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King Abdullah Petroleum Studies and Research Center

Role of Oil in the Low Carbon Energy Transition

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About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is a non-profit global institution dedicated to independent research into energy economics, policy, technology and the environment, across all types of energy. KAPSARC's mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

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Key Points

The way the world uses energy services has entered a period of profound change. However, there is continuing uncertainty about its trajectory in terms of the speed and extent of transition. This will dictate whether the world achieves the 2°C target, and if not, by how much. But what would the world look like if policymakers treated greenhouse gas (GHG) emission targets as binding?

- Based on current scientific consensus, and following the Paris Agreement, the world is not yet on a path that even comes close to the target and the majority of the world's economies are still anticipating a long-term role for fossil fuels.

- Under a binding constraint, the energy transition would have an impact on demand for hydrocarbons, including oil, which would probably peak.

- Although Gulf Cooperation Council (GCC) oil producers are better placed to survive periods of greater price volatility that are expected as part of this transition than higher cost suppliers, they are still exposed to fiscal risks if they do not diversify from reliance on hydrocarbon revenues.

- The energy transition poses challenges for both companies and governments. Those institutions that assume that it's business as usual face a threat to their business models. For financial institutions, the uncertainty posed by this transition represents a major risk factor.

- A first iteration of a scenario 'game' in which the emissions cap was treated as binding resulted in participants finding that the interactions between their policy prescriptions achieved only one-third of the required reduction. Future iterations will require more innovative strategies that may challenge preconceptions of who is truly at risk in a climate-constrained world.

Executive Summary

In 2016 and 2017, a number of scenario reports from respected global energy organizations highlighted how the energy transition is likely to impact global oil demand. All of these scenarios pointed to slowing demand for hydrocarbons, including oil, and several suggested that demand will peak and start declining within a foreseeable future. Recent flattening of growth and even decline in demand for coal, the pace of investment in renewables and evolving trends in smart mobility suggest that we are entering into an energy transformation, already dubbed by some as the 'Grand Transition', comparable to the switch from coal to oil at the beginning of the 20th century.

This transition has been driven by concerns about climate change in richer economies and by air quality in those that are still developing. The debate has coalesced into a single target: the need to limit global warming to 2°C above the level recorded in pre-industrial times. The Paris Agreement established a system of voluntary measures known as Nationally Determined Contributions (NDCs). Independent analysis of the net effect of all the measures announced to date in the NDCs suggest we are far from achieving the 2°C cap. For the time being, actions do not match the rhetoric and apparent urgency required. But what if policymakers were to act as if the emissions limits were binding?

The conflation of energy policy and climate policy has been challenged by the U.S. withdrawal from the Paris Agreement, but the pace of technological innovation means that the continuing drive to low carbon energy, storage and reducing energy intensities will still challenge fossil fuels where their hold is most tenuous. However, the pace of change may be over-estimated by proponents of new business models. Testing the limits of what is foreseeable for the displacement of oil, for example, leaves plenty of room for coexistence and long-term demand, even if at levels that are one-third lower in 2040 than today. Low carbon technologies would include carbon capture, usage and/or storage (CCUS) if costs can be reduced by anything similar to the renewables technology cost curves.

For oil-producers in the Gulf Cooperation Council (GCC) region in particular, any slowdown in oil demand represents a transient threat while markets rebalance and a longer-term loss of revenue as prices stabilize at a lower level than previously anticipated. But the region's low cost base means that it is likely to retain a larger share of a smaller cake against higher cost resource-holders. This possibility is already recognized by strategies to diversify national economies away from oil dependency – it is a process that is already well underway in the region.

The financial sector, in line with its normal response to risk, has begun reallocating asset portfolios and reducing exposure to sectors where there is real and perceived risk from the effects of the transition. The risk is greater for international oil companies (IOCs) whose core business model is increasingly under threat and there is evidence that they recognize this and are diversifying into areas such as natural gas, which still have some room for continued growth – at least in the medium term.

In the meantime, doubt remains as to the speed of the current trajectory of the energy transformation and its ability to ensure climate targets are achieved. Will policy interventions by anxious governments change the current dynamic? Or will a breakthrough technology emerge leading to an even faster transition?

Whatever future is viewed as most likely, long-term economic success requires that policymakers prepare for the worst case and develop strategies

to thrive in the midst of hardship. Workshop participants tested this proposition by imposing a constraint that free-riders could be eliminated and challenging them to devise strategies, representing nine different archetype economic blocs, which minimized the damage to their societal welfare in meeting the now binding targets. All participants proposed policy prescriptions that would meet their goals in isolation, but the equilibrium effects of policy interaction between blocs resulted in less than 25 percent reduction in GHG emissions (versus a needed 75 percent reduction).

Conventional strategies, including carbon taxes, increased forestry, energy efficiency and the like did not deliver the target and future workshops will force deeper strategic thinking from which, perhaps, free-drivers may emerge – economies that can meet their targets without damaging their own economies but at the expense of others. Our intuition is that current expectations of rich economies benefiting at the expense of those still emerging from poverty is not inevitable and that more constructive policies may emerge if all participants see the potential to end up as losers if they do not cooperate.

Background to the Workshop

During 2017, KAPSARC launched a new research initiative, including a two-day workshop in The Hague on April 19-20, focused on the role of fossil fuels, particularly petroleum, as the world transitions to a low carbon future after the COP 21 Paris Agreement. Starting in 2017, mainstream projections of the global fuel mix in 2050 continue to forecast combustion of more fossil fuels than are consistent with a scenario that caps global warming at 2°C since pre-industrial times. In the absence of cost effective carbon capture, usage and storage (CCUS), or the emergence of some other disruptive technology that can substantially limit emissions, the 2°C scenario will not be met without a peak in global coal consumption (and likely peaks in oil and gas consumption as well). Already, coal demand in some regions is in decline and some scenarios, including the International Energy Agency (IEA) and World Energy Council (WEC) point to a peak in oil demand before 2050 depending on the trajectory taken by the global energy transition.

Traditional economic theory would suggest that peak demand will only occur if consumer prices are high enough to stifle and reverse demand growth or lower cost substitutes are available at scale. Producer prices will have to be low enough to limit supply at the level of resulting demand. However, recent history has shown that the global economy is sufficiently resilient to handle oil prices of close to $150/bbl – while prices of $40/bbl did not lead to enough oil field shutdowns to affect supply. Clearly, price signals alone are not going to fast-track the process of reducing greenhouse gas (GHG) emissions unless they go beyond their respective limits of this wide band and the gap is filled by some policy instrument. Is the world destined to suffer the impacts of a failure to limit global warming to a 2°C rise in temperatures, or can this target be achieved using alternative strategies?

Despite the absence of binding targets covering carbon emissions, the workshop's objective was to ask "What if there were?" and, through discussion and a team exercise, to identify innovative, economically sustainable strategies that could achieve this outcome, at the least social cost. In other words, to imagine the economic impacts of countries optimizing their own positions if there were no scope for potential free-riders.

To address this scenario, The Hague workshop was the first in a series focused on several key questions:

> How can individual countries achieve binding carbon emission targets at least cost and do their strategies result in the lowest cost transition at an aggregate global level?

> What is the range of macroeconomic adaptation strategies and is this a zero-sum game?

> How will producer/consumer relationships be affected?

> Is there a great reconfiguration in the future for refining, chemicals and energy-intensive industries? – Will future stranded assets be the fossil fuel reserves in exporting countries or the infrastructure to consume them in resource-importing countries?

Energy in a Changing World

Mainstream energy scenarios increasingly suggest that growth in global per capita energy demand is slowing, and even go so far as to suggest that demand for some primary energy sources, including oil, could soon peak. Slower global population growth, reduced energy intensity, competing fuels and government policies in a carbon-constrained world are mitigating against fossil fuel demand growth. So, is the 'Grand Transition' inevitable and will resource-holders and energy companies start planning for a different future?

The evidence of the last few years shows that some form of energy transition is a reality, not an aspiration. Carbon emissions have peaked in some regions, energy intensity is falling, coal demand growth has stalled and, subject to India's plans, may even turn negative. Renewable energy sources now provide more than half of the world's electricity supply capacity growth – although a somewhat lower proportion of the growth in consumption. Oil demand growth rates are falling in percentage terms and possibly in absolute volume terms, leading to the key question: When will oil demand peak and enter into decline?

Many foresee an inevitable continued role for oil in the global energy mix thanks to its high utility in terms of energy density and logistical convenience. It will be hard to dislodge as a key transportation fuel and as a feedstock for petrochemicals, but perhaps the historical period of untrammeled growth is coming to a close. The greater, and more polarizing, debate is about what role oil should play in the future. This is wrapped up in more than just the climate dialogue, spilling over into geopolitics, energy security and air quality as well.

Much of this discussion is framed as a zero-sum game – an assumption that reducing oil consumption by importing nations will result in reserves being left in the ground, at the producing nations' costs, and emissions being avoided. But this misses the potential for innovations in both technology and industrial development strategies by producers faced with extinction as their alternative. Assumptions in the Organization for Economic Cooperation and Development (OECD) that fossil fuel resources will be 'stranded' may be wide of the mark. It could be investments in the infrastructure to consume fossil fuels that suffer this fate, while energy exporters move to a model of exporting 'embodied energy' in the form of intermediate commodities and even energy-intensive finished products.

The way the world uses and produces energy has entered a period of profound change. But while there is no doubt that we are in the early stages of the next energy transition, there is continued uncertainty about its trajectory in terms of its speed and depth. This will dictate whether the world achieves the 2°C target, and if not, by how much it will miss this target. Based on current scientific consensus, the world is not yet on a path that even comes close to the target and the majority of economies are still seeing investments in infrastructure that locks in obstacles to achieving it. The argument that the solution lies in electrification of the energy system, followed by decarbonization of the electricity supply system sounds attractively simple. The future that its proponents envisage is a solar- and, to a lesser extent, wind-powered system balanced by batteries that will be much cheaper than today. This may fail to recognize seasonal versus short-term demand variation and the need for negative emissions to compensate for overshooting GHG emission targets in the medium term. This seems most likely to be achieved cost effectively through consuming biomass in thermal power plants accompanied by CCUS.

In this future, electric vehicles charged from home-based photovoltaic (PV) systems and using the batteries to manage load variations in the low-voltage electricity system (i.e., at the household level) could actually limit the ability to benefit from economies of scale that high-capacity thermal power stations with CCUS provide in reducing GHG concentrations in the atmosphere.

The Relationship Between Energy and Climate Policies

Although the energy transition effectively holds the key to how costly it will be to mitigate climate change, it is clear that as the energy transition gains traction, in some geographies, it is becoming increasingly disconnected from the climate change debate. An example of this is in the U.S. The significance of the decision by the Trump Administration to pull out of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement has been down-played by most analysts. U.S. carbon emissions are already on a downward trajectory. Many analysts agree that the decision to withdraw from the Paris Agreement will have a limited impact on the speed of a transition that is increasingly driven by technology, city- and state-wide policies (driven by air-quality rather than climate change concerns) and market forces (such as lower renewable energy costs).

Even if it is agreed that U.S. federal government policy is not relevant to the pace of transition, there is continuing debate, globally, over the three key drivers of the energy transition; technology, government policy and consumer acceptance. There is no clear consensus on the answers to these questions such as the interaction between these drivers and whether technology and consumer preferences are moving fast enough to reduce or even eliminate the need for direct government intervention. However, the experience of the U.S. over the coming years is likely to help provide insight because the energy transition there is more advanced than commonly perceived, even if less than some of its OECD peers. Analysts will be able to tease out the effect of reduced federal government intervention versus the impact of city- and state-wide policies.

Clearly, a complex interaction between the energy technology transition, energy policy and climate policies is at play. While they are closely related, they are not the same. The energy transition moves to a different rhythm than some governments would like and they attempt to accelerate it through energy policies. Energy policy is often seen as a tool of climate policy, offering levers that are easy to pull but are associated with higher risks of economic damage.

Innovation not yet delivering the goods

Overall, technological progress is the key. Whether it is energy storage, solar PV systems or electric vehicles, technology is clearly evolving both in terms of higher performance and lower costs and there is now a belief among some that a technology tipping point will soon be reached, providing a further major boost to the energy transition. For them, the question is not if, but when.

Future demand for oil and gas

However, the policy/technology dichotomy is just one element of the energy transition; as mentioned earlier, consumer expectations and societal behaviors are also key drivers on the demand-side. Phenomena including ride-sharing and a move away from traditional car ownership are all set to impact energy demand for mobility. Indeed, the electric vehicle revolution is an area where some believe that policy, technology and consumer choice will create a perfect convergence. The U.S. is increasingly the test-bed for examining changing consumer patterns when confronted by new mobility technologies.

Overall, consensus suggests oil consumption growth will slow and, possibly, peak as demand falls in key sectors such as passenger vehicles, power generation and residential. However, demand is expected to increase from other transportation sectors such as aviation and shipping. Petrochemicals is often held out as a major area of growth. The growth in electric vehicles (EVs) is likely to be exponential, driven largely by technological advances and consumer choice rather than by climate policy but the amount of oil displaced is not as much as popularly thought. While global oil demand growth for transportation fuel is likely to fall, it will be hard to reduce net consumption without dramatic policy measures from policymakers, especially at the city level, and major changes as outlined earlier. The Corporate Average Fuel Economy (CAFE) standards in the U.S. show that such measures can work. California presents a good case study of possible future trends in transportation but, even if replicated globally, this case is just about consistent with a 1.5°C increase in global temperatures.

There have been some studies exploring the limits of what could be achieved, in other words going beyond the current policy prescriptions of California, that find vehicle automation combined with high electrification, favorable urban transportation policies and a consumer-driven move toward shared mobility to be consistent with a 1.5°C global warming target. Indeed, in such scenarios, global oil demand would not only peak but decline substantially. An extreme case that has a combination of 60 percent of on-road trucking switching to alternative fuels, a 20 percent improvement in logistics vehicle miles traveled (VMT) via digitalization and a 30 percent fall in VMTs due to ride-sharing could lead to global oil demand declining from 95 million bbl/d today to below 60 million bbl/d by 2040. However, this scenario requires a number of factors to converge and probably represents the more aggressive end of the transition spectrum.

Falling demand for hydrocarbon liquids from passenger vehicles will be partially offset by rising demand from petrochemicals though many feedstocks (such as ethane and liquid petroleum gas) are from sources that may not be a direct by-product of crude oil production. It is clear that petrochemicals will not come to the rescue of oil demand alone. But a disruptive combination of increased EV sales and higher plastics recycling could contribute to an earlier-than-expected peak in global oil demand. At current trajectories, oil demand from passenger vehicles is set to fall by around 3 percent, well below the 9 percent consistent with a 2°C scenario and far short of a 1.5°C increase in temperatures.

Low carbon energy supply

Uncertainty also surrounds two traditional clean energy sources that could provide a major boost to meeting carbon targets, namely nuclear and hydro. Both are able to generate a plentiful supply of clean energy, though each suffers from issues of societal acceptance and, in the case of nuclear, the increasingly prohibitive cost of next-generation fission reactors and the even more nebulous costs of fusion technologies. Potentially disruptive technologies such as the development of small-scale fission or nuclear fusion have the potential to change the energy landscape, especially in countries where social acceptance is less of an issue such as China, but these undertakings are at the early stages in the innovation cycle and cannot reasonably be expected to make a contribution in the short term.

On the mitigation front, CCUS is accepted as an enabling technology but, as in the case of

nuclear and hydro, is hampered by issues of social acceptance in richer economies. There is an apparent lack of interest among less developed economies that do not see themselves as being in a position to incorporate a carbon price into their energy supply costs at a level that would justify CCUS. In the short term there is scope for selective deployment where added value can offset the high cost of implementing projects, such as enhanced oil recovery through injecting carbon dioxide into the reservoir. Ironically, it is normally cheaper to source carbon dioxide from natural reservoirs than in capturing combustion emissions and such applications are therefore unlikely to make a tangible difference in reducing net carbon emission in the absence of cost breakthroughs or policy mandates.

Economic Adaption: Challenges for Governments and Companies

There is little here to comfort those who resolutely believe that climate change is an existential risk that will crystallize if policymakers let this view of the energy future come to pass. Skepticism about whether oil (and other fossil fuels) will be easily dislodged from the energy mix is most pervasive among oil company executives and representatives of oil exporting countries. They assume, perhaps correctly, that a loss of economic competitiveness will not be tolerated. Furthermore, they question whether citizens in rich economies will accept the loss of welfare arising from higher energy prices or the loss of utility if they are forced to accept less reliable energy-based services, particularly personal mobility.

Policymakers in developed economies may assume that reductions in demand for oil will reduce wholesale market prices (earned by producers) leaving space for them to gather increased fuel duties or carbon taxes. Furthermore, they expect that the availability of low cost substitutes in the future will weaken the bargaining position of exporters. This would mean that losses to importing economies would be small, even nonexistent, while exporting economies would carry the major burden of decarbonization. The possibility of exporting economies adopting strategies that impose costs on importers seems to be dismissed.

What would happen if we continue with the current posture of climate policy – nations making promises that they may not keep and, in any case, not summing to the required level of mitigation? In the face of demand uncertainty, the potential for price decreases and the fear of stranded assets, oil producers and companies alike would likely embark on strategies to become leaner and more efficient just as they have responded to previous cycles. One likelihood is that low-cost producers, such as those in the Middle East, would be best placed not just to survive but to benefit from price spikes as high-cost producers are priced out of the market. But it is far from clear that their economies would be able to weather these storms without rethinking the diversification in their economies and the hedges that this can create.

For both corporations and the financial sector, the energy transition is a major risk factor. Those institutions that assume that it's business as usual face a major threat to their business models. Financial institutions are becoming wary as to how to allocate energy investments in their portfolios. Their reaction to the energy transition could actually accelerate it, turning their fears into reality through their investment decisions – divesting from hydrocarbons and declining to allocate funds to potentially exposed sectors.

International oil companies, in particular, would be forced to re-invent themselves as shareholders put pressure to ensure continued returns. But there is a risk that companies start to focus on short-term dividends rather than long-term growth creating a self-defeating spiral of under-investment. Indeed, identifying the right investment policy during the transition is going to be key to their long term survival. Oil companies face the risk of losing out if they take a knee-jerk reaction against investing in exploration and production and failing to diversify into the new opportunities offered under the transition to cleaner energy. Advocates of a rapid transition view the demise of investment in fossil fuel resources as a positive. However, the risk is that if replacements are not available without subsidy and at scale, energy costs will slow economic growth with negative consequences for societal welfare. A transition that rations the decline in demand for fossil fuels without sharp discontinuities may be

desirable, but difficult to achieve in practice if the past is any guide.

Oil companies with exposure to high-cost oil face the additional risk that such oil, including heavy oil and oil sands, often has the biggest carbon footprint. Overall, oil companies will come under pressure from investors to focus on low-cost, high-return investments or return cash to shareholders. Even as oil demand slows, with output from existing oilfields declining at up to 5 percent each year, the oil industry will have to continue to invest heavily in new supply. Assets are unlikely to become stranded unless they have a massive carbon footprint. The main risk is a stop-go investment scenario that results in oil price volatility.

Traditional oil companies face a quandary as to where value will migrate during the transition. Should they expand into new areas such as gas or power generation? They would face risks in new businesses in which they have no experience, but the risks of doing nothing are also high: small variations in demand can have a disproportionate impact on companies; a 10 percent decline in coal demand has had a massive impact on all global coal companies.

Opportunities and Challenges for GCC Producers

Legacy low-cost producers such as Saudi Arabia, Kuwait and Abu Dhabi are clearly best placed to survive a future dominated by greater oil price volatility. They continue to invest heavily in maintaining and even increasing capacity but are following diametrically opposed strategies in terms of their relationship with foreign investors; Saudi Arabia is looking for new investors through its initial public offering (IPO) while Abu Dhabi has increased its share of its upstream joint ventures.

All resource-holders face the challenge of securing markets in a competitive environment and investments in complex refineries in Asia mean that the Middle East's hitherto captive market is now able to source crude globally. The region will maintain its advantage as a low-cost producer, but oil trade flows seem set to change. China, a net importer, is now positioning itself as a major crude oil trader and is using oil as a tool for global diplomacy. Producers are looking for demand security but this is likely to be in short supply as the transition progresses.

Oil dependent economies, including those in the Gulf Cooperation Council (GCC), will come under increasing pressure to diversify into non-oil sectors. Saudi Arabia and the United Arab Emirates (UAE) have already embarked on major economic transformation and diversification programs. Oil-producing countries with large populations and less robust economies could face a range of domestic challenges as they come under fiscal pressure. The social contract with local populations in countries with large energy resources will need to be reconfigured if subsidies are to be addressed. Reform is essential but it needs to be gradual and managed in a way that does not undermine social welfare.

Governments that are leading climate change mitigation efforts tend to be those in more developed economies and who are best placed to pay the economic price for such measures. For Gulf producers, the challenge becomes one of mitigating economic changes resulting from other governments' measures to mitigate climate change. The economic burden is not likely to be evenly spread, nor must it inevitably fall on the oil and gas producers.

Energy supply security concerns are waning in the current era of energy abundance amid mounting resource-holders' concern about the need for increased demand security. In Europe, there is growing demand for 'climate-proof' energy with a tax on oil with a high carbon footprint. As the climate change debate widens to include household energy consumers, politicians and policymakers are being forced increasingly to listen to the public voice calling for low carbon energy. However, there is a risk that the abundance of energy is lulling consumers into a false sense of security. Transitions can be very fast and, even if they can be carried out in an orderly fashion, there is always a risk of unintended consequences caused by feed-back loops. Extreme price volatility is a risk and policymakers are not immune from reacting to high prices with measures that exacerbate the problem.

GCC producers would suffer the consequences of policies designed to limit reliance on oil and gas, whether these policies made sense to their customers or not. Their protection lies in developing strategies that retain the value of their resource endowments regardless of whether the current global climate governance prevails or the Paris Agreement evolves into a framework in which targets are binding and there is no scope for free-riding.

The Grand Energy Transition: A World with Binding Climate Policies?

The purpose of KAPSARC's research project is to explore what would happen if all governments adopted policies that actually limited emissions to the level necessary to achieve the 2°C target – for simplicity, we interpret this as all countries achieving the same emissions per capita by 2100 and each moves to that level in a linear progression from where they start today. Obviously this sidesteps the debates about differences in affordability and equity but provides a useful basis to force consideration of strategies that do not include free-riding.

Energy transitions are not new. What is different this time is that the transition is driven not just by technology and market forces but also by energy and climate policies. Past transitions progressed at their own multi-decadal pace but in the current transition a sense of urgency prevails. For the first time, society and nation states consciously want to accelerate the process of change. A consensus view is that the current commitments under the Paris Agreement is not enough to ensure the 2°C target will be achieved.

Pulling the easy levers is also unlikely to be enough and at the workshop we demonstrated this by using a process of role-playing and policy choices. To achieve this, nine archetypal countries or groupings were created that could be used to represent all significant populations and economies. These were:

- China
- U.S.
- European Union
- India
- Japan
- Brazil
- Saudi Arabia
- Russia
- Morocco

All other economies were represented by scaling their demographics and aggregating them to follow the policy choices of their archetype. All economies were constrained to meet the same per capita emissions in 2100 so, for example, India had scope to grow its emissions and the U.S. had to reduce them significantly. The nine teams were given the objective of meeting the 2050 target (interpolated from today's position to the 2100 end point) while damaging their economies to the minimum extent compared to the macroeconomic reference case. Oxford Economics agreed to support KAPSARC's use of its global model for this analysis.

Proposed policies were typically an extension of current plans with limited trading of allowances and collaboration that might have created synergies with other countries. Above all, they tended to focus on mitigating climate change without weighting the objective of offsetting economic impacts. Nearly all countries reduced their subsidies and installed a carbon tax, expecting a market response to reduce carbon emissions. Beyond this, switching in the power sector to less carbon-intensive fuels and growth in renewables was the next tier of responses. Thirdly, efficiency measures in industry, homes and transportation were popular. Lastly, sequestration through carbon capture and storage (CCS) and forestry were used by some countries. There were a few specific proposals, such as the carbon trade between India and the U.S., restarting nuclear power in Japan and heavy investment in public transport for Saudi Arabia to round out the policies.

Looking more specifically at the policies chosen by the U.S. team, these included a broad range of options including carbon taxes, investment in CCS, the closure of coal-fired power plants, the end of new sales of internal combustion engine (ICE) vehicles by 2030 and increased investments in energy efficiency. The carbon tax on fuel was offset by lower income taxes. Added to these measures, the U.S. agreed to an ambitious deal with India to buy 2 billion tons a year of CO_2 emission rights at a fixed price of $30/ton for the period to 2050. The result of multiple policies meant that the U.S. carbon emission were more than halved while economic growth was maintained. India, for its part, saw per capita emissions double while the financial boost from its carbon trade with the U.S. led to record consumer-driven economic growth.

Looking past the end of the period and with the end of the effect of the carbon trade, the U.S. posted a modest reduction in carbon emissions despite a wide range of policy measures and gross domestic product (GDP) growth was proportionally higher. India, for its part saw its carbon footprint continue to rise, albeit modestly, but its economic growth takes a major hit starved of revenues of $60 billion a year.

On a global level, these nine countries consist of approximately 75 percent of all carbon emissions and the remaining 25 percent of global emissions were covered by the roll up of the archetypes. The direct impact of the actions taken reduced total carbon emissions by 25 percent versus the business as usual case. While admirable, this result falls short of the global carbon budget necessary to meet the goals. If only 500 gigatons of available headroom still remain, the rate of GHG emissions will need to fall by at least 75 percent overall by 2050, or three times the reduction seen from the proposed slate of policies. The equilibrium effects and interactions between policy choices in one economy prevented other economies from achieving the full benefits that they assumed in their own prescriptions. This complexity highlights the need for greater awareness of the implications of not just sovereign choices but also the impact of choices being made elsewhere on a national, regional and global level.

Future KAPSARC workshops in this series will provide participants with an opportunity to expand and explore alternative policies during subsequent iterations of the team exercise.

About the Workshops

In 2017, KAPSARC convened a series of workshops on the Role of Oil in the Low Carbon Energy Transition. The second event was held in The Hague on April 19 and 20, 2017 in association with the Clingendael International Energy Program (CIEP). The Workshop was held under a modified version of the Chatham House Rule under which participants consented to be listed below, having joined on one or both days. However, none of the content in this briefing can be attributed to any individual attendee.

List of Participants

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About the Workshops

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About the Team

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Paul Mollet is a former journalist and energy market analyst with almost thirty years of experience in international energy markets. He has lived and worked in London, Madrid, Dubai, Lisbon, Doha and Sweden. Previously, he was Middle East Bureau Chief for Platts and Petroleum Argus.

Colin Ward

Colin Ward has worked in the energy industry for ten years in various capacities including seismic field work, refinery design and consulting for all the major IOC and NOC players worldwide. He is currently focused on cost estimation for energy projects and environmental impacts of the global energy industry. His education includes a degree in Electrical Engineering from the University of Houston and an MBA from the University of Texas.

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