Petroleum Engineering Center.

A luncheon was then hosted by Amin Nasser, and closing remarks were given by Ali bin Ibrahim Al-Naimi, who expressed great appreciation to all who had attended the week's CSLF events. The day's events ended at 2:35 pm.

UPCOMING MEETINGS

Solar World Congress 2015: The 2015 International Solar Energy Society (ISES) Solar World Congress (SWC) will take place in Daegu, the Republic of Korea, from 8-12 November, hosted by the Korean Solar Energy Society. The ISES Annual General Meeting will also take place during the Congress, on 10 November. **dates:** 8-12 November 2015 **venue:** EXCO **location:** Daegu, Daegu-Gyeongbuk, Republic of Korea **contact:** Jung June (Jason) **phone:** +82-53-746-9967 **fax:** +82-53-742-9007 **e-mail:** info@swc2015.org **www:** http://www.swc2015.org/ or http://www.swc2015.org/down_data/SWC2015_brochure%28website%29.pdf

Clean Cooking Forum 2015: The four-day 2015 Biennial Clean Cooking Forum will include topics on: building consumer confidence; applications for mobile technology; consumer finance; cross-sector integration; refugee and other humanitarian needs; and performance evaluation. **dates:** 10-13 November 2015 **location:** Accra, Greater Accra, Ghana **e-mail:** forum@cleancookstoves.org **www:** http://cleancookstoves.org/events/154.html or http://cleancookstoves.org/about/news/05-04-2015-clean-cooking-forum-2015-call-for-abstracts-and-sessions-guidelines.html

2015 IEA Ministerial Meeting: The 2015 IEA Ministerial meeting, 'Innovation for a Clean, Secure Energy Future,' will emphasize the importance of increased cooperation among IEA member countries, emerging economies and the business community. The Ministerial meeting convenes every two years to help set strategic priorities for the IEA and will be chaired by US Energy Secretary Ernest Moniz. **dates:** 17-18 November 2015 **venue:** IEA Headquarters **location:** Paris, Ile-De-France, France **phone:** +33-1-40-57-65-00 **www:** http://www.iea.org/newsroomandevents/events/name-139194-en.html

24th Session of the UNECE Committee on Sustainable Energy: The 24th Session of the UN Economic Commission for Europe (UNECE) Committee on Sustainable Energy will meet under the theme 'Pathways to Sustainable Energy.' The meeting will be preceded by the third Geneva Energy Conversation on 17 November, which will address the role of fossil fuels in sustainable energy systems. **dates:** 18-20 November 2015 **venue:** Palais des Nations **location:** Geneva, Geneve, Switzerland **e-mail:** sustainable.energy.committee@unece.org **www:** http://www.unece.org/index.php?id=38539#/ http://www.unece.org/fileadmin/DAM/energy/se/pdfs/comm24/24.CSE.Week.outline.pdf

UNFCCC COP 21/CMP 11: COP 21 will take place in December 2015 in Paris, France, together with the 11th session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP 11), and meetings of subsidiary bodies. **dates:** 30 November - 11 December 2015 **location:** Paris, Ile-De-France, France **contact:** UNFCCC Secretariat **phone:** +49-228 815-1000 **fax:** +49-228-815-1999 **e-mail:** secretariat@unfccc.int **www:** http://www.unfccc.int

11th CO2GeoNet Open Forum: Following COP 21 in Paris in December 2015, the 2016 Open Forum will focus on the future of CCS and in particular the role CO2 storage will play in hitting crucial low carbon targets. **dates:** 9-11 May 2016 **location:** Venice, San Servolo Island, Italy **e-mail:** info@CO2geonet.com **www:** http://www.CO2geonet.eu/

GLOSSARY

CCS	carbon capture and storage
CO2	carbon dioxide
COP	Conference of the Parties
CSLF	Carbon Sequestration Leadership Forum
EOR	enhanced oil recovery
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change


A view of Saudi Aramco offices