

Global Energy Governance Reform and China's Participation

Consultation Draft Report

Energy Research Institute, NDRC; Grantham Institute for Climate
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Disclaimer

This is a draft research report circulated for consultation purposes only. It does not represent the views of the Chinese or the UK government. Our research is continuing and we will review our conclusions in the light of discussions and comments on this draft.

Introduction to the Steering Committee

This research was supported by the British and Chinese senior experts. The Project Steering Committee has been set up to provide the guidance and influence of senior officials and experts to the project process. The Project Steering Committee consists of four members. Minister Zhang Guobao, Co-Chair of the Steering Committee, Chairman of the National Energy Advisory Committee of China and former Vice-chair of the National Development and Reform Commission; Lord Browne of Madingley, Co-Chair of the Steering Committee, Partner of Riverstone LLC and former BP Group Chief Executive Officer; Shi Dinghuan, Counsellor of the State Counsel and former Secretary-General of the Ministry of Science and Technology; David Sandalow, Inaugural Fellow of the Columbia University Center on Global Energy Policy and former Assistant Secretary at the US Department of Energy.

Responsibility for the Report

The Joint Project Team wishes to express its thanks to the many people in China and around the world who have contributed their ideas to this report, and for the general guidance of our Steering Committee. However the contents of the report remain the sole responsibility of the Joint Project team.

At this stage the report does not necessarily represent the views of the steering committee. In light of consultations of the report, we expect the Steering Committee to offer its own views, in the form of advice to international leaders, later this year.

Please send your comments and ideas on the report to the following:

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Executive Summary

Energy is a global issue. The main objectives of energy policy, to support sustained economic growth through affordable, stable, secure energy supply, to eradicate fuel poverty, and to protect the local and global environment can only be achieved through international cooperation.

The global energy landscape has changed dramatically in recent decades. The big emerging economies, including China, have become major players and the main focus of energy trade has shifted to the Asia Pacific Region. The volatility of energy markets is a special concern for both developed countries and those countries experiencing rapid economic growth. Relations between OPEC and the energy consuming countries have matured and although differences remain, there are now many areas of common interest. Climate change has become recognize as a grave threat requiring a strong international energy policy response. And the shocking fact remains that nearly 1.3 billion people are without access to electricity and more than 2.8 billion people rely on traditional, unhealthy biomass for cooking.

We have carried out extensive international discussions on whether today's institutions for international cooperation on energy, and especially the role that China plays in them, are fit for purpose in the modern world. Our consultations are far from complete and we are making this report as a consultation draft to stimulate debate and comment and to help us reach our final conclusions.

We believe that the institutions for international cooperation on energy have not kept pace with the changes in world energy and that energy governance reform is needed to enable the major developing countries to play their necessary role, to reflect the shift of energy trade to the Asia Pacific region, to improve cooperation between producing and consuming nations, to promote international investment and address the causes of market instability, and to pursue climate mitigation and support low carbon development options and fuel poverty eradication with real urgency.

In Section 2 of our report we review the main existing institutions of international energy governance. It is not our intention to belittle the achievements of these existing bodies, many of which have made huge contributions in their existing roles. There are strong reasons for adapting existing institutions, rather than creating new bodies, if this can be achieved, at least in the short term. However, reform of existing bodies can also be difficult and it is possible that new bodies will be needed in the longer term.

We have identified the following as the main themes of energy governance reform:

- Strengthening the concept of a common global energy security;
- Strengthening international cooperation in multilateral mechanisms, and sharing the best practice in energy exploitation and use;

- Reforming and strengthening existing energy governance mechanisms;
- Jointly building a new international energy order, including energy and financial order;
- Extending the current financial analysis of commodity markets into the energy sector;
- Establishing dialogue on policies that impact the stability of key energy producing regions;
- Improving energy market transparency and data quality of statistics;
- Establishing an effective strategic reserve mechanism;
- Improving fairness in energy trade and energy investment;
- Strengthening the development of renewable energy and new energy;
- Jointly promoting energy efficiency and new energy advances in technology, promoting energy innovation and the transfer and deployment of these technologies.

Our main conclusions are set out in Section 3 of the report. First of all, the international governance framework needs to better reflect the aspirations and voices of emerging and developing countries and the more mature relations between OPEC energy producers and consumers. This requires:

- Reforms of the IEA to enable it to play a genuinely global role. The IEA's Association proposals are a first step and making a success of them should be a priority for the IEA. This will require a substantial realignment of the IEA's agenda towards the interests of developing countries as well as a more international approach to energy policy on the part of China. The IEA should also amend its treaty to lift the provision restricting membership to OECD countries to strengthen its openness and fairness.
- A greater role for the G20 in providing leadership on energy governance reform, possible through a new Working Group, and a strengthening of the G20's role as an important and representative discussion platform for G20 leaders on energy issues, especially those relating to finance and economics issues. Upgrading the cooperation between the IEF, OPEC, and the IEA to create a shared understanding of energy markets and address the causes of instability.
- Strengthening the emerging regional/technology bodies for concrete cooperation on sharing the best practice and advance technology transfer.

We make recommendations to update and upgrade emergency response mechanisms, strengthen international law for investment protection, support developing countries in the development of their low carbon strategies, and build more robust regional dialogues.

China has emerged as a major player in the global energy market, but China is still

inexperienced in global energy affairs. Just as stated in the 18th Third Plenum of China that China needs “to push on with modernization of the country's governing system and capabilities”, China needs to modernize its capacity for participation in international energy governance as well, so that China can master and make full use of existing international frameworks and fully participate in shaping and developing international rules and institutions. We make a number of recommendations on how China can build this capacity.

To be able to participate fully in international energy governance China will need to pursue more internationally minded energy policies and to make a greater effort to explain Chinese energy policies to the international community to achieve fully and objectively understanding of these policies. We make some proposals on how this can be achieved.

Introduction

"China and Global Energy Governance" is a joint project of China's Energy Research Institute of the NDRC and the Grantham Institute for Climate Change, Imperial College London. The existing global energy governance framework was established in the 1970s. But with the increasing importance of emerging economies in the global energy landscape, it is no longer fit for purpose. The project has engaged in extensive discussion with a wide range of international experts and aims to contribute to debate and make recommendations for the reform of global energy governance and also to enhance the participation of China and major developing countries in cooperation on global energy policy issues. The project includes recommendations to strengthen international energy institutions and support Chinese authorities in their analysis of global energy policy issues. In order to achieve the above project objectives, the joint Project Team conducted the following research activities:

- Established the "Steering Committee" with leading Chinese, British, and American experts to contribute project guidance¹.
- During September 2012 to March 2013, the project conducted visits to China, the UK, and the U.S. to hold discussions with government experts and think tanks as well as visiting the International Energy Agency in Paris, and the Energy Charter Treaty Organisation in Brussels. In all, the project has held discussion with more than 80 senior experts. The project has listened to their views on the reform of global energy governance, and has gained an enhanced understanding of what emerging economies expect of global energy governance as well as the expectations that the international community has of emerging economies².
- In September 2012, a member of the research group gave a keynote speech on "Global Energy Governance Reform" at the Beijing Energy Club and members of the group took part in discussion and listened to expert views.
- In September 2013, the project held an international seminar entitled "Global Energy Investment and global energy governance", to explore, from the perspective of the oil and gas industry, the role of the global energy governance framework for energy investments and the status of Chinese overseas investment.

The project intends to convene a high-level international seminar on "China and the global energy governance" in Beijing in March 2014, to review this consultation draft report with senior international experts.

The study involved a wide range of issues of global energy governance, including

¹ See Introduction to the Steering Committee

² See Annex: Project access institutions and experts

reform of the global energy governance structure, promoting G20 leadership in terms of energy policy options, further developing the role of the International Energy Agency (IEA) including enhanced cooperation with China through its "Association" proposal; promotion of the "Energy Charter Treaty"; the potential for BRIC network multilateral energy cooperation; regional energy cooperation; energy cooperation initiatives to help the global economy; China's existing international energy and climate governance institutions; and possible changes in many aspects of the role of oil companies with regard to China's role in global energy security.

Global energy governance is a dynamic discipline. This study aims to start from a blank sheet, and has proceeded through widespread discussion of the core objectives and principles of global energy governance. We have looked at today's global energy governance framework and today's energy governance needs and tried to find options for bridging the gap between the two. This report summarizes the results of our discussions thus far and offers a number of ideas for reform in order to trigger a broader, more in-depth discussion in the international community and, ultimately, to seek more consensus.

We are grateful for the advice of many international experts and for the guidance of our Steering Committee. However, responsibility for the content of this discussion document rests with the Project Team.

1. Trends of global energy governance reform

The current overall pattern of global energy governance was formed 40 years ago. The formation of OPEC and the oil crises of the 1970s largely stimulated a broader and deeper development of global energy governance into current lines. The International Energy Agency (IEA) was established in 1974, under the OECD framework, largely as a response to the perceived threat from OPEC. The International Energy Forum (IEF) was established to improve the dialogue between energy producing and consuming countries. IEF held its first meeting in 1991. In recent decades, climate change, the promotion of technology transfer, and the need to strengthening regional cooperation, have broadened the original objectives of energy governance. As a result more institutions have been established with specific roles such as the United Nations Framework Convention on Climate Change (UNFCCC, established in 1994), the Clean Energy Ministerial (CEM, established in 2009), the International Renewable energy Agency (IRENA, also in 2009), the Global Carbon Capture and Storage Institute (GCCSI, also in 2009) and so on. Meanwhile, energy policy has become an increasingly important topic for major global and regional economic governance institutions, including the Group of Seven (G7), the G8 (sometimes meeting with the "Plus 5"), and to a limited extent the G20, especially through its meetings of Finance Ministers. Regional organisations have developed, for instance, the Shanghai Cooperation organisation was established in 2001.

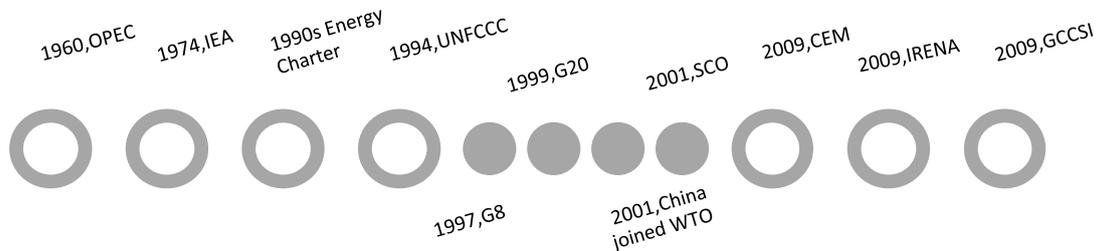


Figure 1. Timetable of the establishment of leading energy/economics governance institutions

In this study, global energy governance means "to cooperate on energy policy through multilateral mechanisms for intergovernmental cooperation." This global cooperation is essential because states are facing common challenges of global energy security and climate change, and no country can solve these problems alone. The current primary means of global energy governance include:

- Discussion and cooperation platforms, including the Group of Twenty (G20), the International Energy Forum (IEF), the Clean Energy Ministerial, and

regional organisations. These provide platforms for high-level policy-makers to meet regularly and discuss issues of global importance and seek consensus. These platforms do not have legally binding structures, and some are loosely organized. This may give them greater flexibility but it also means that their conclusions are not binding.

- Legal and protocol mechanisms. Including the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol, the World Trade Organisation (WTO), and the Energy Charter Treaty. These can establish enforceable international rules.
- Coordination mechanism such as the International Energy Agency (IEA). Although the IEA normally proceeds by consensus and its agreements do not generally have legal force it is a treaty organisation and its strategic oil reserve emergency response mechanism has a legal base.

These are the major institutions which together provide the tools and platforms of today's global energy governance structure.

1.1 Defects in the current global energy governance structure

Rapid changes in the global economy and patterns of energy markets have occurred in the past few decades. First, the supply and demand balance has changed. Oil shale has shown great potential for development, dramatically reducing dependence on foreign energy in North America. The United States has experienced the financial crisis, and is in the process of self-repair. The economic crisis in Europe has also contributed to limiting the growth of energy consumption in developed countries while higher economic growth and increased energy demand in developing countries has shifted the focus of world energy trade toward the Asia-Pacific region. Second, global warming and climate change have become recognized as common challenges, and the need for low-carbon technologies to protect the global and regional environment has become increasingly urgent. Third, economic, geopolitical and other factors, including instability in the Middle East, have caused sharp fluctuations in oil prices.

The above changes have highlighted the importance of international energy cooperation to maintain the balance of the international energy market and to sustain global growth and world harmony. Energy is a global issue. No country alone can achieve national security of supply, and global cooperation is needed to protect the stability of the international system, and provide adequate, affordable energy supply. Energy security in the new era is not limited to oil security but will also cover natural gas, electricity, and the environment. Global energy governance is becoming an increasingly important issue.

As mentioned earlier, 40 years since the current global energy governance structure was formed in the 1970s, a huge change in the global energy economy has led to the obsolescence of the original energy governance framework. The current global

energy governance structure has shown the following main shortcomings:

- **Not representing the emerging and developing countries**

The existing governance structure, led by the United States and other developed countries, does not include and cannot adequately represent emerging and developing countries. The International Energy Agency's (IEA) security mechanisms are not as effective as they were when the OECD countries dominated world energy trade. The system will need to adapt to enable the emerging countries to participate, especially in the areas of emergency response, climate change, and energy poverty. The emerging economies now expect a greater voice and a respected place with equal rights in energy governance, as well as opportunities for technology transfer.

- **Does not establish an effective energy dialogue between producer and consumer countries**

One of the features of increased globalisation is that the relationship between producer and consumer countries is less antagonistic and the need for cooperation and dialogue has increased. A greater degree of global cooperation is needed to achieve the energy policy goals of all major market participants and to disseminate energy technologies. However, mainstream energy governance institutions, linked to the OECD, have not entirely got rid of the original intention, when they were first established, of countering OPEC, and to some extent this is still an obstacle to closer cooperation between producers and consumers. The IEA and OPEC are still the main energy governance institutions of the OECD countries and OPEC producers respectively. The International Energy Forum (IEF), based in Riyadh, includes both consuming and producing countries. But there is a need to strengthen the capacity of its secretariat because the IEF is still not effective enough as a decision-making mechanism.

- **Cannot cope with the new risks brought about by multipolar energy supply**

Existing energy security governance mechanisms were designed primarily for oil supply security. During the 1970s OPEC accounted for about 40% of global oil supply and the strategic reserves of the IEA emergency response mechanisms provided a good counterbalance. However, the further development of the international economy, and the emergence of developing countries as major consumers, has given the global energy market multipolar characteristics. The main risks to the global energy market have shifted from supply disruptions to price volatility. Meanwhile, the North American shale gas revolution has brought a series of chain reactions. Energy prices have been impacted by the reduced demand for coal in the US and there has been a change in global energy trade flows. Japan's Fukushima nuclear accident has also had important consequences for global energy markets. At the same time, the emerging countries are demanding the right to speak on energy prices. This includes emerging producing countries who have different perspectives on price from those of traditional producing countries. These changes need to be taken into account in the global

energy governance framework and they require timely analysis and response. Global energy governance mechanisms have been slow to respond to these needs.

▪ **Summary of "blind spots" of today's energy governance**

Areas that have been identified as possible "blind spots" of global energy governance include:

- Lack of large developing countries' voice;
- Lack of energy markets financial regulatory mechanisms;
- Lack of intellectual property protection both to protect the energy sector, but also to promote technology dissemination;
- Insufficient attention to the problem of fuel poverty.
- Lack of international governance for low-carbon energy policies. Although the United Nations Framework Convention on Climate Change (UNFCCC) and other international conventions are working towards agreement on climate mitigation, no international institution effectively promotes the development and implementation of low-carbon policies and technologies as a whole for developing as well as developed countries ;
- Lack of energy transit governance mechanisms to resolve disputes. Energy transport factors go wider than energy prices, and are another important influence on energy supply. The key international sea lanes are controlled largely by the US, but the US itself is becoming less dependent on energy trade. There is a lack of effective mechanisms to address energy trade disputes. Energy investment in emerging countries is playing an increasingly important role, but it is inevitably subject to political uncertainties. There is a risk of increased political disturbance. However the protection for international trade and investment remains limited. The Energy Charter, the World Trade Organisation (WTO), and other relevant agencies, make important contributions but the international regime is far from perfect.

Overall, the current global energy governance mechanisms are widely considered to be in need of reform. The changes in the global economic landscape further underline the need to deepen the global energy governance structure in a multi-polar direction, reflecting more diverse governance objectives. But it should also be noted that there is a limit to what can be achieved through broad-based global energy cooperative governance mechanisms. Some subjects are not suitable for resolution through multilateral mechanisms and matters of this kind should be resolved through bilateral negotiations. Meanwhile, bilateral relations between major economies should also be a part of the global energy governance model design.

1.2 Core objectives of global energy governance reform

How can we best improve and adapt existing global energy governance structures to adapt to the globalization of markets, and the multipolarity of supply and demand, and to deal with new risks?

Based on extensive discussions with international experts, this study suggests that the purpose of the global energy governance is to protect the security, stability and sustainability of the global energy system and to assist Governments to achieve integrated sustainable energy development goals.

First, we need to support sustainable economic growth through affordable, stable and secure energy supply. This will mean understanding the differences between oil producing and consuming countries on the reasonable prices of resources. Second, to protect the global and regional environment we must find ways of energy production, transport, conversion, and consumption, that minimize local pollution and mitigate global climate change; A third key factor is the need to enhance international energy market transparency to ensure market efficiency; fourth is to provide conditions to ensure stable, adequate international energy investments to meet growing energy demand and transition needs; Fifth we must adopt best practices for energy efficiency and the adoption of clean energy technologies; and sixth is to address energy poverty and to ensure, as far as possible that all energy consumers enjoy the same secure access to energy markets.

The process of global energy governance reform should seek common principles widely recognized by the international community. These principles will provide the cornerstone of the new global energy governance. These principles include: First, emphasis on common interests and common goals. Some goals that already have a broad consensus on a global scale, such as the United Nations millennium development goals, should be the cornerstone of global energy governance; Second, resolution of policy differences between major countries. Developed and developing countries should listen to each other. Designing a new governance framework will be difficult since there is also a lack of governance consensus among developing countries. Global energy governance should create a discussion platform for cooperation on major global policies so as to avoid ineffective efforts going in different directions. Third is the importance of equality. No country has the right to impose agreements on other countries; each State should have the right to fair and equal treatment.

1.3 The key areas of global energy governance reform

The new global energy governance framework should play a role in the following key areas.

Area 1: Global energy security and market governance mechanism

First, to minimise the volatility of energy prices by improving price formation mechanisms. Lack of market transparency and lack of investment are key issues, and other aspects of how the market works are still being studied. Also, one of the main problems is that we may not have the most appropriate price benchmarks. The WTI price is now seriously out of line with global oil markets, but the volumes of oil represented by Brent, the other main benchmark, are small and declining. These two benchmarks do not reflect transactions in the Middle East but the Oman and Dubai benchmarks have not achieved similar status. There is a need for more effective benchmarks that better reflect prices in the main international markets.

Second, there is a need to improve the transparency of the market by improving the availability and quality of energy statistics and data.

Third, we must improve the governance of speculation in financial markets. Speculation has good and bad effects, and there are currently no academic studies to show that speculation distorts prices. However further studies are in progress. The main regulatory body in this field is the International Organisation of Securities Commissions (IOSCO), which has two main responsibilities: financial regulation; and monetary policy. Improvements in international financial exchange to improve currency convertibility and make it easier to hedge in Asian currencies will have a tremendous impact. Chinese currency convertibility will change the global market, and create new opportunities to hedge price fluctuations in Asia. In addition, some governments are also enhancing financial regulation. The U.S. Energy Information Administration (EIA) has carried out a special study on the impact of financial markets on oil prices and this concluded that the long term price of oil is guided by market fundamentals, but that oil prices may be affected by financial speculation in the short term, although there is no clear evidence of this. Thus increasing the transparency of the energy market data and improving financial governance is also important.

Area 2: Global Energy (Petroleum) Emergency Management and Strategic Reserves

At present it is mainly in the oil market that governments hold energy reserves and operate emergency management mechanism, although there is an argument for extending this to gas, and particularly LNG. There are many discussions on how the international arrangements can be improved. Proposals for cooperation between China, Japan and Korea for East Asia market cooperation have not been successful. The IEA has established sound emergency response mechanisms, but these are confined to OECD countries and China does not participate. At present China does not have the legislation for publishing details of its oil reserves and does not have sound statistical information. The international community believes that data on changes in China's oil reserves is necessary market information.

Area 3: Green, low-carbon, environmentally friendly energy development, tackling climate change and energy efficiency cooperation

Climate change is one of the most daunting challenges facing global energy governance, and includes the following areas:

- Climate change governance;
- Carbon trading and carbon transfer mechanisms;
- Clean Development Mechanism (CDM);
- Promoting development of renewable energy and new energy, as well as low carbon energy sources;
- Promoting the use of Carbon Capture, Use and Storage;
- Coordination of policies for environmentally safe energy use.

International cooperation on energy efficiency needs to be emphasised. Also best practice sharing on energy structure reform needs to be increased.

Area 4: Emerging energy industry development governance

The development of new energy industries is important not only to deal with climate change and environmental challenges, but also as a powerful new driving force for economic recovery and development. Governance requirements in this area include:

- Promote the development of advanced energy technologies and mechanisms used to support clean technology policy;
- Renewable energy and new energy policies, resolving energy and energy equipment trade disputes;
- Transfer of energy technologies to promote energy security as well as climate mitigation.
- Promoting energy innovation. Protect the necessary investment on energy innovation, as well as proper access to intellectual property (IP) for innovation while also protecting the legitimate interests of developers.

Area 5: Regional energy cooperation and governance

Regional energy cooperation needs to concern more detailed governance issues, including:

- Cooperation on energy poverty;
- Regional environmental protection, including air and water quality;
- Regional cooperation, such as on the issues that concern the Shanghai Cooperation and the regional grid cooperation promoted by Energy Charter.

1.4 Objectives for China's participation in global energy governance

China has become both the world's largest energy consumer and the largest energy producer, the second largest importer of crude oil and a leading country in renewable

energy developments. China plays a strong role and is a pivotal country in the world's energy affairs and China's energy policies and initiatives are of the greatest interest to the international community. However China's role in global energy governance lags far behind China's role in the global energy economy. China and other emerging countries have played an increasingly important role in the world in terms of GDP or energy consumption in recent decades and it is now only reasonable that they should participate fully in global energy governance. This is a strategic opportunity for China and, indeed, for the other major participants. Participation in global energy governance will provide opportunities for China to use peaceful means to further reshape the international energy rules. China, and other developed and developing countries should play their unique role, accepting the burden of their responsibilities in global energy governance. China's energy policy will need to further open outwards, and give greater attention to the international perspective, but international institutions also need to adapt so that China and other emerging countries can participate.

China plays a significant role in the current international energy governance structure, through the various agencies involved, but the actual level of cooperation achieved is not deep. The organisations in which China is involved include the relevant United Nations bodies, G20, APEC and other regional organisations. China has some involvement with the International Atomic Energy Agency (IAEA). China has maintained good cooperation with the International Energy Agency, which is a mainstream energy organisation, but China is not a member. (For detailed analysis of China's existing and potential role in the various agencies see Chapter 2)

China's limited role in today's global energy governance architecture greatly weakens its effectiveness. The defects of the global energy governance structure, (referred to above) are related to China's limited participation. The IEA's emergency response and petroleum reserve mechanisms are good examples. Meanwhile, China's own energy policy is also hampered by China's limited participation in global energy governance. For instance:

- China's limited experience of international energy governance has impaired China's effectiveness in influencing international energy policy. For participating in the international agencies, a large amount of membership fees have been paid by China but little concrete progress has resulted;
- China lacks an international voice in key areas such as energy prices, emergency response, etc.;
- China sometimes encounters unfair treatment in international energy investments;
- China is not able to make the most skilful use of legal means to protect itself in the face of international trade disputes;
- The positive contributions of China to the international energy market, including overseas oil and gas investment, and the contribution of new

energy products and manufactured goods, does not receive due recognition but is received with suspicion and accusations.

Therefore, both from an international and from a Chinese perspective, enhanced participation by China should be seen as a primary goal of international energy governance reform. Discussion of China's participation in global energy governance is a vital first step towards reforming the global energy governance framework.

China's participation in global energy governance has the following main objectives and requirements.

First, the maintenance of global and Chinese energy security. Global energy market activity is closely related to the vital interests of China. Since China's reform and opening up, China has been largely self-sufficient in energy, but in recent years, and in spite of China's rich reserves of coal, China has become a net importer of oil. China is now highly dependent on imported oil and, therefore, on international oil markets. Natural gas imports have also been rising rapidly in recent years.

The developed countries have a high level of capacity in the geopolitics and finance of international oil but China so far has only managed the resource properties of oil, and is not so involved in managing financial aspects, such as futures trading. China has been a passive participant in the global oil market, and this passivity is reflected in the overall lack of influence on price and import sources, and pipeline governance rights. Actively protecting the security of the global oil market is an important goal of China's participation in global energy governance.

Second, avoid the risk of energy price volatility. International oil prices increased by three times in the last 10 years. The volatility of oil prices is a great burden on the global economy, and has an especially negative impact on the Chinese economy. Each \$1 per barrel increase in oil prices, costs China more than \$2 billion. Changes in international oil prices affect international energy affairs, and China needs to participate actively to respond to this risk.

Third, responding to climate change and the cooperation on environmental protection. The vital need to respond to climate change has become an international consensus. Due to different national conditions, this problem is more complex than the energy market issues. Through the UNFCCC international system and platform, national emission reduction commitments have increased, but at present greenhouse gas emission reductions, and the commitments of States to control global warming emissions, still fall short of what is needed to meet the promised emission reduction targets and the 2°C target. Hence the need for an international emissions reduction framework to make progress, with a fair share of responsibilities. This creates a paradox: how to reflect the common but differentiated responsibilities? Developed countries need to face the responsibility for historic emissions, but must also control future emissions. Developing countries need to balance emissions reduction with the need for economic development. Meanwhile, China also needs to participate in the process of setting an international emission reduction path, including setting the path

of China's own emissions reduction, taking account of the growth in energy demand , but also changes in the structure of energy and reductions in the share of fossil fuels. China's progress in these areas can have a great impact on the world.

Fourth, to promote new cooperation on energy efficiency and renewable energy.

China should participate in the international renewable energy platform for cooperation and promote global renewable energy technology cooperation, the elimination of trade barriers, and cost reduction, and enhance the pace of domestic energy restructuring. Meanwhile, China needs to show the world the results of its development of renewable energy, share experiences, and increase cooperation. Similarly, with its own huge and vitally important programmes of energy efficiency, China can contribute more to the international effort in this vital area.

Fifth, the use of international resources to meet the huge demand for energy technology innovation.

The substitution of new and renewable energy for fossils fuels is very important for China both because of China's lack of domestic energy resources, and because of China's responsibility for emissions reduction. There is a global need for advanced energy technology innovation. This includes the need for the rapid development of energy efficient technologies, technologies for reduction of conventional pollutants (including regional pollutants SO₂, NO_x, etc.), and global pollutant (CO₂) emission reduction technologies, renewable energy technologies, and energy storage technology. The global development of these technologies requires extensive cooperation but also intense competition. There is a need to establish an international regime, reflecting the interests of all countries, and to remove barriers to technology transfer. There are two main aspects: First, trade protection. Technology transfer can lead to a decline in the competitiveness of domestic enterprises, resulting in calls for protectionism. How can we cooperate better to promote low cost renewable energy development? China needs to participate further in international discussion. Second, we need to make rational use of the intellectual property system. Appropriate protection of intellectual property rights is needed to encourage innovation, but overprotection is not conducive to technology transfer. Developed countries have a legal obligation to support developing countries to fund technology. We need to find appropriate ways to relax the intellectual property system for new energy technologies so as to achieve a smooth transfer of technology to developing countries. But it is also necessary to protect business interests. This requires efforts to improve the framework of regulation at the government level.

Sixth, respond positively to international expectations.

The international community expects China to improve the quality and transparency of energy data, including information on oil reserves and consumption. Also, if the relationship between the Chinese state-owned energy companies and the government was more transparent, this would help reduce the mistrust and sensitivity that surrounds overseas investment. China needs to participate in global energy governance processes to respond to these expectations, in order to open the door to more efficient participation in the global market activities.

Seventh, to contribute to the alleviation of international fuel poverty. In recent decades China has achieved the greatest poverty relief in the history of mankind. China is now well placed to work with other nations and through multilateral organisations towards lifting fuel poverty around the world.

China accounts for one fifth of world energy demand. China can insist on raising the status of the developing countries, adhering to the principles of equality and mutual benefit, in global governance. And China can play a constructive, positive role, both through China's impact on the global energy, and also through China's own domestic energy development.

2. Reform of major global energy governance platforms and China's participation

In preparing this study, we have visited the International Energy Agency Energy, and the Energy Charter Secretariat, and we have explored energy governance reform with energy authorities and experts in China, the United Kingdom, and the United States.

2.1 The International Energy Agency

Founded in the 1970's as a response to the threat of Arab oil embargo, the IEA is today the most substantial and influential body for international energy cooperation. Main functions include:

- Reporting on oil and gas market outlooks.
- Providing international energy data.
- Coordinating emergency preparedness and the use of emergency stocks.
- Cross fertilisation of energy policies.
- Influential publications such as the World Energy Outlook and Energy Technology Perspectives.
- Technology networks.

The IEA is a treaty organisation. The treaty restricts membership to OECD countries and almost all OECD countries, 28 in all, belong. The IEA generally operates by consensus, but there are voting procedures which, in some cases, require the approval of 50% of members as well as 60% of "weighted" votes. Most of the members are European because all EU countries belong individually. The US has about a quarter of the weighted votes and European countries, together, about half. Japan is the individual country with the most weighted votes after the US. Voting is fairly common for the appointment of the Chairman and the Executive Director of the Agency. Otherwise it is rare. The Treaty provides a voting procedure for the triggering of a stock draw but these original treaty mechanisms are cumbersome, and to some extent outdated, and in recent years a simplified procedure has been used that requires consensus.

In recent years the Executive Director has generally been European (except for one Japanese incumbent) but the Deputy-Executive Director has always been from the US. Generally it makes sense to regard the IEA as a consensus body.

The IEA's future as a major international energy agency is not in doubt. But the IEA is also aware that, with the rise of major developing economies, its role as a genuinely global energy agency is already under threat. The Governing Board has been active in considering reform options. Specifically, the IEA are proposing an "Association" with Brazil, China, India, Indonesia, Mexico, Russia, and South Africa. These countries

would join with IEA member countries in an Association Council, meeting twice a year, with one co-chair each from the IEA members and from the new partner countries. As with the IEA Governing Board, these meeting would be at senior official (generally Director General or Director) level. IEA associates would also have the opportunity to participate in the IEA's Standing Committees.

The Association would be established through an “umbrella” agreement between the IEA and all the associate countries, setting out the broad objectives of cooperation plus separate agreements with each associate country with more specific plans.

The IEA have identified four broad areas for this cooperation:

- Data and statistics
- Energy security (including oil emergency planning)
- Energy technology (including efficiency and renewables)
- Peer reviews of national energy policies

This study suggests that, if the IEA has the ability to reform itself and to provide a platform for true equality and cooperation of developed and developing countries, with the corresponding change in its priorities and agenda, then the IEA could regain the key position in global energy governance. Otherwise, the shortcomings in global energy governance can only be addressed through a new organisation.

China has been cooperating with the IEA in many aspects. China already has a “Joint Statement” with the IEA which sets out some common principles and a programme of joint activities. China has at times participated in the IEA's emergency exercises. China's Ministry of Science and IEA have established good communications channels for policy research. The Chinese Ministry of Science and technology has a cooperation agreement with the IEA's network of 40 international technology cooperation agreements. As a result China belongs (as of 2010) to six of the IEA's “Implementing Agreements” for technology collaboration and has regularly participated in the IEA's senior technology committee (Committee for Energy Research and Technology CERT).

At the IEA Ministerial meeting in November 2013 China, along with other partner countries made a Joint Declaration in which they showed mutual interests in pursuing closer cooperation with the IEA through the proposed “Association”.

Bilateral cooperation between China and the IEA will continue and can be enhanced through the Association. International experts believe that China has a number of important options for expanding cooperation with the IEA, including : inviting the IEA to conduct an "in-depth policy assessment" of China's energy policies, which will also enable Chinese experts to have the opportunity to participate in other national policy assessments. This study suggests that Chinese energy policy evaluation should indeed learn from the experience of the IEA. China can create its own energy policy assessment team to evaluate Chinese energy policy, drawing on the IEA assessment framework, inviting IEA expert guidance, and completed its own independent policy

assessment. Meanwhile, China could suggest sending a team of experts to participate in the IEA's policy assessment, so that they could gain experience of IEA's policy assessment process.

Joining the proposed "Association" would enable China to get round the table with other associates and IEA members twice a year and to participate in senior IEA Committees. The main benefits would be in terms of communicating China's energy policies, mutual understanding with the other participants, and an inside track for China in working with the secretariat on current energy issues.

However, as part of the association package the IEA will be looking for progress in such areas as data disclosure and cooperation in emergency planning. To some degree the extent and timing are open for negotiation. Obviously China cannot be expected to commit herself to comply with IEA emergency measures until and unless China is a full part of the decision making process. However, a degree of common planning – enabling China and the IEA to coordinate emergency measures if they so decide at the time – may make sense. The timing of Chinese disclosure of oil stock data may also be for negotiation. One of the reasons (apart from the restriction of membership to the IEA) why China is not yet ready for IEA membership is the weakness of China's energy statistics. It would be difficult for China to join the Association unless China intends to move towards greater openness at some time. However non-disclosure of this information will to some extent inhibit China from taking a leading role in any kind of international cooperation aiming to improve the transparency and efficiency of energy markets.

China's aim in energy governance is, and should be, to achieve a position of full equality, such as China has at the G20. The Association proposal offers this to some degree – since all Association and IEA members are equal around the table of the Association Council. Nevertheless, it is an association with an organisation (the IEA) from which China is excluded. Could the IEA ever reform in such a way that it could fully represent the interests of China and other major developing nations as well as its existing members? That is a tough question.

China will not play the role of supplicant to the IEA. But some indication that if the Treaty ban was lifted China might seriously consider IEA membership would greatly assist those within the IEA who are arguing for reform.

The IEA's Association proposal is a highly significant step. This study suggests the following steps that could help the IEA to develop into a genuinely global energy body:

- Establish an "IEA+6" office, with the 6 countries proposed in the Association. This office could be based in developing countries, e.g. in Beijing, and have the following functions:
 - Conduct research on IEA reform;
 - Accomplish and organise the annual affairs of IEA+6 cooperation, such as publishing annual reports for IEA+6, making annual

cooperation plans etc.

- Decision making and evaluation of major cooperation issues between IEA and the 6 countries, such as if a joint oil market response is needed.
- Give more emphasis to the study of energy options for developing countries, especially low-carbon development, improved energy access, and the relief of energy poverty, possibly through a new Directorate at the IEA. This would enable the IEA to give greater support to the UNFCCC process, and especially its Technology Mechanism;
- Strengthen relations with OPEC. The IEA's informal relationship with OPEC has improved greatly in recent years. Perhaps it would now be appropriate to form a joint OPEC/IEA Committee to share outlooks on energy markets.
- Finally, and very importantly, lift the treaty provision that limits IEA membership to non-OECD countries (this will not lead to developing countries becoming members in the short term, but it will stimulate discussions for IEA reform). Lifting the treaty will not only show the willingness of IEA's openness on membership to developing countries, but also the willingness of providing an equal basis for both OECD and developing countries.

2.2 The G20

Group of Twenty (G20) includes both developing and developed countries on an equal basis and is one of the most representative organisation, and could have an important leadership role in energy governance. However, hitherto the G20 has mainly focused on economic and financial issues. This research suggests that the strength of G20 is to provide an important discussion platform for global leaders on energy issues.

From 2005 to 2009 the G8 met with the "Plus 5" (Brazil, China, India, Mexico, and South Africa). This group worked on a number energy and climate change issues and was closely supported by the IEA. The 2005 Gleneagles Summit also launched a "dialogue on clean energy, climate change, and sustainable development" in which a wider range of major producing consuming countries took part (but not the main OPEC countries).

This structure has, of course, now been succeeded by the G20, which better reflects the new realities of the global economy. The G20 (like the G8) has no standing secretariat, although both China and Brazil have proposed that it should have one. A "Troika" of past, present and future Chairs provides a degree of continuity.

The main mission of the G20 so far has been in the areas of financial regulation and economic recovery. G20 Leaders have taken little interest in energy. However the

G20 Finance Ministers and Heads of Central Bank Governors have taken an interest in the functioning of energy markets. At their meeting in Moscow in July 2013 they called for improvements to the JODI database and gave their support to the joint work of the IEA, IEF, and OPEC on oil, gas, and coal markets (See below). They also supported IOSCO's collaboration with the three secretariats on the regulation of oil derivative markets.

In 2013 a G20 Outreach Energy Regulators Round Table, hosted by Russia as a part of its G20 Chairmanship, made a strong statement on sound regulation and promotion of investments in energy infrastructure. In 2009 G20 leaders committed to the elimination of fossil fuel subsidies in the medium term.

Reform Discussion

G20 is still developing as an organisation. So far its meetings have generally involved heads of government, foreign ministers, and finance ministers. This study proposes that the G20 should consider the institution of a Working Group to give the necessary high level leadership to the global energy policy issues discussed in this report. The Working Group could be asked to report on the following matters:

- Options for improving interim energy market stability, including the potential of different regions;
- The upgrading of JODI and the IEF / IEA / OPEC cooperation programme. (See below) into a comprehensive system of energy market information and analysis;
- Establish a global clean energy mechanism that would promote technology transfer. This might link the Clean Energy Ministerial with other relevant institutions, such as the UNFCCC Technology Mechanism and the IEA.
- Strengthen the security of investment in energy, for instance draw on the principles of the Energy Charter Treaty.
- More discussions on analysing the financial influence on the energy market and strengthening the monitoring of it.

There may also be occasions when it will make sense for Energy Ministers to meet in the G20 format.

China's participation

Former Premier Wen Jiabao proposed a multilateral co-ordination on the global energy market in the framework of the G20. As presently constituted, the G20 cannot be the institution for day to day cooperation on energy, but it has the capability to provide leadership, at the highest level, for new international energy policy initiatives and the reform of international energy institutions. This would depend on the

emergence of consensus. An Energy Working Group of the G20 could facilitate this process.

Meanwhile, there are many opportunities for China to contribute, more than in the past, to energy related work of the G20 below the level of leaders. This includes the continuing work of the Finance Ministers on energy markets, and whatever structures Australia may set up for preparatory work on energy for the G20 Summit that they will chair in November 2014.

2.3 The International Energy Forum (IEF)

The International Energy Forum (IEF) is the largest gathering of Energy Ministers from around the world. Unlike the IEA or OPEC, for instance, its membership is comprehensive, including producing, consuming, and transit nations, whether developed or developing. China is one of the 89 member countries and is also a permanent member of its 31 strong Executive Board. In recent years, the IEF has acquired a Charter and a small secretariat based in Riyadh. The current head of the Secretariat is Mexican.

The IEF aims to be a “neutral facilitator of informal, open, informed energy dialogue” and to “foster greater mutual understanding and awareness of common energy interests in order to secure global energy security”. The IEF meets every other year at Ministerial level. The last meeting, was hosted in 2012 by Kuwait (co-hosts Algeria and Netherlands) and the next meeting, in 2014, will be hosted by Russia (co-hosts Iraq and the UK). There is an associated Business Forum.

Generally speaking the IEF is a body for exchanging views and high level networking, rather than making policy. However, in recent years the Secretariat has organised events and made reports on a variety of subjects, including cooperation between NOCs and IOCs, energy poverty, Carbon Capture and Storage (CCS), and energy efficiency.

The IEF also has an important role as a facilitator/co-ordinator of the Joint Organisations Data Initiative (JODI) and other joint activities of the three Secretariats of the IEA, OPEC and IEF.

China is generally well represented at a very senior level at Ministerial meetings of the IEF. As a member of the Forum and its Executive Board, China could offer to host or co-host one of its Ministerial meetings. Also China could provide experts to work in the secretariat and assist with its programme of events and analysis. Because of its unique neutral position, the IEF merits more attention.

2.4 Joint activities of the IEF, OPEC, and IEA secretariats (JODI and the post-Jeddah programme)

The joint activities of the three secretariats of the IEF, IEA, and OPEC secretariats can

be regarded as a pragmatic way to fill the gap left by the absence of any global body for the coordination of energy policy. They represent the best efforts of the international community to address the key challenges of energy security and price volatility. Useful work has been, and is being, done but there is no clear line of responsibility for the high level leadership of this work, since each secretariat reports to its own governing body.

However, both the IEF and the G20 Finance Ministers have taken a degree of ownership and given their support and guidance. Historically, the Jeddah Oil Summit of 2008, which brought consumer and producer nations together at a time of crisis, has played an important part in initiating these programmes. Meetings of G20 energy ministers could provide the strong leadership that this process requires.

2.5 The Joint Oil Data Initiative (JODI)

JODI is collaboration between the secretariats of the IEA, IEF, and OPEC, and other bodies concerned with energy statistics (APEC, Eurostat, OLADE, and UNSD). JODI publishes a JODI-Oil World Database intended to improve the transparency and stability of international oil markets. JODI is planning to extend this database to include gas and perhaps eventually other international energy.

JODI has made a useful contribution to international oil data, but there is still progress to be made in terms of timeliness, completeness, and reliability.

2.6 The Jeddah Oil Summit and the Other Joint Programmes of the IEA, IEF, and OPEC Secretariats.

In 2008, as oil prices peaked at over \$140 per bl, an emergency oil summit of major producers and consumers, as well as oil companies, was called at Jeddah. This summit, and a subsequent event in London, besides re-emphasising the importance of JODI, initiated a joint programme of the IEA, OPEC, and the IEF to share their analyses of:

- The outlook and trends of the oil market, and
- The impact of financial markets on the level and volatility of oil prices.

Since then the three secretariats have held a series of workshops to compare their oil market outlooks with a view to clarifying their differences. A Third Symposium on Energy Outlooks was held in 2013. Also, the three secretariats have been collaborating with IOSCO on aspects of the regulation of derivatives markets.

China has participated in the work of JODI, through the ERI, and, for instance, hosted the 8th International JODI Oil Conference in Beijing in 2011. As a member of the IEF and the G20, and a major participator in energy markets, China could increase its participation in all this work by providing experts to contribute to the analysis. However, since much of this work is related to market transparency, a more open policy with

regard to China's own energy data would be consistent with a more leading role for China.

2.7 Petroleum exporting countries (OPEC)

OPEC is the main representative body of energy producing countries. However to some extent changes in the oil market are also affecting the position of international organisations and OPEC's influence may be declining compared to that of some non-OPEC producers such as Russia. OPEC currently has 11 member countries. Development of unconventional oil and gas is having a big impact on the pattern of global energy, and rapidly increasing supply from outside OPEC areas. OPEC continues to be an important player in the global market in the short-term, but has been unable to dominate the global market. The oil and gas production of its member states represent about 40% and 14% of the world's oil and natural gas production respectively. However, OPEC's oil exports still account for some 60% of world oil trade, and OPEC still has a significant impact on the international oil market, through its decisions on oil production.

The quotas and price policies of the OPEC countries alone have not always been sufficient to contain the volatility of oil markets. This would require more powerful governance institutions. OPEC and the IEA have cooperated to some degree and there are a number of bilateral cooperation initiatives between the IEA and OPEC countries covering such areas as renewable energy, energy statistics and energy efficiency. For example, the IEA has signed technical agreements with the United Arab Emirates, Kuwait and Algeria. The IEA also has some bilateral cooperation with Saudi Arabia and Angola.

OPEC and the IEF have closer cooperation. The IEF was a product of the "producer consumer dialogue". In 2002 the member countries decided to establish a permanent secretariat, supported by Saudi Arabia, to support the IEF. The Secretariat is responsible for convening the biennial ministerial meeting, and cooperates with the IEA, OPEC, APEC, and other statistical bodies on the JODI data initiative. In 2008, due to the surge in oil prices, it was recognised that the IEF needed to be strengthened in order to enhance understanding of the energy market. So in 2011 an IEF Charter was created, together with an enhance programme of joint working with IEA and OPEC experts. There are currently 89 IEF member countries who have signed the IEF Charter. Together with China, the United States, Russia, and Saudi Arabia are the largest national contributors. The IEF holds seminars on market forecasts, oil regulation and other issues. G20 convened a workshop on coal and natural gas markets in 2012, with participation from the IEA, IEF, and OPEC. The three key areas of the trilateral work plan of the IEA, IEF, and OPEC are the energy outlook, oil and financial markets, natural gas and coal.

The international community has widely called for closer cooperation between OPEC and energy consumer organisations. But the establishment of new governance

institutions takes a long time. Based on the above considerations, an expanded IEA may be a more practical solution. The new framework of IEA, IEF, and OPEC cooperation platform is beginning to become more effective. But there is an inevitable conflict of interest between the IEA and OPEC that needs to be taken into account.

China is a leading country seeking to maintain good relations with a majority of OPEC countries. However, as its name implies, only oil exporting countries can be members of OPEC.

2.8 Energy Charter

Energy Charter Treaty Organisation was founded in the 1990s, following the break-up of the Soviet Union to promote international energy investments by the West in Eastern Europe. Most of the countries in Western and Eastern Europe are full members, as are many Nordic countries and countries in Central Asia. Members include energy producing and consuming countries and transit states. For a period, Russia has informally complied with the Charter. United States and China are observer countries.

The Energy Charter is the only organisation with international legal rules in the energy sector. The Charter aims to enhance confidence in international energy investment, transport, and trade, and reduce risk, through its legal framework. The provisions of the Charter have been used to settle international disputes on many occasions. The Energy Charter has been focused on northern Eurasia and the Caspian region. The original framework of the Energy Charter was adopted in the 1990s in these areas. There is a high degree of implementation amongst member states of which there are 51. Of these only five have not yet ratified the Charter. These countries are Australia, Belarus, Iceland, Norway and Russia. There are 21 observer countries including Pakistan, China, South Korea, Iran, and ASEAN countries in recent years have become observers of the Charter. The Energy Charter supports international energy cooperation and does not distinguish between producer and consumer countries. So far, the Charter has contributed positively to a secure foundation for the international energy sector investments in the areas that it covers.

Currently the Energy Charter is gradually opening up to non-traditional areas and further modernization in accordance with the requirements of the new international environment. Specifically, the Charter is currently updating its articles of association.

China's participation

The Energy Charter has a special interest for China. China has benefited from the Energy Charter because several of China's important energy trade partners, such as Turkmenistan and Mongolia, as well as several other transit countries in Central Asia, are charter members or are in the process of becoming members. Meanwhile, Russia also has close ties with the Charter. The Charter is trying to promote the "Asian super-grid" plan, aimed at transporting electricity from the Gobi desert to Eastern

China, and this is also of interest to China. The Energy Charter can provide a platform for discussion of Central Asian energy transport.

This study believes that China should eventually aim to become a member of the Energy Charter. However China will need to give careful, in-depth study to the relevant legal obligations. In the meanwhile, China should become more involved in the current process of modernization of the Charter and carry out closer cooperation with the Charter. Such cooperation will help China to achieve more of its national energy goals. The biggest advantage of the Energy Charter organisation is that its treaty provides clear legal rules, which means that the Charter is not just a platform for discussion. The International Energy Agency treaty is currently the only other legally binding agreement on energy policy.

2.9 World Trade Organisation (WTO)

The World Trade Organisation (WTO) currently has 159 member states and is the legal and organisational basis for the global multilateral trading system, sometimes known as the "Economic UN." Currently the WTO's governance role, through its relevant agreements, extends to major international energy markets for trade in energy products, trade in energy services, energy, property rights and other aspects of technical support mechanisms. In recent years, the WTO has been engaged in anti-dumping and countervailing duty disputes relating to energy equipment.

Although the WTO is not an energy agency, it can provide a specific policy coordination mechanism for energy trade and an energy trade dispute settlement mechanism, and could play a greater role than at present. But the WTO itself is also facing reform challenges. Key areas for reform include the inclusion of the special attributes of energy products and enhanced participation of developing countries in the reform process.

2.10 UN agencies (INCLUDING UNFCCC)

A number of United Nations agencies play important roles in energy governance. These include the United Nations Development Programme (UNDP), the Food and Agriculture Organisation (FAO), the Industrial Development Organisation (UNIDO) and the Environmental Project (UNEP). The United Nations has also established an Energy Commission. This research suggests that the UN should strength its role on global energy governance, and putting energy issue as a long term major focus, in areas such as energy poverty, technology transfer and the balance of energy developments. This study also calls for global leaders to increase using the platform for the UN for promoting global energy governance.

UNIDO has made an important contribution working with China on technology transfer. The Secretary General of the United Nations' initiative on Sustainable Energy for All (SE 4All) makes a key contribution to the fight against energy poverty and has

initiated a Decade of Sustainable Energy for All, beginning in 2014. A UN High Level Panel of Eminent Persons has recommended that universal access to modern energy services be included in the Post 2015 Development Agenda. And the US has launched a Power Africa initiative aimed at doubling electricity access in Africa over five years.

The United Nations Framework Convention on Climate Change (UNFCCC) is probably the most influential energy related UN body. A number of institutions have been set up under the UNFCCC framework to help developing countries implement their low-carbon energy growth strategies. These include the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN) and other technical mechanisms, as well as the Green Climate Fund. The CTCN is hosted by the UNEP headquarters in Denmark. Developing countries have been encouraged to respond to climate change through the development of national emission reduction plans (NAMA) and technology needs assessments (TNA).

The new institutional framework under the UNFCCC technology mechanism is just beginning to have an effect on China and China is involved in helping developing countries to adopt low-carbon growth strategies. China is already a member of the Technology Executive Committee, one of three members from the Asia Pacific region.

2.11 Clean Energy Ministerial (CEM)

The Clean Energy Ministerial (CEM), launched in 2010, is an international organisation for leadership in clean energy technologies, but it is fairly limited in its current policy levers.

The CEM currently has 23 member countries and regions, including many OECD countries, the five BRICS countries and the UAE. These countries account for about 80 percent of global greenhouse gas emissions and 90% of clean energy investments. The CEM is a global high level forum for promoting clean energy policies and programs for energy efficiency and energy access. There are three main working mechanisms: the annual meeting; cooperation between industry and government; and 13 clean energy initiatives. Generally speaking member states meet once a year. The first three ministerial meetings were hosted by the United States, United Arab Emirates, and the United Kingdom. The most recent meeting was, held in April 2013 in New Delhi, India. CEM was established by Steven Chu, as U.S. Energy Secretary, in December 2009. The U.S. leads 8 of its 13 initiatives and occupies a dominant position in the organisation.

As of July 2013, China participated in four of the thirteen CEM initiatives including co-sponsoring one of the electric vehicle cooperation initiatives with the United States. The other three in which China participates are the carbon capture and sequestration initiative (CCUS), the International Smart Grid Action Network initiative (ISGAN), and the Global Sustainable Cities Network (GSCN) initiative. A vice minister of China's Science and Technology Ministry led a delegation to attend the fourth meeting of the

CEM.

The Clean Energy Ministerial has achieved significant success in engaging large developed and developing countries in practical cooperation to speed the deployment of clean energy technologies. Practical cooperation on energy efficiency has been a high priority. The Clean Energy Ministerial provides a useful model for future cooperation

2.12 BRIC countries

The BRICS countries have identified energy as an area for cooperation but so far have not agreed any energy policies and programmes except for their support of the UNFCCC process and the Doha agreement on climate change.

BRICS is an important organisation for developing countries. So far it lacks an energy governance framework. This is expected to be completed in the near future but until this is in place BRICS cannot be effective in this field. BRICS is a relatively loose informal organisation, and all its activities are open to the public. BRICS cooperation mechanisms are currently limited to their top level meetings. Of the BRICS countries, Russia and Brazil are energy producers, while India and China are consuming countries. The BRICS have discussed the possibility of establishing a network for multilateral energy cooperation.

2.13 Organisation of Asia-Pacific (APEC)

The Asia-Pacific organisation (APEC) has had an energy dimension for many years. The APEC Energy Working Group has a base in the APEC Energy Research Center in Japan which publishes its Energy Outlook report annually. Work is carried out on clean fossil energy, energy efficiency and energy conservation, energy data and analysis, new energy and renewable energy, and several other sub-sectors. China has a limited participation and provides annual data.

2.14 Shanghai Cooperation Organisation (SCO)

Shanghai Cooperation Organisation (SCO) is considered to be one of the organisations with the greatest potential for energy cooperation in Asia. The establishment of the SCO as a permanent international organisation was announced in Shanghai on June 15, 2001. The SCO now includes China, Russia and other Central Asian countries. Individual meetings have included a wider range of observer states and dialogue partners. SCO's basic function is for national security and counter-terrorism, but it also has the potential to contribute to energy security in Central and East Asia.

SCO is the most representative governance organisation in East Asia. This study suggests that regional organisations should play a greater role in global energy governance, and the SCO has significant potential for solving energy problems in

East Asia. There are many challenges of energy cooperation in East Asia. Relations are complex and there is a need to build trust in the face of historic tensions and territorial disputes. There is a need for further dialogue and cooperation between China and Japan.

The idea to establish some kind of energy organisation in the SCO framework has been proposed for many years. An SCO energy club was first proposed in 2005. Before the SCO summit in September and November 2013 Chinese leader Xi Jinping and Russian Prime Minister Dmitry Medvedev called for the establishment of an SCO energy club. This proposal for an agency to study the regional potential of Asian countries has not yet been fully realized. This agency should be able to do theoretical research and promote the development of energy cooperation based on a variety of suggestions and recommendations that would enable the club to make its own significant contribution.

SCO is one of the few Chinese-led international governance institutions. There is a valuable opportunity for member states, including Russia and China, to further explore its potential worth.

2.15 New technology specific organisations

In recent years a number of technology specific organisations for energy cooperation have been founded. Among the most significant are:

- The International Renewable Energy Agency (IRENA)
- The Global Carbon Capture and Storage Institute (GCCSI)
- The International Partnership on Energy (IPEEC)

IRENA was established in 2009 and headquartered in Abu Dhabi. IRENA currently has 120 member countries, including almost all European and African countries, and major economies such as U.S., Japan, Australia, and the United Kingdom. China announced in 2013 that it had applied to join IRENA, and is currently listed as one of 43 member states in the process of becoming members. Cooperation on renewables is enormously important for climate mitigation and energy supply and IRENA is making a valuable contribution in this area.

The GCCSI, founded in 2009, is largely funded by Australia and chaired by Australians. China is one of the member states, and is also represented on the advisory committee. The GCCSI headquarters are in Australia, but it has bases around the world, including in China. The GCCSI focuses on construction and investment in CCS research projects and large projects.

IPEEC is an independent body hosted at the IEA, "so that the IPEEC can make full use of the knowledge, experience, and capacity of the IEA". This has some similarities with the proposed structure of the IEA's Association. India currently chairs the

Executive Committee. China is listed as a participant in one of its task forces on Industrial Efficiency. In almost all global scenarios energy efficiency is recognized as making the greatest single contribution to climate mitigation, and IPEEC has the potential to make a major contribution in this area.

2.16 A new organisation of international energy governance?

The need for a new order of global energy governance is widely recognized. But this does not necessarily require a new body. This study suggests that, where possible, the improvement of existing institutions is a more reasonable choice. The creation of a new body would have a high cost, be time consuming, and face strong political obstacles. In the short term, the improvement of existing institutions is more realistic and efficient.

However, reform of existing institutions may also be difficult to achieve and in the longer term new institutions may be necessary. This study suggests that a new global energy governance platform could be built around the BRICS and the Group of Seven (G7) meeting on an equal basis working in association with current energy institutions such as the IEA, AIRENA, the World Bank, and the WTO. The G7 plus BRIC could be regarded as representing the major developed and emerging economies. Some experts have proposed a platform of G7 + BRIC (Brazil, Russia, India, and China) +6 international organisations (IEA, OPEC, UNFCCC, WTO, IMF and WB). These organisations would seek to enhance cooperation in such areas as, strategic oil reserves and crisis management, producer/consumer dialogue, climate mitigation, energy markets, prices and financial regulation, and energy poverty.

However, the difficulty of establishing new mechanisms of this kind cannot be ignored. Possibly some combination of reform of the IEA plus the leadership role of the G20 can achieve a similar result.

3. Conclusions: Global energy governance reform policy recommendations

3.1 Overall direction of global energy governance reform

This is the report of the first phase of the global energy governance cooperation project of the Energy Research Institute of China's NDRC and the Grantham Institute, Imperial College, London. Global energy governance reform should be carried out according to the dynamic adjustment of international energy markets. We have not been able to complete the task in a single study. We recognize the need to draw extensively on international opinion and seek consensus. That is the primary purpose of this discussion draft. We will then aim to define detailed reform proposals, and propose a reform roadmap. In this preliminary study we suggest some general principles of global energy governance reform, and of China's further participation. In the coming year of our project we will further explore the reform of global energy governance in the light of international opinion and work towards a roadmap.

Here are some proposed focuses for energy governance reform:

- Strengthening the concept of a common global energy security;
- Strengthening international cooperation in multilateral mechanisms;
- Strengthen existing energy governance mechanisms;
- Jointly building a new international energy order, including energy and financial order,
- Extending the current financial analysis of commodity markets into the energy sector;
- Establishing dialogue on policies that impact the stability of key energy producing regions.
- Improving energy market transparency and the quality of statistics,
- Establishing an effective strategic reserve mechanism;
- Strengthening the development of renewable energy and new energy;
- Jointly promoting energy efficiency, promoting energy innovation, and new energy advances in technology.

Recommendation 1: The international energy governance framework should better reflect the aspirations and voices of emerging and developing countries and the more mature relations between OPEC energy producers and consumers.

The international energy governance structure needs to reflect the existing global energy situation, and should allow for the equal participation of emerging and developing countries. We suggest the following major areas of reform for

consideration:

- Reforms of the IEA to enable it to play a genuinely global role in international energy policy and analysis. The IEA's Association proposals are a first step in this direction and making a success of them should now be a priority. However the IEA should also lift the treaty provision that restricts its membership to the OECD so that it can play a genuinely global role.
- A greater role for the G20 in providing leadership for energy governance reform, possibly through a G20 Working Group and meetings of G20 energy ministers, when that is appropriate. Calls for global leaders to increase using the platform for the UN for promoting global energy governance. The UN should strength its role on global energy governance, and putting energy issue as a long term major focus, in areas such as energy poverty, technology transfer and the balance of energy developments.
- Upgrading of the cooperation between the IEF, OPEC, and the IEA, including JODI and enhancing cooperation on market analysis between OPEC and the IEA, perhaps through a joint committee.
- Strengthening the international rules for international energy trade and investment to implement a more equitable framework for developing countries. This could include development of the principles of the Energy Charter Treaty.
- Major international energy agencies to increase hiring of developing country employees, including to senior positions involved in decision-making;
- Major energy governance institutions such as the IEA should consider the establishment of offices in major developing countries for addressing energy issues of greatest relevance to the region, including energy access and fuel poverty.
- Consider setting up a special fund for international cooperation on energy-related training to enhance the capacity of staff in developing countries. The training includes international energy cooperation, energy data and statistics, rules of interpretation of international energy law;

Recommendation 2: Update and upgrade the global response to the energy crisis of the emergency response mechanism

Energy security is a core necessity of global governance and the mechanism for energy security and for dealing with the energy crises needs to be upgraded. Security of LNG trade, as well as oil and gas, should be considered within the scope of global energy governance. China needs to develop its role and the role of IEA and other major international organisations also need to be developed to coordinate responses beyond the traditional IEA membership. Governments should consider how emergency response mechanisms could be expanded with mechanisms aimed at addressing not only supply disruptions, but also extreme price fluctuations. The major

international bodies need to work together with wider participation from consumer countries to jointly cope with supply crises.

Recommendation 3: Strengthen energy research cooperation. Especially clean energy research should be explored at the global level.

Global level discussion is needed to promote international cooperation on innovation and the development of clean energy technology, including renewables, while establishing a sound system of global protection of intellectual property rights. The international community should consider a major “game changing” global initiative in a critical area of low carbon technology such as PV or Carbon Capture and Storage. The existing international cooperation on nuclear fusion (ITER) provides an interesting example of international cooperation on large scale energy research.

Recommendation 4: International law should further improve the resolution of energy trade disputes, investment protection and other aspects.

The international economic crisis has increased the risk of trade protectionism, and of energy trade disputes. The current principal legally binding global energy governance mechanisms include the relevant provisions of WTO, and the Energy Charter Treaty. With the globalization of the energy market it has become increasingly clear that there are gaps in international law. Global mainstream energy governance institutions should be strengthened to improve the relevant legal framework, and to promote wider participation in the process of developing the rules in the legislation, and to create a more healthy and efficient international energy governance order.

Recommendation 5: Create a platform to build more robust global and regional dialogues.

The increase in mutual dependence on the global energy market, the impact of U.S. shale gas on global prices, and the increase in Japanese imports of LNG as nuclear power has declined, have all had knock-on effects on the global energy landscape. There is a need to establish a more effective, powerful dialogue between the major energy supply countries such as China and Japan, China and Russia, to solve energy problems.

Recommendation 6: International agencies for energy cooperation should focus on low carbon strategies for developing countries, and give their support to the UNFCCC's new Technology Mechanism.

It is now clear that, while developed nations must give a lead and contribute support, the ability of developing nations to manage and eventually reduce their carbon emissions in a way that supports their development ambitions will be critical for climate mitigation. Support for these nations to develop their nationally appropriate low carbon strategies should therefore be a major objective of international energy cooperation. This could be spearheaded by the International Energy Agency through

a new, internationally supported directorate, or through other governance mechanisms.

Recommendation 7: Building on the existing UN programmes, major international bodies for international energy cooperation should give much greater attention to the challenges of energy access and fuel poverty.

Recommendation 8: Promoting renewable energy development, energy efficiency cooperation and energy innovation.

International cooperation is needed for sharing the best practice of renewable energy development and energy efficiency, as well as discussions on energy structure reform. Promoting energy innovation requires the protection of the necessary investments on energy innovation, as well as proper access to intellectual property for innovation and investment while also protecting the legitimate interests of developers.

3.2 Policy recommendations for China to further participate in global energy governance

China has emerged as a major player in the global energy market, but in the international energy affairs China is still inexperienced. China's participation in global energy governance and capacity building is still in the exploratory stage. China should establish a modern capacity for participation in international energy governance so that China can fully master and make use of existing international frameworks and fully participate in shaping and developing international rules and institutions. China should gradually become deeply involved in global energy governance so that China can play its part in international energy leadership. Specific recommendations are as follows.

Recommendation 1: China should modernize and build on its capacity for energy management, strengthen the ability to participate in global governance.

Third Plenum of the Party's 18th "Decision on reform" paper noted that China should "push on with modernization of the country's governing system and capabilities". Modern governance capacity in the energy sector is also of paramount importance. This study suggests that China needs to modernize its energy management capabilities relating to global energy governance. This should include the following:

- **Capability to proactively shape international energy issues.** This includes working with representatives of developing countries to develop major international platforms on key issues, including strategic research based on international issues raised by China Energy;
- **Ability to use international energy rules.** Not only to adapt and integrate into the existing international rules, but also to enable China, in the next stage, to make skilled, flexible use of relevant international law to resolve

trade disputes;

- **The design of a modern government framework for international energy cooperation.** There is a need for appropriate government architecture for energy management. The National Energy Administration is not best prepared for this role. There is a need to expand its capacity and its functions, so that it is able to make use of a full range of diverse ways of increasing Chinese participation in global energy governance. The government should be innovative in designing its architecture. The International cooperation department should be more flexible and simplify procedures for approving participation in international events abroad.
- **Modern understanding and use of energy diplomacy is required.** This includes the use of both official and private networks, and the comprehensive use of public relations methods to explain, and win international recognition for China's energy policies.
- **Modern use of expatriate human resources and management capabilities.** Human resources are very important. For example, the oil exploration industry needs talent, including people with cross-border skills such as cross-cultural returnees, not only from English speaking countries. Meanwhile China also lacks strategic research personnel, and people with negotiating talents. This is not just a question of basic language skills, but also includes in-depth understanding of international cultures that is necessary for taking the initiative in international discussions. There is a need to simplify procedures to promote international exchange of talent to ensure that Chinese people can be fully effective and have appropriate influence in international discussions and institutions.

Recommendation 2: China should give more consideration to the international energy market in the development of energy policy and take a more international approach.

China's energy policy-makers should be fully aware of the growing international dimension of China's energy policy. Increasing imports of oil, natural gas and even coal are subject to international market shocks, and participation in global governance and understanding of energy policy developments international markets must be considered essential. Only by fully understanding the international environment will it be possible to circumvent the policy and market risks. China's energy policy should, therefore, be developed with an important international perspective.

Recommendation 3: China should actively promote foreign understanding of its energy policies

There is widespread misunderstanding of China's energy policies in the international community. Chinese culture is not to be very outspoken, especially as an emerging player in the global market. China's international experience is still limited and China

is learning from experience. In fact China's participation and international energy investments make a vital contribution to global energy security. There is much speculation on whether China's engagement should be regarded as an opportunity or a threat. The Chinese government needs to increase its efforts to explain its policies to the outside world, because they are so often misread. And national media also should be more communicative to reduce misunderstanding. The main state-owned energy companies should pay attention to capacity building of international public relations, publishing reports in English, explaining the policy, enhancing data transparency, and enhancing advocacy efforts. For example, the state-owned energy companies can actively explain the positive effect of their foreign investments in the global energy market, eliminating misunderstandings of the international community of China's energy policy and investment behaviour, for instance in the United States.

Recommendation 4: The need to significantly strengthen energy statistics.

China should enhance energy data quality not only for the purposes of international cooperation but also because this is an important step in improving market efficiency. Improved data quality also helps to raise the transparency and quality of the energy statistic system more quickly. A national energy statistics department is needed to deal with energy data, and to conduct a careful study of the necessary scope of state secrets so as to maximize the data that can be made public. It is almost impossible for China to participate in any international cooperation activities on energy market efficiency without making its own data available.

Recommendation 5: It is recommended to strengthen the openness of China's energy resources in particular areas.

Application of international rules is bidirectional. Use of international rules to protect China's foreign investment also means protecting foreign investment in China. The hope for more open international markets also means a certain degree of opening up the domestic market. Opening international investment opportunities in China's energy resources has a strong international appeal. China should define the areas that require international cooperation, increase the degree of openness, increase the opportunities for absorption of foreign advanced technology and experience, and use of foreign capital to promote the competitiveness and dynamism of the domestic energy market, to achieve a win-win energy development, so as to deepen pragmatic cooperation and the degree of international market opening in China.

Recommendation 6: From a strategic point of view to expand and deepen cooperation with the international energy institutes.

We recommend that national energy authorities issued "International Energy Agency Cooperation Guide," proposals for cooperation on major international energy existing governance institutions (IEA, IEF, G20, OPEC, the Energy Charter, etc.). This should define substantive roles in the various international platforms for cooperation. It would give guidance at all levels of government to fully expand cooperation with the

International Energy Agency. It would provide a clear national strategy for carrying out a full range of more effective international cooperation.

Recommendation 7: The establishment of an international energy conference and event participants list.

We recommend that national energy authorities should develop "a list of international energy conferences and events." National energy departments in charge of international cooperation should further clarify the name of international energy conferences and events, including the conference name, the time each year, who should be sent to participate, what level of officials should attend, etc.

Recommendation 8: China should be prepared to respond positively to international expectations of closer engagement with global energy governance.

China should respond actively to international expectations on closer engagement with international energy governance, recognizing a degree of international responsibility for China's energy strategy. This includes issues connected with the IEA's proposed Association, such as emergency response and data transparency.

Recommendation 9: establish consultation mechanisms for international cooperation and diplomacy of China's energy sector.

International cooperation projects in China's energy sector have a high international profile and tend to be viewed as a whole by the international community. Organisations involved in China's overseas energy investments and diplomacy should therefore work together and have a common approach to the policies and activities that will affect international opinion and on their presentation. That will enable China to get a powerful and positive message across more effectively.

Recommendation 10: China should actively use the unofficial forces and international forces, establish discussion platform to expand research and capacity building to participate in global energy governance.

China's current government in the energy sector is extremely busy. Global energy governance requires in-depth study and discussion, it needs more capacity. Western society has deep experience in the establishment and governance of global rules for handling international affairs and a more extensive understanding. China should use the power of Western society, with the power of universities and research institutions of global governance to make up this deficit in energy research. The scope of Global energy governance research is very broad, and includes political, economic, military, diplomatic, legal and other aspects. It typically needs a lot of debate and discussion. In the next phase of our project we intend to do our utmost to promote international debate of this kind.

Annex: Project access institutions and experts (by order of visit)

Beijing

Han Wenke, director of the National Energy researcher
Zhou Dadi, former director of the National Development and Reform Commission of Energy, researchers
Yang Honglin, former ambassador to Saudi Arabia, Kuwait, Bahrain, Iraq, China
Zhang Guobao, former deputy director of the National Development and Reform Commission, former director of the National Energy Board
Professor He Jiankun, former vice president of Tsinghua University
Wang Haiyun, General, Director of marine energy diplomacy Research Center
Wang Nengquan, Chief Economist, Sinochem
Shi Dinghuan, State Department counsellor, former Secretary-General of the Ministry of Science
Yang Yuanhua, Xinhua News Agency Senior Fellow
Chen Weidong, chief energy economist of CNOOC Group
Xu Xiaojie, Academy of Social Sciences Institute of World Economics and Politics Fellow
Shan Weiguo, director of the Institute of Market Economy Research Institute of Petroleum Technology

London

Lord Browne
David Concar (FCO)
Edmund Hosker (DECC)
Chatham House: John Mitchell, Antony Froggatt etc
John Topper, IEA Clean Coal Centre
Malcolm Brinded, ex-Shell, UK Business Ambassador
Jim Skea ex-head UK Energy Research Council
Tim Yeo MP, Chair of the Parliamentary Select Committee on Energy
Angus Gillespie, et al. Shell Oil Company
Joan MacNaughton, former Chair of the Governing Board of the IEA

IEA

Maria van de Hoven (IEA Executive Director)
Ambassador Richard Jones, IEA Deputy Executive Director
Julie Jang, Programme Officer, China
Dr Fatih Birol, Chief Economist
Keisuke Sadamori, Director of Energy Markets and Security
Martin Young, Head of Emergency Policy Division
Antoine Halff, Head of oil Industry and Markets Division

Jean-Yves Garnier, Head of Energy Data Centre

Brussels

Energy Charter Treaty Organisation: Urban Rusnak, Secretary General.

Washington

Energy Information Administration

John Conti, Assistant Administrator

Sam Napolitano, Director, Office of Integrated and International Energy Analysis

Joseph C. Ayoub, Director, International Energy Analysis

Tancred Lidderdale, Senior Industry Economist

Alexander Metelitsa, Industry Economist, Industry Energy Analysis

Mike Mellish, Economist, Office of Electricity, Coal, Nuclear, and Renewables Analysis

Ayaka Jones, Engineer – Coal Analysis

US Department of Energy

David Sandalow, Under Secretary of Energy (Acting)

Jonathan Elkind, Principal Deputy Assistant Secretary

Elizabeth Sasser, International Relations Specialist

State Department

Robert Cekuta, Principal Deputy Assistant Secretary

Richard Westerdale, Director, Policy Analysis and Public Diplomacy, Bureau of Energy Resources

Douglas Kramer, Deputy Director, Office of Europe, Western Hemisphere, and Africa

White House

Michael B.G. Froman, Assistant to the President and Deputy National Security Advisor

David M. Moore, Director for Energy, Office of International Economics, National Security Staff

World Wildlife Fund

Keya Chatterjee

Brad Schalert, Program Officer, Climate Change Programme

Round Table at CSIS

David Pumphrey, Senior Fellow at CSIS, Chaired the discussion

Others present from industry, CSIS, etc included;

Guy Caruso, Senior Adviser on Energy and National Security

Jennifer R. Walto, Manager International Government Affairs, Chevron

Dr Bo Kong, Assistant Research Prof, Energy Resources and Environment Program, Johns Hopkins University

Kevin Jianjun Tu, Director, China Energy and Climate Programme, Carnegie Endowment for International Peace

Herman Franssen, Executive Director, Energy Intelligence

Discussion with Senior CSIS Associates

Dave Pumphrey (Chair)

Guy Caruso

Frank Verrastro, Senior Vice President

Lisa Hyland, Research Associate, Energy and National Security

World Resources Institute

Dr Kevin Kennedy, Director, US Climate Initiative

Leo Horn-Phathanothai, Director International Cooperation

Michael Oko, Director, Media Relations

Paul L Joffe, Senior Foreign Policy Council

Ramping Song, Team Lead, China Climate and Energy Program

Denise Leung, Research Analyst

Luke Schoen, China FAQs Manager

Senate Foreign Relations Committee

Michael Schiffer, Senior Advisor (majority), Senate Foreign Relations Committee

Melanie Nakagawa, Counsel. Committee on Foreign Relations

Senate Committee on Energy and Natural Resources

Isaiah Akin, Senior Professional Staff Member

Bill Martin, former Executive Secretary of the National Security Council and former

Deputy Secretary at the Department of Energy

Brookings Institute

Erica Downs, Fellow, John L Thornton China Centre Foreign Policy

Govinda Avasarla, Senior Research Assistant Energy Security Initiative

New York

UN experts

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About Energy Research Institute

The Energy Research Institute (ERI) of the National Development and Reform Commission (NDRC), which was established in 1980, is a national research organisation conducting comprehensive studies on China's energy issues. ERI's research mainly focuses on the fields of energy economics, energy supply and demand forecasts, energy security, energy efficiency, energy environment & climate change and renewable energy. In recent years, ERI has recently accomplished hundreds of projects related to energy strategy, medium and long term energy planning, energy policies, energy efficiency, climate change and renewable energy development as well as energy consultation projects. www.eri.org.cn

About Grantham Institute for Climate Change

The Grantham institute is committed to driving research on climate change, and translating it into real world impact. Established in February 2007 with a £12.8 million donation over ten years from the Grantham foundation for the protection of the Environment, the institute's researchers are developing both the fundamental scientific understanding of climate change, and the mitigation and adaptation responses to it. The research, policy and outreach work that the institute carries out is based on, and backed up by, the world-leading research by academic staff at imperial. www.imperial.ac.uk/climatechange

About Imperial College London

Consistently rated amongst the world's best universities, Imperial College London is a science-based institution with a reputation for excellence in teaching and research that attracts 13,000 students and 6,000 staff of the highest international quality. Innovative research at the college explores the interface between science, medicine, engineering and business, delivering practical solutions that improve quality of life and the environment - underpinned by a dynamic enterprise culture. Since its foundation in 1907, Imperial's contributions to society have included the discovery of penicillin, the development of holography and the foundations of fibre optics. This commitment to the application of research for the benefit of all continues today, with current focuses including interdisciplinary collaborations to improve health in the UK and globally, tackle climate change and develop clean and sustainable sources of energy. www.imperial.ac.uk