



## China's Sustainable Fuel Strategies



## About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is an independent, non-profit research institution dedicated to researching 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.

## Legal notice

© Copyright 2015 King Abdullah Petroleum Studies and Research Center (KAPSARC). No portion of this document may be reproduced or utilized without the proper attribution to KAPSARC.



## Summary for policymakers

KAPSARC's China Research Project is investigating the policy-economic nexus that underpins the growth and evolution of China's energy economy. This workshop investigated one of the major emerging trends of China's energy transformation: the development of sustainable fuel use.

Any discussion of sustainable fuel use in China is likely to start with the statistic that the last two decades have seen China move from being a net exporter of coal and oil to being the largest importer of both. Yet beyond the underlying surge in energy demand, the consumption of coal and oil raise very different sets of questions in terms of sustainability.

For coal, the discussion largely centers on its environmental costs. The international debate on climate change and the domestic questions of poor urban air quality have thrown the spotlight on China's ability to continue to use coal as it has in the past. In contrast, the discussion around the sustainable use of oil revolves around China's rising oil import ratios and what this means in terms of the country's involvement in the international energy markets and the actions necessary to ensure security of supply.

Despite the different questions, three distinct themes underscore the dangers of setting policy in isolation and failing to coordinate with other initiatives and so recognize the broader context:

- Policies are a means to an end, not an end in themselves: policymakers will always respond to realized outcomes in the ongoing pursuit of their goals, and models of policy effectiveness risk irrelevance if they do not take this into account.
- Policies that induce changes in consumer energy use do not necessarily drive desired changes in the underlying fuel mix.
- Coordinating energy policies between economies in North East Asia has proved extremely difficult, but the potential benefits make it a priority still worth pursuing.

As China's importance in global energy markets continues to grow, the effect of its policy decisions will be felt throughout the world in economic, environmental and political arenas. Understanding the motivations of policymakers and aligning the research with real-world political problems is a critical step in informing the debate around China's sustainable fuel strategies.



## Background to the workshop

In November 2014 KAPSARC hosted the second in its series of workshops on China's Energy Economy to explore the potential for sustainable fuel strategies in China. The workshop was held in Riyadh, and built on the previous workshop held in Hong Kong in April.

This series of workshops is designed to facilitate a continuing, open, and collaborative space for the discussion of some of the most pressing questions facing the development of China's energy economy as they arise out of KAPSARC's research agenda. Each workshop is presented as a self-contained discussion, but one that leverages off the policy and economic knowledge platforms KAPSARC is constructing. In this way, they become a forum for cross-discipline interaction that advances the research agenda while also leading to policy relevant insights.

Despite still being self-sufficient for over 90% of its energy needs, the last two decades have seen China swing from being a net exporter of coal and oil to the world's largest importer of both. In particular, China's burgeoning energy use has resulted in two problems:

- The country's reliance on coal as an energy back-stop has contributed to environmental pressures which have gained widespread recognition in light of Beijing's poor air quality
- Growing oil import ratios have raised concerns around oil supply security as the country faces further increases in its oil imports and becomes further enmeshed in international oil markets, viewed by some as largely controlled by OPEC and the IEA.

The discussions on coal focused on a series of questions, stemming from its position as the overwhelmingly important fuel in terms of its

contribution to the domestic economy (67% of total primary energy supply) and its environmental effects.

- The coal industry is more than just a supplier of energy but also a major employer and a key shaper of infrastructure. What will be the future for China's coal use?
- China is embarking on a second round of urbanization and we can expect major shifts in household energy use. What are the demographic trends, how do households currently use energy, and what are the social costs of continued coal use?
- China's energy economy is both complex and ever changing. What is the *current* state of Chinese energy policy and what can we expect in the *near future*?
- As energy is just one part of the political landscape, what are China's policy priorities and how have they changed?

As stated, with oil, China's main concern relates to energy security. Over 50% of China's oil is imported and this is set to rise.

- What does *sustainable fuel use* mean in the context of China's growing domestic supply gap?
- What possibilities are there for energy cooperation and regional energy governance to reduce the probability and cost of supply failure?

## Introduction

China has made several announcements about its intention to move to a more sustainable form of development. At the heart of the 12th Five Year Plan is a commitment to reduce the country's carbon intensity by 40% by 2020 from a 2005 benchmark. More recently, the APEC meeting in November 2014 was the setting for an announcement by Presidents Obama and Xi to further curtail CO<sub>2</sub>



emissions. China has apparently committed to zero growth in CO<sub>2</sub> emissions after 2030.

The wider context in which policies are set is important if they are to succeed. Examples of separate policy initiatives having conflicting results include:

- A resource tax intended to reduce coal consumption may promote imports of foreign coal, damaging the domestic coal industry, while doing nothing to reduce overall coal consumption.
- Moves to optimize the domestic coal industry may succeed in boosting coal production and reduce the need for foreign imports but at great cost to fragile local eco-systems.

**“Policies set in isolation may lead to unintended consequences”**

The conflicting needs of the various underlying policy drivers (pollution control, local employment, optimized industry structure) are best stated clearly so that researchers and policymakers can understand the full range of factors that need to be taken into account. This is unlikely to avoid unintended consequences altogether, but may help to reduce the number and lessen their consequences.

Understanding the tensions in China's bureaucracy and policymaking apparatus can also be useful in this context. The flexibility provincial governments have in implementing Beijing's initiatives can lead to variable compliance and competition between provinces that can undermine national benefits. To take an example, there is a fear that the improvements in environmental protection afforded by the coastal provinces could lead to the migration of industry to inland, poorer provinces with weaker regulatory environments hungry for new jobs and investment.

Recent changes in the criteria for promotion within the Party, to include environmental protection as well as economic performance, should reduce the danger. But without clear ranking of priorities, it is difficult to understand how performance against two potentially contradictory indicators will be scored.

Transparency in ranking performance priorities can help both policymakers and researchers better understand the likelihood of particular outcomes from a range of possible policy instruments.

### Policy is dynamic

KAPSARC's own work in compiling the KAPSARC Energy Policy Database (KEPD) has revealed the dynamism of China's energy policy environment. Policies not only shape the energy economy, they also respond to changes in the economy. The story of price deregulation in coal and, to a lesser extent, oil and gas is a story of feedback loops with policy changing incrementally both in response to underlying tensions and in order to promote specific outcomes. Electricity reform, of both price and grid ownership, is perhaps interesting for its contrasting lack of dynamism; here entrenched interests in the form of the grid companies and concerns over the inflationary effects of rising power prices have stymied actual reform, despite a history of debated policy initiatives.

Sustainable policies are those that promote stable energy supplies, environmental protection, and poverty reduction. Where policies fail to balance this trilemma they will become inherently unsustainable and invite the renewed attention of policymakers. But energy supplies, the environment, and society are not static entities; for this reason policies will continually change as policymakers seek to maintain some kind of dynamic equilibrium. New technologies, too, can result in policy obsolescence, as can events that reshape public opinion.



Examples of changing policies abound. Following the Fukushima nuclear disaster, public acceptance of nuclear power in China fell and the government responded by reducing its targets. In 2013/14 the Chinese government launch seven pilot Emission Trading Schemes with the intent to launch a national scheme after 2016. A national coal cap is expected to be brought in to constrain coal use, but already certain provinces (including Beijing) have introduced their own caps along with moratoria on new coal-fired capacity.

The effects of dynamic policy are sometimes forgotten in models of China's energy economy. For example, if modelling the effect of coal caps on PM2.5 levels, the question may be better framed in terms of the cap required to achieve a certain PM2.5 concentration. If policymakers are determined to reduce air pollution, the coal cap is better modeled as a means to the end, rather than the end in itself. Analyses that suggest existing plans are insufficient to meet the target are more useful if extended to go beyond highlighting the shortfall by suggesting possible remedies.

**"Models do not provide answers, only better understanding of the question"**

The adage that models do not provide answers, only better understanding of the question, is especially true in this environment. Models that assume policy is static and do not go beyond the shortfalls of current or proposed legislation are of limited use. The energy sector, a part of the economy which tends to be highly regulated, is a particular example because policymakers may be less comfortable with allowing the market to find its own solution.

In this context, a useful framework for understanding how China and other countries construct policy initiatives may be provided by classification between:

- Strategic programs (overarching policy issues such as energy efficiency or air pollution which have strong political support and clear targets).
- Investment programs (generally benefiting state owned enterprises or local governments, these again have strong support and clear targets).
- Sector reform programs (these arise through protracted policy debates and are implemented over many years through a series of increments with focused support but also focused resistance from the 'losers'; price reforms represent one example).
- Policy experiments (where the center's political and financial support is limited, the beneficiaries unclear but the resistance low, a series of pilots can be used to test alternatives).

By their nature all four are dynamic, though in different ways, and have different prospects for sustained success. Strategic programs are dictated by the emerging political priorities of the central government and, as political weight is thrown behind them, are assured at least short-term success, despite often widespread local resistance. Investment programs, at which China excels, are dynamic: infrastructure needs change through time. Sector reform programs should be the most dynamic of all, but vested interests can often slow or block policy initiatives. Last, policy experiments are clearly dynamic and often short-term, such as the current emission trading scheme pilots.

This framework for understanding policy initiatives can help devise the best question to inform the policymaker's needs. By understanding what the policymaker is seeking to achieve, and the routes open to them through this framework, incorporating the dynamic nature of policy-setting directly into research can increase the relevance of any recommendations. In contrast, traditional approaches have more likely viewed constant policy changes as impediments to the modeler's success.



### **Policies that induce changes on household consumption do not necessarily alter the fuel mix**

China's target to reduce coal to 65% of its primary fuel mix is a key part of the country's plan to reduce its reliance on coal and curtail environmental degradation. Yet the route to successfully reducing coal's proportionate role is far from clear. Two related issues prevent an easy win.

- Households already account for 35% of China's energy demand and this share is set to rise as urbanization increases, yet relatively little coal is used by households directly.
- The fuel mix is to a large extent determined by the fuel supply. Coal remains the gap-filler as gas and direct electricity lag significantly below pent-up demand levels.

These two issues can be illustrated through everyday examples. Urbanization is generally assumed to lead to an increase in gas use and Chinese gas consumption is certainly concentrated in urban areas. But urbanization also leads to increased electricity demand and the majority of electricity is coal-fired. Any reduction in direct coal use attributed to a rural to urban move will likely be more than offset by the increase in coal use through the increase in electricity demand. Urbanization is therefore at best neutral in terms of coal use and likely negative.

Among the measures to reduce air pollution in China's cities has been the promotion of electric cars. Electric buses are found in several cities in China, and Shenzhen has a world-famous fleet of electric taxis from the Guangdong-based car manufacturer BYD. Yet while electric cars can reduce oil demand and improve roadside air quality, China's reliance on coal for its power generation means that electric cars likely increase coal consumption and increase aggregate emissions.

These pressures on coal use are exacerbated through the significant demographic shifts expected in the next ten to twenty years. While overall population growth is expected to be relatively low (despite a relaxation of the one child policy), the number of households is expected to grow by over a third in the two decades to 2020. This will lead to significant increases in overall energy demand, especially for electricity.

Urbanization, atomized households and growing wealth will affect energy use in unpredictable ways. While modelers can map shifting population patterns to the differences in energy use between rural and urban areas, taking account of changing attitudes is much more difficult. Fuel use varies by household type, age and sex. Will the breakdown of the traditional multi-generational family lead to altered eating and cooking habits? Will fewer people cook at home and more patronize restaurants? Will microwaves gain ground in China as they have in other cultures? What is the future of car use? The attitudes of future energy consumers are the wild cards for energy modelers, but once again, China's reliance on coal as the stop-gap fuel means that increases in electricity demand could undermine attempts to reduce coal's share of primary energy to 65%. The future is inherently unpredictable – perhaps what could end up pushing coal's share of the fuel mix down might not be a cap on coal use so much as runaway demand for liquid fuels.

### **Regional cooperation is difficult but could be highly beneficial**

Energy producers and consumers share a range of pressures.

- Promoting energy efficiency domestically reduces energy import costs for consumers and boosts the availability of exports for producers.
- Energy producers can become overly reliant on the domestically produced fuel type and fail to



benefit from a more diversified fuel mix. Energy consumers want a diversified portfolio of suppliers and fuel mix to reduce the risk of supply disruptions.

- Consumers focus on security of supply; producers worry about security of demand. These are two sides of a single coin, security of energy flow.

While research has been conducted on understanding how one economy affects another, there is a research gap in understanding how economies can fit together and through the alignment of interests reduce economic costs.

These shared challenges and the benefits of aligning interests are of special importance in the context of Gulf energy exporters and North East Asian importers.

- Within North East Asia, various initiatives to promote regional energy cooperation have all ended in failure, despite a widely held belief that such cooperation could unlock benefits for all the involved economies, improving stability and prosperity.
- Within the Gulf, moves for an integrated energy system that would improve efficiency and boost the export potential of all countries have progressed slowly, while individual countries are heavily reliant on liquid fuels, which are used inefficiently owing to a history of government subsidies. Between these two regions, the development of cross-border governance and cooperation structures could reduce domestic costs associated with ensuring security of supply or demand by aligning interests to focus on security of flows.

While researchers and policymakers may be united in their realization of the possible benefits of cooperation, attempts to institutionalize such beneficial relations have foundered on two key areas.

First is uncertainty over what cooperation actually means. For OPEC, cooperation has been described as acting as a selling cartel. Does this mean that North East Asia should form a buying cartel? At the other extreme, regional cooperation could simply involve sharing best practices and harmonizing standards and policies. Most of the initiatives in North East Asia have focused on promoting investment and trade, and attempts to integrate infrastructure. This is also an element of the Gulf's attempts to achieve regional energy cooperation.

Second is the tendency of domestic pressures to hold cooperation initiatives captive. Both the Gulf and North East Asia are home to a range of competing domestic agendas which can periodically undermine the well-understood benefits of foreign cooperation.

The two regions could learn from each other in their approaches to cross-border energy cooperation, but they could also benefit from establishing stronger inter-regional ties. The Middle East lies at the pivot of China's new Silk Road; the relations between the two regions have been deeply affected by recent changes in the USA's energy sources and diplomatic focus. Yet while economic relations have improved and while there are plans to strengthen the trade links yet further, this has yet to translate into strong inter-regional (even on a bilateral basis) governance.

There is space to improve the understanding of the potential costs of failing to build policies to institutionalize cross-border energy cooperation. Key to this is understanding how trust, essential in all relationships, whether narrowly transactional or more broadly and deeply strategic, can be established, built, and enhanced.

### China's sustainable fuel strategies

Despite China's well documented energy and environmental challenges, the country has outlined impressive targets for both the medium and long



term. In setting out the “Chinese Dream”, Xi Jinping is seeking to build “a moderately prosperous society and realize national rejuvenation”. Part of this national rejuvenation is the attempt to build a “bountiful China” with high standards of living, a “harmonious China” with social amity, and a “beautiful China” with a healthy environment. Central to this is the need for China to find a path to more sustainable fuel use; ensuring stable energy supplies, continued development and poverty reduction, but with improved environmental safeguards.

No country has successfully transitioned to a green growth model. This means that China has no reliable guide to follow and finds itself becoming a leader in developing a sustainable green growth model by default. It is also in the midst of major campaigns to urbanize and develop, with the continued need to lift millions out of poverty. Yet a problem with the environmental agenda is that it often conflicts with a country's comparative advantage. Both South Africa and China find their energy comparative advantage in coal. Reducing its use may be an environmental imperative, but the costs could still fall disproportionately on the shoulders of the poor. In this sense, comparisons of modern Beijing's air pollution with the pea-soupers of London in the 1950s or the smog of Pittsburgh (1930s) are misplaced. Not only is the chemistry of the pollution more complicated, the effects of the pollution and the costs of cleaning it up are more democratized. If the costs in the 1930s fell on a factory-owning elite, the costs of environmental amelioration programs in Beijing may affect millions, many of whom are on low incomes.

In fact China has already become a world-leader in renewable energy generation. There have been major campaigns to improve energy efficiency, from the national campaign of the 11th Five Year Plan to

a more detailed provincial and sectorial set of targets in the 12th Five Year Plan. Wind generation capacity is expected to be between 200 and 300GW by 2020. Despite these achievements, their actual output will remain a drop in the ocean given the scale of China's coal use.

China still lacks a specific Ministry of Energy to coordinate its energy policy and overcome many of the highlighted problems. Its Ministry of Environmental Protection is weakened by the fragmented, authoritarian nature of China's bureaucracy. Overlapping responsibilities split between multiple administrative bodies and a continued bureaucratic tension between the center and the provinces all contribute to the challenge.

China's progress towards putting its coal use on a more sustainable footing is complicated, but the situation is even more so with regard to oil. Here, China needs not only to marshal domestic solutions that do not cause a counterbalancing resurgence in coal demand, but also contend with the vagaries of regional and international politics and markets.

Ultimately, China can be expected to update its policies in a range of spheres, not just energy, as it works to transition its economy towards a more sustainable future. The policy environment will remain dynamic as feedback from consumer responses drives policy innovation. China's place within a regional energy context will likely become more pronounced and may begin to weigh more heavily on domestic policies.

The energy trilemma (economic development, energy security and environmental protection) remains as important for China now as it ever has been, and only through the careful, coordinated and dynamic balancing of these sometimes conflicting tensions will China succeed in finding its sustainable fuels strategy.



## About the workshop

KAPSARC convened a workshop in November 2014 with some 35 international experts to facilitate a discussion to explore the challenges facing China's Sustainable Fuel Strategies as they pertain to coal and oil. The workshop was held under the Chatham House Rule of capturing the discussion on a non-attribution basis. Participants comprised:

**Philip Andrews-Speed** - Principal Fellow & Head, Energy Security Division, Energy Studies Institute, National University of Singapore

**Saleh Alawaji** - Deputy Minister for Electricity, Ministry of Water & Electricity

**Samer AlAshgar** - President, KAPSARC

**Jean-Pierre Cabestan** - Professor in Political Science, Head of Department, Hong Kong Baptist University

**Chen Zhanming** - Associate Professor of Energy Economics, Renmin University of China

**Gaye Christoffersen** - Professor of International Politics, Hopkins-Nanjing Center

**David Daniels** - Chief Energy Modeler, Energy Information Administration (EIA)

**Brian Efird** - Program Director, Research Fellow, KAPSARC

**Fan Ying** - Director, Centre for Energy and Environmental Policy Research, Institute of Policy and Management, CAS

**Philipp Galkin** - Senior Research Associate, KAPSARC

**Howard Gruenspecht** - Deputy Administrator, Energy Information Administration (EIA)

**Fatma Al-Hakmani** - Director of Energy Department, Economic Affairs, The Cooperation Council for the Arab States of the Gulf

**Mun Ho** - Visiting Scholar, Institute of Quantitative Social Science, Harvard University

**David Hobbs** - Head of Research, KAPSARC

**C.S. Kiang** - Chairman, Sustainable Development Technology Foundation

**Leo Lester** - Research Fellow, KAPSARC

**Liu Xiying** - Research Fellow, Energy Studies Institute, National University of Singapore

**Li Taoya** - Director of International Cooperation, Department of Comprehensive Administration, State Information Center

**Coby van der Linde** - Director, Clingendael International Energy Program

**Abdulhadi Al-Mansouri** - Vice President, KAPSARC

**Marwan Masri** - President Emeritus, Canadian Energy Research Institute (CERI)

**Gerard McCloskey** - Partner, Merlin Trade & Consultancy

**Bader Al-Otaibi** - Energy Department, The Cooperation Council for the Arab States of the Gulf

**Yongduk Pak** - Senior Research Fellow, Korea Energy Economics Institute (KEEI)

**Axel Pierru** - Program Director, Research Fellow, KAPSARC

**Hamad Al-Sayari** - CEO, Oasis for Industrial Investments

**Sheng Lei** - Division Chief, State Information Center

**Sang Yoon Shin** - Associate Research Fellow, Korea Energy Economics Institute (KEEI)

**Su Bin** - Fellow, Energy Studies Institute, National University of Singapore



**Masakazu Toyoda** - Chairman & Chief Executive Officer, Institute of Energy Economics, Japan (IEEJ)

**Emma van der Veen** - Researcher, Clingendael International Energy Program

**Wang Zhenglian** - Senior Research Scientist, Duke University

**Kenneth White** - Senior Research Analyst, KAPSARC

**Yukari Yamashita** - Board Member, Director, Institute of Energy Economics, Japan (IEEJ)

**Yang Fuqiang** - Senior Advisor on Climate and Energy, National Resources Defense Council

**Sonia Yeh** - Research Scientist, Institute of Transportation Studies

**David Youtz** - Senior Consultant, National Committee on United States-China Relations

**Yao Yu** - Energy Attaché, Embassy of the People's Republic of China in the Kingdom of Saudi Arabia

**Zhang Dongxiao** - Dean of the College of Engineering and Director of the Institute of Clean Energy, College of Engineering, Peking University

**Zhang Junjie** - Assistant Professor of environmental economics, School of International Relations and Pacific Studies, UC San Diego

**Zhang Xueying** - Director-General, State Information Center

**Zhang Zhongxiang** - Distinguished Professor and Chairman of the Department of Public Economics, Fudan University

**Zhao Xiaowei** - Economist, State Information Center

## About the research team



**Brian Efird** PhD is a Research Fellow and Program Director for Policy and Decision Sciences at KAPSARC leading teams on China, Transportation, Demography, and Bargaining Models.



**Axel Pierru** is a Senior Research Fellow and Program Director for Economic Modeling and Analytics at KAPSARC. He holds a PhD in economics from Pantheon-Sorbonne University.



**Philipp Galkin** is a Senior Research Associate specializing in economic and policy analysis. He holds a PhD in International Economic Relations and an MBA.



**Kenny White** is a Senior Research Analyst at KAPSARC focusing on Chinese energy policy. He has an MPP from Stanford University.



**Leo Lester** is a Research Fellow leading the China Research. Previously working in strategy and portfolio development for an international oil company, he has a PhD and is a CFA and FRM.

## About the China Research Project

The goal of this research project is to understand the context of China's energy economy, decision making process, and (even) social mores. This understanding will enable the collection of relevant and accurate data to both feed analysis and drive the interpretation of model outputs. The project aims to analyze and assess information to obtain policy relevant insight. The focus is on investigating the global consequences of changes to energy markets within China.

The overall objective is to combine an understanding of the fundamentals of China's energy economy (derived from KAPSARC's Energy Model for China) and of the policy landscape (through the construction of the KAPSARC Energy Policy Database). The two platforms and the associated knowledge are then used to answer a range of questions looking at the reform of China's energy sector, ultimately leading to an informed view on the future of China's energy mix.

In line with KAPSARC's overall objectives, the intent is to produce policy relevant insights that help actors outside China understand the consequences of decisions taken by actors within China.

The workshop series fits into the overall project by providing a space for a continuing dialogue that raises the key issues, provides feedback on current work, and can set future directions. In addition, the workshops are an open collaborative forum that enables the discussion of particular questions that feed into the overarching research questions.