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Workshop on Carbon Management Bulletin

A Summary Report of the International Experts Workshops on Carbon Management and its Implications

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SUMMARY OF THE INTERNATIONAL EXPERTS WORKSHOPS ON CARBON MANAGEMENT AND ITS IMPLICATIONS: 27-30 APRIL 2015

The International Experts Workshops on Carbon Management and its Implications took place from 27-30 April 2015 in Al Khobar, Saudi Arabia. The workshop, organized by Saudi Arabia's Ministry of Petroleum and Mineral Resources and Saudi Aramco, took place in two parts: the 1st Global Methane Initiative (GMI) for Oil and Gas Sector Workshop and Exhibition in the Middle East convened from 27-28 April; and the International Experts Workshop on the Adverse Social and Economic Impacts of Mitigation Measures, from 29-30 April.

The GMI Workshop and Exhibition was also organized in partnership with the GMI and the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC). The meeting was attended by around 200 representatives from government, private sector, international organizations and academia. Participants considered *inter alia*: operational safety and energy security *via* methane emissions management; flare mitigation programme activities in Saudi Arabia; methane emissions and mitigation opportunities; methane emissions inventory experience in the Middle East; and methane emissions detection and measurement techniques, equipment and costs.

Case studies from Saudi Aramco, the US and other countries were presented, as well as oil and gas partner case studies. On Tuesday afternoon, participants went on a field trip to the Saudi Aramco Engineering Solutions Center in Dhahran, Saudi Arabia.

The aim of the International Experts Workshop on the Adverse Social and Economic Impacts of Mitigation Measures, also organized by the Ministry of Corporate Planning, Saudi Arabia, was to advance understanding of how to increase resilience to the adverse impacts of climate change mitigation. The workshop was attended by more than 50 representatives from government, private sector, academia and international organizations. Case studies were presented, analyzing vulnerabilities and identifying the best options from different sectors to address these vulnerabilities.

This report contains a summary of the 1st Global Methane Initiative (GMI) for Oil and Gas Sector Workshop and Exhibition in the Middle East and a summary of the



HRH Prince Abdulaziz bin Salman bin Abdulaziz Al-Saud, Vice Minister, Petroleum and Mineral Resources, Saudi Arabia, delivered opening remarks.

International Experts Workshop on the Adverse Social and Economic Impacts of Mitigation Measures.

A BRIEF HISTORY OF THE GLOBAL METHANE INITIATIVE

Methane is a short-lived greenhouse gas with an atmospheric lifespan of approximately 12 years. Though short-lived, methane is responsible for more than a third of total anthropogenic climate forcing, and has a global warming potential over 20 times greater than that of carbon dioxide. The production, processing, transmission and distribution of oil and natural gas form the second largest anthropogenic source of methane worldwide.

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The Global Methane Initiative (GMI) is a voluntary, multilateral partnership that aims to create a non-binding framework for international cooperation to reduce anthropogenic methane emissions, and advance the recovery and use of methane as a valuable clean energy source. It is an international network of partner governments, private sector members, development banks, universities and non-governmental organizations.

The origins of the GMI date back to 2004, when 14 governments signed the Methane to Markets Partnership agreement, with the aim of enhancing international cooperation for methane mitigation. In 2010, building on the growing success of projects developed through the Partnership, 37 partner countries and the European Commission officially launched the GMI. Its aim is to enable stronger international action to address climate change while developing clean energy and stronger economies.

The GMI focuses on the five main methane emission sources: agriculture, coalmines, municipal solid waste, oil and gas systems, and wastewater. Within the oil and gas sector, the GMI aims to enable international leadership to mitigate global methane emissions by sharing technical knowledge and experience on the abatement, recovery and use of methane as a clean energy source. Key objectives of the Initiative within the oil and gas sector are to increase environmental quality, improve operational efficiency, and strengthen the economy. The GMI creates a collaborative forum within which partner countries and project network members work together to build capacity and remove barriers to methane mitigation project development.

A BRIEF HISTORY OF RESPONSE MEASURES

Climate change response measures taken by a country can negatively impact the social and economic development of other countries. Under the UN Framework Convention on Climate Change (UNFCCC), Article 4.8, parties are required to take into consideration, the concerns and needs of developing countries arising from the adverse effects of climate change and the impact of the implementation of response measures.

The Kyoto Protocol, in its Articles 2.3 and 3.14, provides a basis for addressing the impact of the implementation of response measures: parties are required to strive to minimize adverse economic, social and environmental impacts on other parties, especially developing country parties.

Over the years, the Conference of the Parties (COP) to the UNFCCC has adopted various decisions on the issue of response measures. In 2001, in Marrakesh, Morocco, parties adopted Decision 5/CP.7 and Articles 2.3 and 3.14 of the Kyoto Protocol as part of the Marrakesh Accords. The decision requested *inter alia*: developed donor countries to assist developing countries, particularly those most vulnerable to the impact of the implementation of response measures, to build capacity to address these impacts. Parties were urged to consider appropriate technological options in addressing the impact of response measures, consistent with national priorities and indigenous resources.

At COP 10 in 2004, parties adopted the Buenos Aires Programme of Work on Adaptation and Response Measures, Decision 1/CP.10, which requested the Secretariat to organize three regional workshops to reflect on regional priorities and one expert meeting for small island developing States. At COP 13 in December 2007, parties adopted the Bali Action Plan, Decision 1/CP.13 and established the *Ad Hoc* Working Group on Long-term Cooperative Action under the Convention. Under the Bali Action Plan, parties agreed on enhanced national and international action on mitigation, including consideration of economic and social consequences of response measures.

In December 2010, at COP 16 in Cancún, Mexico, parties agreed to convene a forum on the impact of the implementation of response measures in June and December 2011 during the meetings of the UNFCCC's subsidiary bodies. The objective of the forum was to develop a work programme under the subsidiary bodies to address impacts, with a view to adopting at COP 17, modalities for operationalizing a work programme and a possible forum on response measures. In December 2011, in Durban, South Africa, the COP decided to establish the response measures forum and mandated it to meet twice a year under a joint agenda item of the subsidiary bodies. Parties also adopted a work programme on response measures aimed at improving understanding of the impact of response measures in eight distinct areas.



L-R: Christiana Figueres, Executive Secretary, UNFCCC Secretariat; Khalid Al-Falih, President and CEO, Saudi Aramco; and HRH Prince Abdulaziz bin Salman bin Abdulaziz Al-Saud, Vice Minister, Petroleum and Mineral Resources, Saudi Arabia

Parties have not been able to make much progress on response measures since Durban. During the closing plenary of COP 20 in December 2014, parties agreed to forward a draft decision 20/CP.20 on the forum, contained in an annex to the COP 20 report (CP/2014/10/Add.3), for consideration by the 42nd session of the subsidiary bodies to be held in June 2015.

REPORT OF THE 1st GLOBAL METHANE INITIATIVE (GMI) FOR OIL AND GAS SECTOR WORKSHOP AND EXHIBITION IN THE MIDDLE EAST

OPENING

The 1st Global Methane Initiative (GMI) for Oil and Gas Sector Workshop and Exhibition in the Middle East opened on Monday morning, 27 April. Welcoming participants, Prince Abdulaziz bin Salman bin Abdulaziz Al-Saud, Vice Minister of Petroleum and Mineral Resources, Saudi Arabia, emphasized his country's commitment to building capacity to overcome global environmental challenges, underscoring technology and adaptation to address climate change. He highlighted the main components of Saudi Arabia's Intended Nationally Determined Contributions (INDCs) for the 21st session of the Conference of the Parties (COP 21) to the UN Framework Convention on Climate Change (UNFCCC) in Paris in December 2015, including developing technologies on energy efficiency, renewable energy, and carbon capture and storage.

Khalid Al-Falih, President and CEO, Saudi Aramco, emphasized that his company recognizes the importance of environmental stewardship alongside managing energy demands. He outlined Saudi Aramco's voluntary initiatives on climate change and biodiversity, and its willingness to collaborate with other companies, countries and international organizations on methane abatement.

Joseph Westphal, US Ambassador to Saudi Arabia lauded Saudi Arabia's strong leadership in responsible sustainable development and welcomed Saudi Arabia's actions on methane mitigation, highlighting the US commitment to reduce methane emissions across sectors.

Christiana Figueres, Executive Secretary, UNFCCC Secretariat, noted the important challenge of decoupling global gross domestic product from global greenhouse gas (GHG) emissions. She highlighted two key issues from the Gulf perspective: cleaner production and transportation of natural gas; and economic diversification. She expressed confidence in Saudi Arabia's commitment to global prosperity and praised the country's investments in solar energy.

Figueres looked forward to Saudi Arabia's INDCs as a welcome announcement that the kingdom is "ready, willing and able to be an engine of global growth for the 21st Century."

ENVIRONMENTAL PROTECTION IN SAUDI ARAMCO

Humoud Al-Utaibi, Saudi Aramco, presented his company's environmental protection policy, highlighting the first formal environmental policy formulated in 1963 and subsequent revisions to the policy, aimed at achieving local environmental

objectives while contributing to global environmental benefits. He explained that the company's environmental policy consists of an integrated framework to support capacity building, technology research, communication and awareness raising.

Al-Utaibi discussed Saudi Aramco's strategic actions, including: ensuring environmental compliance of projects and operations; reducing air emissions from operations and from products; enhancing water and wastewater management; and conserving biological diversity.

He concluded that Saudi Aramco will continue to pursue environmental stewardship for the sake of future generations.



Humoud Al-Utaibi, Saudi Aramco

ADVANCING CLIMATE PROTECTION, OPERATIONAL SAFETY AND ENERGY SECURITY VIA METHANE EMISSIONS MANAGEMENT

Scott Bartos, US Environmental Protection Agency (EPA), discussed the importance of addressing methane emissions alongside carbon dioxide, in order to keep global temperature rises below 1.5°C. He highlighted the cost-effective nature of methane reduction strategies, mentioning several co-benefits such as improved air quality, industrial safety and energy security. He noted the EPA's focus on vented gas, emphasizing its greater contribution to climate change compared to flared gas.

Bartos discussed specific technologies that have been successfully developed to enable the identification of invisible leaks of vented gas. He highlighted the EPA's support for voluntary mechanisms such as the GMI and CCAC, and remarked that efficient information sharing can reduce overall costs, whilst expanding technical knowledge and fostering trust.

METHANE EMISSIONS AND MITIGATION OPPORTUNITIES: NINE CCAC SOURCES, OTHER GMI SOURCES

Don Robinson, Vice-President, ICF International, discussed the nine sources of methane emissions: natural gas driven pneumatic controllers and pumps; fugitive equipment and process leaks; glycol dehydrators; reciprocating compressors rod seal and packing vents; hydrocarbon liquid storage tanks; well venting for liquid unloading; centrifugal compressor with "wet" seals; well venting and flaring during well completion for hydraulically fractured wells; and casinghead gas venting.

Robinson explained the distinction between "uncontrolled" and "controlled" methane emissions, emphasizing that intentional emissions are designed into normal operational equipment while fugitive emissions are unintended. He then discussed instruments such as the



Don Robinson, ICF International



Christiana Figueres, Executive Secretary, UNFCCC Secretariat

infrared leak detection camera, used for detecting leaks. He described control options and highlighted options for offshore platforms and other sources.

CCAC – OIL & GAS METHANE PARTNERSHIP (OGMP):

Philip Swanson, UN Environment Programme (UNEP), provided an overview of the OGMP aimed at enabling partner companies to fully understand and flexibly manage their emissions over time. He said the OGMP is one of several initiatives under the CCAC focusing on short-lived climate pollutants, and that the oil and gas sector forms the largest anthropogenic source of emissions after agriculture.

Swanson outlined that the partnership focuses on nine core emission sources that account for the bulk of global methane emissions. He further noted that: the reporting format is designed to evolve over time; the CCAC provides technical support and capacity building; and three task forces have been created to finalize technical guidance documents and reporting templates aimed at creating a new standard in methane management.

Responding to a question on how the nine sources were determined, Swanson explained that they are sources said to account for the bulk of methane emissions in typical upstream operations and that over time, midstream and downstream sources will be added.

One participant asked why only one US company is participating in the OGMP, and whether reporting requirements are too burdensome. Noting the voluntary nature of participation, Swanson observed that generally, the partnership is more useful to companies involved in the oil and gas sector and that legal issues limit the participation of some companies, while others feel that there is already enough regulation in the sector. On reporting requirements, he emphasized that these had been developed during consultations with oil companies and take into account the needs of stakeholders requiring assurances that companies are taking a systematic approach to addressing methane emissions.

SAUDI ARAMCO METHANE REDUCTION EFFORTS: FLARING MINIMIZATION PROGRAMME

Adel Al-Ghamdi, Saudi Aramco, presented his company's flaring minimization programme consisting of three elements: the Master Gas System initiated in the 1980s, the Corporate Flaring Roadmap established in 2000, and efforts toward near zero flaring since 2012. He noted that the Master Gas System collects gas for power and water supply, and that its successful implementation has enabled the recovery of 4.2 billion standard cubic feet per day of the associated gas, equivalent to about 95% of the total flared gas.



Philip Swanson, UN Environment Programme (UNEP)



Adel Al-Ghamdi, Saudi Aramco

Having explained the Corporate Flaring Roadmap's main components, Al-Ghamdi underscored Saudi Aramco's achievement of 50% flaring reduction to 100 million standard cubic feet per day in 2012, as well as US\$400 million investments in zero discharge technologies. He concluded by drawing attention to global recognition of the company's efforts on methane emissions reduction.

CCAC – OGMP: PARTNER REPORTING MECHANISM

Swanson presented a potential partner reporting mechanism being developed for use in the OGMP. He explained that the aim of the mechanism is to make reporting as simple as possible for the nine core methane source categories. He noted that the voluntary reporting tool is currently in draft form and presented a prototype spreadsheet version.

Swanson suggested that it might be developed into a secure web-based interface to help countries gather their methane emissions data. He discussed technical guidelines for methodologies, but noted that partners would be free to use their own methodologies. He also observed that overlapping membership to different partnerships could be coordinated and synchronized through the tool, thereby reducing the reporting burden on partners.

METHANE EMISSIONS DETECTION AND MEASUREMENT TECHNIQUES, EQUIPMENT AND COSTS

Larry Richards, President and CEO, HY-BON Engineering, discussed equipment to detect or measure methane emissions. Recognizing the identification and quantification of gas leaks as a main challenge facing the oil and gas industry, he highlighted the advantages and costs of each technique, and emphasized the need to use different tools under different conditions.

Regarding identification, Richards outlined a range of techniques including infrared cameras, laser leak detectors, soap bubble screening, organic and toxic vapor analyzers, and acoustic lead detection. Concerning quantification measures, he discussed turbine meters, thermal dispersion flow meters, calibrated vent bags and high volume samplers. He concluded by recommending that industries use gas analysis sampling kits in order to accurately design adequate control or recovery technologies for gas leaks.



Larry Richards, HY-BON Engineering

METHANE EMISSIONS AND REDUCTION PROJECT EVALUATION AND IMPLEMENTATION

Larry Richards presented on strategic project evaluation and implementation for methane emissions and reduction. He discussed a variety of practices for reducing emissions and their related economics. More specifically, he outlined mitigation options for the nine core sources of methane emissions highlighting two vapor recovery projects in Angola and Libya.

One participant asked whether companies have any preference regarding particular options or if mitigation options are selected on a case-by-case basis. Richards acknowledged



Ahmed Al-Bassam, Saudi Aramco, presented a case study on volatile organic compounds (VOC) controls.

that liquids production is the primary focus for most producers, but recommended that each company adopt a holistic approach, considering both economic and environmental benefits.

SAUDI ARAMCO AND INTERNATIONAL PARTNER EXPERIENCES, CASE STUDIES

Ahmed Al-Bassam, Saudi Aramco, discussed volatile organic compound (VOC) emissions control at bulk plants. He said a typical bulk plant has two types of operations: storage tank offloading and off-loading operations. The major sources of VOC and other hydrocarbon emissions are floating roof tanks and truck loading operations from vapor vents. He explained that Saudi Aramco conducted an assessment using infrared cameras to monitor and identify VOC and other hydrocarbon emission sources from floating roof tanks.

Emphasizing Saudi Aramco's commitment to environmental protection by minimizing VOC and other hydrocarbon emissions, Al-Bassam noted that the company is in the process of installing vapor recovery units at major bulk plants. He then provided an overview of an off-loading facility in the central region. He noted that an occupational health hazard assessment had indicated potential exposure to VOC, and explained that emission sources were controlled through modifications.

In response to a question, a Saudi Aramco representative explained that the VOC emissions control programme is driven by environmental rather than economic reasons, noting that all power plants are required to incorporate a vapor recovery system in their design.

Harikrushna Patnaik, Cairn India, shared his company's methane mitigation initiatives. He highlighted steps taken to minimize loading workers' exposure to benzene, by providing them with organic vapor canisters.

Ibrahim Al-Sayed Ibrahim, Kuwait Oil Company (KOC), discussed his company's air emissions management strategy, highlighting a long history of managing air emissions by reducing gas flaring. He said flaring reductions had been

achieved by: prioritizing flare reduction; investing in state-of-the-art facilities and operations; and cooperating with the Global Gas Flaring Reduction Partnership.

Al-Sayed Ibrahim highlighted a methane emissions desktop study of three KOC facilities undertaken to estimate methane emissions and identify potential recovery opportunities. He explained that the next step would be to conduct a field study on flares and other methane emission sources.

OIL AND GAS PARTNER CASE STUDIES

Syifail Ramadhana, Star Energy, shared experience from the oil and gas sector in Indonesia. He noted the importance of controlling flare gas emissions, for which he estimated the potential revenue loss at one site alone at US\$530,000 per month. Ramadhana detailed his company's existing and proposed emission reduction practices, including flare gas recovery and engine starting system retrofit.

Homood Al-Hilal, Saudi Aramco, gave an overview of his company's Leak Detection and Repair (LDAR) programme designed to identify and repair leaking equipment to reduce fugitive emissions of hazardous air pollutants and VOC. He detailed the LDAR's scope of work and best practices developed within Saudi Aramco. Al-Hilal described his company's pilot automated LDAR technology, capable of continuously detecting hydrocarbon gas leaks at distances of up to 500 feet. Workshop participants expressed appreciation for the case study and interest in the new technology.

CLOSING REMARKS

Khalid Abuleif, Ministry of Petroleum and Mineral Resources, Saudi Arabia, thanked the organizers, presenters and participants for their efforts. He underscored that there are always technological solutions to global environmental challenges, noting that the deliberations from the workshop have the potential to enable further mitigation of methane emissions. He closed the workshop at 10:58am.



Harikrushna Patnaik, Cairn India



Khalid Abuleif, Saudi Arabia, delivered his closing remarks

REPORT OF THE INTERNATIONAL EXPERTS WORKSHOP ON THE ADVERSE SOCIAL AND ECONOMIC IMPACTS OF MITIGATION MEASURES

FRAMING THE ISSUE IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

The International Experts Workshop on the Adverse Social and Economic Impacts of Mitigation Measures opened on Wednesday morning, 29 April. Chair Khalid Abuleif, Ministry of Petroleum and Mineral Resources, Saudi Arabia, welcomed participants. He explained that the workshop would discuss efforts towards advancing sustainable development and tackling climate change.

Chair Abuleif emphasized that sustainable development is an important aspect of the UNFCCC's objectives, and that response measures are related to the economic and social components of sustainable development. He drew attention to the importance of adaptation and the need for an inclusive international agreement, underscoring challenges facing international discussions around sustainable development before and after 2020.

Macharia Kamau, Co-Facilitator of the Post-2015 Intergovernmental Negotiations moderated the session.

Highlighting the upcoming Conference on Financing for Development in July and the UN Summit to adopt the post-2015 development agenda in September, Kamau stated that the world is at a critical milestone in the context of sustainable development. He observed that addressing response measures requires a new paradigm to ensure that the development of some countries does not undermine the development of others.



William Agyemang-Bonsu, UNFCCC Secretariat

William Agyemang-Bonsu, UNFCCC Secretariat, presented on the status of response measures under the UNFCCC.

He highlighted the establishment of the forum and work programme on the impact of the implementation of response measures at COP 17 as important steps in creating a common space for focusing on response measures. He emphasized the need to discuss both positive and negative impacts, acknowledging, however, the limited capacity of many countries to accurately assess the impacts of response measures.



George Manful, UNEP

George Manful, UNEP, presented sustainable development as the overarching principle for responding to climate change. He noted the challenge of implementation across different sectors due to diverse interpretations of the meaning of the principle. He noted that developing countries

are aware of their role in mitigating climate change, but highlighted the need to improve understanding of the economic, social and cultural impacts of response measures in order to enable implementation of successful mitigation policies.

Mariama Williams, South Centre, discussed synergies and trade-offs of mitigation response measures, and implications for sustainable development. She noted that many countries have particular vulnerabilities that make them susceptible to response measures, and that mitigation policies need to be mindful of these vulnerabilities. She highlighted various response measures, noting, for example, that the removal of fossil fuel subsidies has implications for livelihoods and wellbeing, particularly of disadvantaged communities in developing countries.



Mariama Williams, South Centre

On sustainable development, Williams said response measures could hold back achievement of the SDGs, calling for establishing baselines

to assess response measure impacts on economies. On the way forward, she advocated basing response measures on the precautionary approach or "no harm principle," highlighting the need for financial support for technology transfer and capacity building to promote economic diversification. Williams emphasized that response measures should be anchored in the 2015 climate agreement.



Peter Govindasamy, Singapore

Peter Govindasamy, Ministry of Trade and Industry, Singapore, presented his country's position on framing response measures within sustainable development. He noted that in order for the 2015 climate agreement to meet sustainable development objectives, it should be anchored in a multilateral rules-based system, affirm the primacy of the UNFCCC, and be universally applicable. He further noted the need for a regular process to systematically address the economic and social consequences of response measures.

Govindasamy proposed establishing a mechanism comprising the forum and work programme on the impact of the implementation of response measures, under the UNFCCC's subsidiary bodies, supported by expert groups, to continue information sharing and to make recommendations to the COP.

Kamau highlighted the means of implementation as a key issue in both the climate change and the post-2015 development agenda debates.

Several participants expressed appreciation for the workshop, noting the value of framing response measures within the context of sustainable development. One participant questioned whether the issue of response measures falls under

adaptation or mitigation, reflecting on the role of national circumstances and implications of response measures on industry.

Several participants mentioned the complexity of addressing international impacts of national policies, bringing up the issue of sovereignty, as well as the need to consider the global picture. Defining a common language was suggested as a way of moving forward. Some participants supported the need for equal attention to adverse impacts and co-benefits to develop a roadmap for sustainable development, and questioned how to address these issues in the 2015 climate agreement.

One participant noted that the preparation of INDCs would be difficult for many countries. The need to address response measures in the context of sustainable development was emphasized, alongside the requirement for effective climate change policy to include equity, development and sustainability.

One participant noted that it had been difficult to reach agreement on climate change and sustainable development during the approval of the Intergovernmental Panel on Climate Change (IPCC)'s Fifth Assessment Report (AR5) synthesis report, due to the diversity of views. He noted that so far, the impact of mitigation response measures has been relatively moderate and emissions have continued to grow, cautioning that the impact of response measures will become more significant in the future as stronger mitigation measures are implemented globally.

In the context of sustainable development priorities, one participant noted that developing countries could not afford to “keep resources in the ground.” Responding to a question on the responsible use of natural resources, Manful underscored the need to take national circumstances into account, noting that each country has its own development agenda, and SDGs have implications for multiple sectors.



Macharia Kamau, Co-Facilitator of the Post-2015 Intergovernmental Negotiations

Agyemang-Bonsu acknowledged the lack of tools for assessing the impact of response measures. He highlighted three areas of convergence: assessing the impact of response measures; economic diversification; and a just transition for the workforce. He called for further efforts from parties and the international community to find relevant tools for assessment and reporting.

Closing the session, Kamau noted that international organizations, including the UNFCCC, have to recognize that the world has changed in the last few decades. He cited changes such as increasing interdependence, globalization and the rising power of the private sector. He emphasized that the response measures discussion has to take place in this context and that response measures will apply to all SDGs, not only climate change.

Kamau added that restrictions placed on developing countries regarding the exploitation of natural resources have to go hand-in-hand with technology transfer. Looking ahead, he pointed out that establishing an enforceable framework for

climate change is challenging, and achieving SDGs requires financing, new institutions and mechanisms, and enhancing the participation of developing countries.

CLIMATE CHANGE SCIENCE AND LITERATURE



Eduardo Calvo, San Marcos University, Peru

Eduardo Calvo, San Marcos University, Peru, presented information from AR5. He referred to the need to consider the intended and unintended consequences of mitigation policies, whilst recognizing that mitigation cannot be delayed. He stated that the extent of the consequences would depend on the policy design, reinforcing the importance of due consideration of the impacts of response measures.

Calvo noted the complexity of optimizing emission reductions whilst considering the social and economic consequences of measures. He encouraged complementary policies across sectors, stressing, *inter alia*, that policies should not adversely impact poverty reduction policies and should address energy poverty. He supported further work on these issues to fill gaps in the IPCC reports.

Mustafa Babiker, AR5 Chapter 6 Lead Author, provided an overview of challenges for developing countries in AR5. He pointed to the lack of integrated framing of sustainable development and response measures in the report.

Babiker said most of the literature supports the conclusion of the Fourth Assessment Report on the negative impacts of response measures on energy exporting countries, trade and capital markets. He called for disaggregated modeling approaches and downscaling to determine the impacts of response measures on developing countries.

Nora Alamer, Supreme Council for Environment, Bahrain, presented on enhancing the work on the impacts of response measures in scientific literature and assessment reports. She highlighted extracts on sustainable development and impacts of response measures in AR5, noting that most mitigation scenarios are associated with reduced revenues from coal and oil trade for major exporters. Alamer noted the need for increased certainty and coverage of response measures,



Mou Wang, Chinese Academy of Social Sciences, China

emphasizing that future work and literature should include comprehensive assessments of impacts from developing countries. She also shared national perspectives on the local academic and research community contribution to literature and how these efforts can be fostered and encouraged.



Workshop participants

Sciences, outlined his country's research that demonstrates that carbon emissions are a precondition for economic progress in developing countries. He made several proposals on global governance of unilateral response measures, including further elaborating UNFCCC principles for carbon governance, furthering discussions among parties, and improving rules for green subsidies and intellectual property rights.

Ama Essel, Ghana, discussed the IPCC's findings on the implication of response measures from the perspective of Sub-Saharan Africa. She underscored relevant considerations for African countries, including mitigation potential in the agriculture sector, high levels of poverty and implications for water. She noted the need for international cooperation addressing response measures, and safeguards to ensure equity and sustainable development. Highlighting research gaps in the adverse effects of both short and long-term response measures, she emphasized the role of cooperation among developing countries in building research capacity.

During the ensuing discussion, the possibility of implementing a model to assess response measures based upon existing econometric modeling tools was considered. Participants concluded that this would be possible in principle, though long-term changes and system shifts should be incorporated into the framework. Participants noted the challenge of including more literature and research from developing countries in IPCC reports.

Participants also discussed the 2°C goal, its political nature and how to achieve it. One participant raised the point that the climate does not differentiate between developed and developing countries, encouraging participants to "shift gears" in UNFCCC negotiations, with reference to the need to develop targets that can feed into the climate change SDG.

Developing countries were encouraged to use their leverage during UNFCCC negotiations for a new 2015 climate agreement to ensure that the new agreement takes their

into consideration. One participant expressed concern at the lack of progress on climate financing under the Green Climate Fund (GCF).

CASE STUDY: TOURISM

Amjad Abdullah, the Maldives, moderated the session on tourism. He opened the session by highlighting the importance of tourism for developing countries in economic development and diversification.

Mayssam Tamim, UN Development Programme (UNDP) discussed interrelationships between climate change and tourism. She indicated that tourism is a key economic sector for developing countries and its future is interwoven with the changing climate. Regarding tourism's impacts on climate change, she pointed out that tourism contributes around 5% of global GHG emissions, of which transportation and accommodation are the main sources.

Indicating that sustainable tourism is a win-win solution, Tamim drew attention to positive impacts of mitigation measures on tourism, such as job creation, long-term growth, and pollution reduction, while also noting negative impacts. She underscored the lack of sufficient understanding on the impact of response measures on tourism flows in developing countries, and called for further exchange of experiences, tools and models, to conduct robust assessments of the related impact.

Philip Weech, the Bahamas, presented on the impact of response measures on tourism in his country. He highlighted negative impacts of the UK's reform of air passenger duty on the Bahamas' economy. Weech noted that the UK's unilateral action fails to take into consideration the importance of tourism for developing countries.

Ali Shareef, the Maldives, gave a presentation on the tourism sector in his country, showing the strong link between economic growth and tourism. He highlighted the Maldives'



L-R: Philip Weech, the Bahamas; Mayssam Tamim, UNDP; Amjad Abdulla, the Maldives; Sarah Baashan, Saudi Arabia; and Ali Shareef, the Maldives

sensitivity to aviation taxes, as well as its vulnerability to climate change. He noted the strong reliance of the tourism sector on fossil fuels, suggesting the need for economic diversification.

Moderator Abdullah reiterated the importance of the tourism sector for small island states and recommended a “holistic approach” by addressing mitigation in the tourism sector at international policy forums. One participant proposed a low-carbon tourism planning strategy to reduce emissions, including increasing energy efficiency and carbon offsetting. Another participant discussed the “conundrum” between environmental protection and poverty relief, noting that developing countries’ choices often put them “between a rock and a hard place.”

Participants discussed the difficulty of measuring vulnerability, noting the need to demonstrate vulnerability in order to receive funding. Discussion also focused on the need for tools to measure the impact of mitigation measures, both domestically and internationally, noting the impact of aviation taxes on different sectors. Concluding, Abdullah remarked that it was key to consider adverse social and economic consequences on the tourism sector, as an issue of serious concern to many developing countries with economies based on tourism.

CASE STUDY: ENERGY

On Thursday morning, moderator Awwad Al Harthi, Saudi Arabia, opened the session on energy.

Rashed Al-Shaali, United Arab Emirates University, discussed energy supply and economic diversification from the perspective of the Gulf Cooperation Council (GCC). Noting rising energy demands, he discussed the development of renewable energy in the GCC and highlighted economic diversification strategies.

Al-Shaali underscored the variation among the GCC in terms of economic diversification, cautioning against a “one-size-fits-all” approach. He concluded that: a transition to a low-carbon economy will have its winners and losers; the difference between obstacles and limits to climate action should be fully understood; and transformation of the GCC countries into “Singapore or Dubai-like hubs” is only possible in the long term, with a guaranteed labor force.

Tosi Mpanu-Mpanu, Democratic Republic of the Congo, presented his country’s policy on climate mitigation in the energy sector. Indicating that the potential impacts of mitigation measures and policies are diverse and must be examined on a case-by-case basis, he noted the challenges for Africa in balancing mitigation and energy access. He also highlighted a proposal for a global partnership to support renewable energy in developing countries, endorsed by the African Ministerial Conference on the Environment.

Mpanu-Mpanu discussed the substantial energy potential in his country and called for further South-South cooperation, with support from the GCF and other financial institutions. He recommended: further evaluation of potential spillover effects of mitigation; proactive responses tackling climate mitigation

and energy access jointly; and a new mechanism under the UNFCCC addressing response measures to support developing countries.

Govindasamy presented information about his country’s energy situation. He noted Singapore’s National Energy Policy, responding to the “energy trilemma” of making energy affordable, diversified and clean. He highlighted the importance of national circumstances in the post-2020 climate agreement.

During the discussion, participants noted that countries have different possibilities for transitioning to renewable energy, depending on geography, service sectors and historic experiences. One participant observed that countries could also undertake energy efficiency programmes. Discussions also considered the challenge of addressing climate change and sustainable development across sectors, suggesting that energy, finance and environment ministries should work together to find cross-sectoral solutions to balance mitigation with energy security. Participants considered the importance of examining the long-term sustainability of measures, noting that resilience is the initial concern of developing countries.

Several participants pointed to the high cost of transitioning to renewable energy for developing countries, emphasizing that energy access is a priority and energy transition a long-term process. One participant noted that economic development is contingent on the use of fossil fuels for many countries.

On economic diversification, one participant highlighted challenges for countries without a low labor cost advantage. Others agreed that economic diversification should be tailored to economic, political and environmental circumstances. The challenge of attracting investors was highlighted and the need to focus on comparative advantage in terms of diversification was emphasized. One participant noted that economic development and energy diversification are mutually supportive.

Acknowledging the complexity of mitigation, one participant pointed to the potentially ambiguous legal status of the 2015 climate agreement.

Chair Abuleif highlighted several economic diversification projects initiated by Saudi Arabia, with support of international organizations, including UNDP. He expressed hope that these projects would translate into substantial changes in the future.

In response to questions raised by participants, Al-Shaali underscored that in order to gain support from business, economic diversification programmes have to be science-based and economically feasible.



Awwad Al Harthi, Saudi Arabia



Peter Govindasamy, Singapore



Tosi Mpanu-Mpanu, Democratic Republic of the Congo

He indicated that the great temperature shift between winter and summer prevents Gulf countries from developing certain industries.

Govindasamy emphasized economic costs as a critical factor to be considered in diversifying economies. He indicated that technology is the major challenge to mitigating the use of fossil fuels, and that countries cannot completely move away from fossil fuels.

Mpanu-Mpanu noted that African countries see their potential of contributing to mitigation although they are only responsible for 3% of global GHG emissions. He drew attention to new opportunities in climate finance and the importance of making policymakers aware of these opportunities. Acknowledging the uncertain legal nature of the INDCs, he said countries should take INDCs seriously rather than call them into question.

Closing the session, Moderator Al Harthi noted that the negative effects of response measures for developing countries outweigh related benefits. He said national circumstances determine a country's ability to expand its energy mix. He noted that the priority for developing countries is to build resilience, using fossil fuels as basis of sustainable development, and to supply energy to those who need it.

CASE STUDY: AGRICULTURE

Moderator Amb. Mahmoud Samy, Egypt, opened the session on Thursday afternoon. He highlighted concerns from parties over the 2016 scheduling of the Subsidiary Body for Scientific and Technology Advice (SBSTA) in-session agriculture workshops, in light of the Paris Agreement due to be adopted in December 2015, which raises uncertainty over how agriculture will be reflected in the Paris agreement.

George Nasr, Lebanese University, presented the impacts of mitigation measures on agriculture, stating that the importance of agriculture varies greatly between developed and developing countries. Giving examples of direct, indirect and deferred impacts of response measures, he proposed a more inclusive approach, in which developing country stakeholders are able to provide input to decision making in developed countries on food and agriculture.

Participants discussed the challenge of addressing and measuring agricultural vulnerabilities relating to agricultural production and consumption. He suggested that developing local knowledge and capacity would enable countries to fully understand their own needs and to design buffers into their policies.



Amb. Mahmoud Ahmed Samir Samy, Egypt



George Nasr, The Lebanese University

Participants considered the impact of agricultural subsidies and food labeling, raising issues of international competitiveness and restricted market access. Discussions reflected on the sensitive nature of the agriculture sector, noting complex linkages with other sectors. Several participants noted the need for more research into the spillover effects from mitigation measures on the agriculture sector, noting this as an issue that is often overlooked by policy makers.

In response to participants' questions, Nasr underscored the correlation between agriculture and energy, called for better agricultural policy taking energy consumption into account, and suggested that forestation and agriculture can go hand-in-hand in developing countries.

One participant pointed out that discussions did not touch upon many difficulties in the agricultural sector of developing countries. Another participant called for approaching agriculture from perspective of energy efficiency and emphasized the need to treat agriculture as an important aspect of response measures to climate change.

THE WAY FORWARD

On Thursday afternoon, Chair Abuleif opened the final session focusing on ways to move forward to address gaps in progress on response measures. Recalling themes covered in the previous sessions, he invited participants to share ideas on the implementation of the UNFCCC up to 2020 and the new climate agreement.

Agyemang-Bonsu discussed the reporting of response measures and their impacts. He highlighted the scope of information on response measures required to be reported by Annex I parties and types of information reported by Annex I parties. He noted that non-Annex I parties are invited to provide information on their specific needs and concerns relating to response measures, but that only a few parties had done so.

Andrei Marcu, Centre for European Policy Studies, presented on how to make response measures a global issue, explaining that his organization has conducted a number of country and sectoral case studies on the impacts of climate change mitigation. He noted the importance of determining the impact of domestic or international mitigation measures, stating that determining what constitutes a sustainable transition to low-carbon economy is not straightforward.

Marcu observed that knowledge of impacts of climate change mitigation measures is not widespread and that there are no established mechanisms for analyzing response measures. He pointed out that in many instances, response measure impacts may not be tangible and that impact assessments are not required in many countries. He emphasized the need for *ex ante* modeling and *ex post* evaluation and proposed the use of surrogate data.

Highlighting the global nature of response measures and impacts, Marcu emphasized the need for global cooperation to enhance understanding of impacts and the tools required to address them.



Andrei Marcu, Centre for European Policy Studies

Calvo discussed negotiation challenges and opportunities, stressing the need for international cooperation. Citing the example of the Kyoto Protocol, he observed that while parties may accept an agreement in Paris COP 21, they may not implement it if it is perceived to be unfair. He further added that perceptions of unfairness would lead to protectionism and trade barriers.

On the way forward, Chair Abuleif highlighted the main issues including actions required to be taken between now and 2020 and the need to designate a “home” for response measures under the UNFCCC process.

During the ensuing discussion, several participants noted the need for a mechanism or platform to address response measures and implement safeguards, with one participant suggesting that the time had come to make progress on the format of such a mechanism. One participant supporting the establishment of a mechanism, making reference to the “global village” in which response measures by one country can directly impact their global neighbors. In response, another participant suggested that it is important that all parties recognize this global responsibility, noting that some had approached response measures from a purely domestic perspective.

Some participants expressed confusion as to why a mechanism does not yet exist, citing several safeguarding mechanisms that are operational in other multilateral bodies, given the recognition that climate change is a serious existential threat.

One participant suggested developing an “early warning system” to ascertain downstream impacts of response measures. Another called for setting up a coordination mechanism between the UNFCCC, the International Civil Aviation Organization and the WTO, noting that climate change is a multidimensional issue, requiring a holistic approach. Responding to this, one participant called for caution, stating the importance of keeping control of the mechanism under the UNFCCC.

Several participants expressed the need to feed the workshop discussions into the UNFCCC process, noting the importance of response measure impacts both pre- and post-2020.

Responding to participants’ comments, Marcu indicated that impact assessments need to include both quantitative and qualitative analysis. Noting the importance of measuring and reporting impacts of climate change, he called for considering functions of other international institutions within a new

climate agreement. He further underscored international cooperation and expressed optimism regarding the Paris outcome.

Indicating that parties have accepted to limit the global temperature rise to 2°C, Chair Abuleif said climate change is a global problem that needs to be resolved within the context of sustainable development. While recognizing the complexity of equity, he pointed out that cooperation could advance the climate change negotiations. He noted numerous challenges facing developing countries such as the implementation of INDCs and limited capacity on assessment and reporting, and added that determining how to use existing international institutions to tackle climate change is a key question for the post-2020 agreement.

Summarizing the main issues, Sarah Baashan, Saudi Arabia, emphasized that response measures are a global concern of vital importance for developing countries, describing sustainable development as the driving force to finding long-term solutions to climate change. Chair Abuleif called for further cooperation to move the climate change negotiations forward. He then thanked participants and closed the workshop at 6:02 pm.

UPCOMING MEETINGS

Second UN SE4ALL Forum: The second annual Sustainable Energy for All (SE4ALL) Forum will continue the momentum from the launch of the UN Decade of SE4ALL (2014-2024) in June 2014. By 2030, the SE4ALL initiative aims to ensure universal energy access to modern energy services, double the global rate of improvement in energy efficiency and double the share of renewable energy in the global energy mix. **dates:** 17-21 May 2015 **location:** New York City, US **contact:** Office of the Special Representative of the Secretary-General Global Facilitation Team, SE4ALL **email:** forum@se4all.org **www:** <http://www.se4allforum.org/>

CCAC High-Level Assembly: The CCAC High-Level Assembly will evaluate CCAC’s progress, provide input on the direction of CCAC’s future work and learn about the latest policy and scientific developments related to SLCs. **date:** 20 May 2015 **location:** Geneva, Switzerland **contact:** CCAC Secretariat **phone:** +33-1-44-37-14-50 **fax:** +33-1-44-37-14-74 **email:** ccac_secretariat@unep.org **www:** <http://www.ccacoalition.org/>

Business and Climate Summit: The Business and Climate Summit will provide a platform to highlight business solutions towards a low-carbon economy and discuss the frameworks and policies needed to deploy low-carbon solutions. **dates:**



Participants at the end of the workshop

20-21 May 2015 **venue:** UNESCO headquarters **location:** Paris, France **email:** contact@businessclimatesummit.com
www: <http://www.businessclimatesummit.com>

Sixth Clean Energy Ministerial (CEM6): 23 participating governments will send energy ministers and representatives to the sixth Clean Energy Ministerial (CEM) to assess progress, decide on a plan for how the forum can be more ambitious and effective, and demonstrate how they are advancing national clean energy goals. **dates:** 27-28 May 2015 **location:** Merida, Mexico **contact:** CEM Secretariat **email:** <http://www.cleanenergyministerial.org/Contact-Us> **www:** <http://www.cleanenergyministerial.org/Events/CEM6>

IPCC Expert Meeting on Climate Change, Food, and Agriculture: The IPCC Expert Meeting on Climate Change, Food, and Agriculture will consider assessment across the IPCC AR5, as well as the most compelling new research since the publication of the AR5. **dates:** 27-29 May 2015 **location:** Dublin, Ireland **contact:** IPCC Secretariat +41-22-730-8208/54/84 **fax:** +41-22-730-8025/13 **email:** IPCC-Sec@wmo.int **www:** <http://www.ipcc.ch>

42nd Sessions of the UNFCCC Subsidiary Bodies: The 42nd sessions of the Subsidiary Bodies to the UNFCCC and the ninth part of the second session of the ADP (ADP 2-9) will take place in June 2015. **dates:** 1-11 June 2015 **location:** Bonn, Germany **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

High-Level Event on Climate Change: The President of the UN General Assembly will convene this high-level event, with the aim of giving momentum and adding impetus to efforts to reach a global agreement in 2015 under the UNFCCC. **date:** 29 June 2015 **location:** UN Headquarters, New York **contact:** Office of the President of the UN General Assembly **www:** <http://www.un.org/pga/calendar/>

Our Common Future Under Climate Change: Organized by the UN Educational, Scientific and Cultural Organization (UNESCO), International Council for Science (ICSU) and Future Earth, in collaboration with a partnership of French organizations, this science-focused conference will examine the latest research around climate change. **dates:** 7-10 July 2015 **location:** Paris, France **contact:** Conference Secretariat **email:** science@commonfuture-paris2015.org **www:** <http://www.commonfuture-paris2015.org/>

Third International Conference on Financing for Development: The Third International Conference on Financing for Development will result in an intergovernmentally negotiated and agreed outcome, as well as summaries of the plenary meetings and other deliberations of the Conference, to be included in the report of the Conference. **dates:** 13-16 July 2015 **location:** Addis Ababa, Ethiopia **contact:** UN Financing for Development Office **phone:** +1-212-963-4598 **email:** ffdoffice@un.org **www:** <http://www.un.org/esa/ffd/ffd3/>

ADP 2-10: The 10th part of the second session of the ADP is expected to convene in August/September 2015. **dates:** 31 August - 4 September 2015 **location:** Bonn, Germany **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

CCAC Working Group Meeting: The CCAC Working Group will continue its work in guiding the CCAC's cooperative actions. **dates:** 8-9 September 2015 **location:** Paris, France **contact:** CCAC Secretariat **phone:** +33-1-44-37-14-50 **fax:** +33-1-44-37-14-74 **email:** ccac_secretariat@unep.org **www:** <http://www.ccacoalition.org/>

UN Summit to Adopt the Post-2015 Development Agenda: The summit is expected to adopt the post-2015 development agenda, including: a declaration; a set of Sustainable Development Goals, targets, and indicators; their

means of implementation and a new Global Partnership for Development; and a framework for follow-up and review of implementation. **dates:** 25-27 September 2015 **location:** UN Headquarters, New York **contact:** UN Division for Sustainable Development **fax:** +1 212-963-4260 **email:** dsd@un.org **www:** <https://sustainabledevelopment.un.org/post2015/summit>

42nd Session of the IPCC: The 42nd session of the IPCC is expected to convene in October 2015. **dates:** 6-10 October 2015 [TBC] **location:** Dubrovnik, Croatia **contact:** IPCC Secretariat **phone:** +41-22-730-8208/54/84 **fax:** +41-22-730-8025/13 **email:** IPCC-Sec@wmo.int **www:** <http://www.ipcc.ch>

ADP 2-11: The 11th part of the second session of the ADP is expected to convene in October 2015. **dates:** 19-23 October 2015 **location:** Bonn, Germany **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

UNFCCC COP 21: The 21st session of the COP to the UNFCCC and associated meetings will take place in Paris. **dates:** 30 November - 11 December 2015 **location:** Paris, France **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** <http://www.unfccc.int>

Tenth WTO Ministerial Conference (MC10): The Ministerial Conference is the highest decision-making body of the WTO. It usually meets every two years, and brings together all members of the WTO. **dates:** 15-18 December 2015 **location:** Nairobi, Kenya **contact:** Ms. Lena Gatabaki **phone:** +254 20 3589000 **fax:** +254 20 3589006 **email:** lena@ginadin.com **www:** https://www.wto.org/english/thewto_e/minist_e/mc10_e/mc10_e.htm

GLOSSARY

AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change
CCAC	Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants
COP	Conference of the Parties
GCC	Gulf Cooperation Council
GCF	Green Climate Fund
GHG	greenhouse gas
GMI	Global Methane Initiative
INDCs	intended nationally determined contributions
IPCC	Intergovernmental Panel on Climate Change
KOC	Kuwait Oil Company
LDAR	leak detection and repair
OGMP	Oil and Gas Methane Partnership
SDG	Sustainable Development Goal
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound
WTO	World Trade Organization