China-EU Energy Cooperation Roadmap 2020 _ Concept Note

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March 2015




EC2

Europe-China Clean Energy Centre
中欧清洁能源中心

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About EC2

The Europe-China Clean Energy Centre (EC2) cooperation project started in 2010 and is supported by the European Commission, the National Energy Administration of China, the Ministry of Commerce of China, and the Italian Ministry for the Environment, Land and Sea. Its main objectives are to promote the increased use of clean energy in China and to support the Chinese Government's efforts to shape a more sustainable, environmentally friendly and efficient energy sector through technology cooperation, institutional advisory services, capacity building and dissemination.

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Disclaimer

List of acronyms
ALA – Asia and Latin America financial assistance tool
CHP – Combined heat and power
DG ENER – European Commission Directorate-General for Energy
EC2 – Europe-China Clean Energy Centre
ECT – Energy Charter Treaty
ETS – Emissions Trading Scheme
EU – European Union
GDP – Gross domestic product
GhG – Greenhouse gas
IPCC – Intergovernmental Panel on Climate Change
IRENA – International Renewable Energy Agency
MIIT – Ministry of Industry and Information Technology
MoHURD – Ministry of Urban Housing and Urban-Rural Development
MoST – Ministry of Science and Technology
NDRC – National Development and Reform Commission
NEA – National Energy Administration
PRC – People's Republic of China
R&D – Research and development
SERC – State Electricity Regulatory Commission of China
UNFCCC – United Nations Framework Convention on Climate Change
UK – United Kingdom

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Executive Summary

Introduction – The process for the definition of an *Energy Cooperation Roadmap* between the EU and China was officially initiated at the first meeting of the Energy Security Working Group held in Beijing in February 2013, following the *China-EU Joint Declaration on Energy Security* of May 2012 that stated the formal establishment of the relationships between China and the EU as energy consumers and strategic partners. This *Concept Note on China-EU Energy Cooperation Roadmap* 2020 has been elaborated by the Europe-China Clean Energy Centre (EC2) and it provides suggestions on cooperation goals and recommendations for a Roadmap to 2020.

Background – Climate change, energy supply security and energy transition are major challenges that both China and the EU are facing. Addressing climate change has become a global priority issue. Over the past few years, the Intergovernmental Panel on Climate Change (IPCC) has continuously introduced research reports presenting a large amount of arguments, which prove that global climate change has led to vast and profound problematic effects for the survival and development of human beings. The proposal of increasing targets on global climate change requires from China-EU cooperation to take further action in the field of energy saving and emissions reduction. Similarly, energy security and energy-related environmental problems are global issues. China and the EU face the joint task of striving for global energy security. In the future, there are many common topics and cooperation opportunities in the dialogue between the two sides. Therefore, strengthening China-EU dialogues and cooperation in the energy sector, promoting the energy transition and promoting a larger role in global energy affairs is a strategic mission for the future of China-EU energy relations. From the perspective of both resource endowment and environmental constraints, the development and utilisation of fossil energy created increasingly larger challenges for China and the EU both for their energy and economic development. Promoting a diversified, competitive, clean and safe energy supply and consumption system is a shared pressing strategic key point to be commonly addressed.

Historical perspective – Energy cooperation is an original feature of the China-EU relation and with time it has grown stronger and more complex to become strategic to the overall cooperation. Energy links have gradually become more institutionalised and perennial through a series of cooperation mechanisms. Currently the EU-China Energy Dialogue, the EU-China High Level Energy Meeting and most recently the Partnership on Urbanisation constitute the three main institutional mechanisms around which the cooperation is articulated. This has been the solid basis on which the mutual interest in sustainable energy and a low carbon economy has been nurtured and enabled to reach a high level of mutual commitment. Concretely the cooperation has grown to address the whole spectrum of sustainable energy including renewables, energy efficiency, clean coal and demand-side management, but it is also mature enough to include energy security. A series of platforms and cooperation projects ensure the energy-related cooperation is fuelled by concrete results and continuously delivers through a series of events, exchanges and initiatives. The flexible nature of cooperation also allows for forward-looking initiatives embodied by the latest Partnership on Urbanisation and the commitment to jointly working on the challenge of sustainable and environmentally friendly cities. The main achievements realised over the years for energy to become a strategic and fertile ground for future cooperation to thrive are summarised.

Issues – A number of issues have been identified in Europe-China energy cooperation. Gaps still exist in the respective strategic visions, in the priorities for an effective climate change strategy, in the cooperation targets and methods in business-to-business relationship. Furthermore, the paradigm of EU-China energy cooperation is shifting from development aid to

joint partnership, which requires time for adjusting to the new situation. There are also internal coordination problems on both sides, which make it difficult for the other side to identify the right interlocutors. Intellectual property rights issues are still to be addressed. Finally, there are several structural problems for the state of affairs in China-EU energy cooperation. A number of cooperation models have been identified in China-EU energy cooperation, including: Policy Dialogue, Capacity Building, Scientific Research, Technological Demonstration Projects, Market Development Projects and City Twinning. For each of the models strengths and weaknesses have been identified based on stakeholders' experience and contribute to informing the formulation of recommendations for the future.

Key areas of future China-EU energy cooperation – There are prospects for more wide-ranging energy cooperation between China and the EU with a view to strengthening joint action and improving its efficiency. Key areas and possible goals for the next five years have been identified in the fields of Energy Supply, Energy End-Use and Crosscutting Aspects.

At present, with the continuous depletion of fossil fuels and changes in the global energy pattern, China and the EU share a number of challenges in the field of fossil energy supply and, at the same time, in the reduction of fossil fuels utilisation. Priority domains of cooperation should include energy crisis prevention and management, fuel standards, and environmental impact reduction of coal mining. As far as renewable energy is concerned, technologies and economic efficiency are still the most fundamental problem that needs to be solved for their development. Future cooperation should take place in renewable energy cost reduction, distributed power generation, combined heat and power (CHP), and the development of the transmission system. As far as nuclear power is concerned, safety, crisis management and waste management have been identified as priority areas.

China's energy consumption per unit of GDP is relatively high, so it has great energy-saving potential in production, conversion and use of energy. Acquiring the advanced demand-side management and energy efficiency experiences from Europe is of great significance. China-EU energy cooperation should have as a goal that of balancing energy end-use and supply by enhancing energy demand management, while improving energy efficiency.

The future cooperation should also focus on promoting a power market structure and system adapted to the large-scale deployment of renewable energy and on the exchange on market-oriented energy price mechanisms, market supervision and regulation. The process of exploitation and the final use of energy affect both the local environment and industrial competitiveness, and mark the contribution to global efforts for the protection of the environment. The EU and China should jointly focus on the mobilisation of the market on environmental protection, associate energy conservation and environmental protection, jointly promote eco-design and develop energy standards in consumer goods.

China has made efforts to develop eco-cities, which include a sustainable approach to energy use. However, several challenges still exist in completing the process and in scaling up a sustainable urban development approach. The cooperation should focus on the optimisation of cities' energy consumption and the development and implementation of sustainable energy action plans where EU experience can provide useful breakthroughs.

Dealing with the frequent energy crises in the international market, reaching a steady energy supply and reducing the corresponding economic fragility are key drivers underlying China-EU energy cooperation. The two parties should include in their cooperation agenda the improvement of trade and investment conditions in the energy sector, China's involvement in international energy institutions, joint actions in third countries and regions.

China-EU Energy Cooperation Roadmap – Against the background of multiple challenges in climate change, environmental degradation and energy security, it is in the interest of both China and the EU to promote low-carbon development, protect the environment, jointly addressing climate change and enhancing clean energy development. Therefore, based on past cooperation initiatives and lessons learnt by both sides, a *China-EU Energy Cooperation Roadmap* should be formulated.

The EU and China should set in the Roadmap the following overall targets of cooperation:

- Recognise that energy cooperation is a key contribution to the overall strategic partnership between China and the EU.
- Enhance mutual trust in energy market and coordination in the cooperation process.
- Contribute to energy structure transformation and to sustainable development of global energy.
- Enhance the collaboration on Energy Supply, Energy End-Use and Crosscutting Issues based on commonly agreed goals.

From 2015 to 2020 an innovative mechanism and expanded areas for energy cooperation should be developed at intergovernmental, busines-to-business, and research institutions levels, including:

1. An energy exchange and cooperation fund.
2. A cooperation mechanism in charge of implementing the *China-EU Energy Cooperation Roadmap*.
3. Overall coordination mechanisms across each side's own departments to attract own enterprises and research institutions.
4. A joint platform for China-EU energy cooperation to provide services for enterprises, research institutions and the public of both sides.
5. China-EU energy dialogues actively maintained with mutual visits process at all levels.
6. New energy cooperation agreements established between China and the EU with harmonisation of those between China and EU Member States.
7. A common investment and financing mechanism for China-EU clean energy, low carbon, and infrastructure to facilitate business matching in each other's market.
8. China-EU enterprise cooperation mechanisms in third countries for energy resource and market development.

The following principles are recommended to innovate in the modes in which China-EU energy cooperation is conducted:

1. Integrate cooperation into respective own domestic agenda of energy efficiency, carbon reduction, and policy innovation.
2. Fine-tune respective policies towards trade and investments in energy equipment and technologies.
3. Continue dialoguing on topics such as geopolitical changes in the world's energy landscapes, improving global energy governance, and more effectively focusing on impacts of climate change.

Roadmap implementation – The suggested steps for the Roadmap implementation are: i. developing the Roadmap Action Plan; ii. establishing a guarantee mechanism; iii. establishing a platform for China-EU energy cooperation; and iv. conducting research on energy cooperation.

Introduction

Since signing the Trade and Cooperation Agreement in 1985, China and the European Union have conducted a vigorous cooperation in the energy field. With the expansion of the trade relations in the 21st century, mechanisms for cooperation, dialogues and negotiations have been gradually established at all levels and in a wide range of fields. Under these cooperation mechanisms, China and the European Union have conducted a broad, in-depth and fruitful cooperation on policies and technologies in the field of sustainable energy.

A key milestone in this process was the *China-EU High-Level Meeting on Energy* held in Brussels in May 2012, in which exchanges on issues such as energy development strategy and energy security have been conducted through dialogues by both sides, and with a series of important consensus achieved. On that occasion, the National Energy Administration of the People's Republic of China (NEA) and the European Commission signed the *China-EU Joint Declaration on Energy Security*, stating the formal establishment of the relationships between China and the EU as energy consumers and strategic partners. In this framework, in July 2012, both parties agreed on the establishment of the China-EU Energy Security Working Group with the intention of establishing a *Roadmap* on energy cooperation. In February 2013, the first meeting of the Working Group was hold in Beijing, in which the process for the definition of the *Roadmap* was officially initiated. Preliminarily, natural gas infrastructures, smart grid, grid connection of renewable energies, safe operation and supervision of large-scale power grid, offshore wind power, solar thermal utilisation, modelling of incentive mechanisms for development of renewable energy and energy strategic problems were determined as key fields in the short-term cooperation. Meanwhile, it was determined that close communication should be maintained on global energy governance issues.

The Europe-China Clean Energy Centre (EC2), following the proposal by NEA and supported by the EU, has elaborated this *Concept Note on China-EU Energy Cooperation Roadmap 2020*, based on field analysis and consultation of experts and stakeholders from Europe and China.

Section 1 of this *Concept Note* outlines the challenges commonly addressed by the EU and China in the fields of Climate Change, Energy Security and Energy Transition.

Section 2 reviews the cooperation process in the energy field from an historical perspective. It analyses government-led, joint research and business-to-business projects, providing a detailed description of the projects in Annex I (ec2.org.cn). Furthermore it outlines the critical issues in energy cooperation, suggesting measures to jointly address them. Finally it provides an overview of EU and Chinese common inputs on the various cooperation models.

Section 3 outlines the key areas for the future of the cooperation in the fields of Energy Supply, Energy End-Use and Cross-cutting Aspects. It provides an analysis of the challenges and opportunities in the key topics, and highlights the possible cooperation goals.

Section 4 recommends the possible course of action to be taken, namely: the overall targets of cooperation; the key steps of the Roadmap in the period 2015-2020; the most appropriate cooperation mode; the arrangements to implement the *Roadmap*.

Background of China-EU Energy Cooperation

1.1 Climate change

Background – Addressing climate change has become a global priority issue. Over the past few years, the Intergovernmental Panel on Climate Change (IPCC) has continuously introduced research reports presenting a large amount of arguments, which proves that global climate change has led to vast and profound problematic effects for the survival and development of human beings. The carbon emission reduction proposal put forward by the IPCC has therefore received positive responses from most countries. Based on the United Nations Framework Convention on Climate Change, the majority of countries are actively taking actions to address climate change.

EU – To this end, the EU has been working towards the reduction of greenhouse gas emissions through a series of measures. These include the promotion of renewable energy and energy use efficiency, the reduction of GhG and energy consumption of transportation notably through the European Emissions Trading Scheme (ETS). According to a recent Council decision[1], by 2030, the EU's greenhouse gas emissions are to be reduced by 40% below the 1990 level, the share of renewable energy is to increase to at least 27% of the EU's energy consumption and 27% energy savings are to be made.

China – As the largest developing country, China also faces many of global climate change's negative effects. In recent years, abnormal weather situations, especially extreme weather events frequently occur in China, with the loss due to meteorological disasters also increasing. Meanwhile, due to the large total amount and fast growing of greenhouse gas emissions, China's carbon dioxide emissions due to fossil fuels have already ranked top 1 in the world. Per capita emissions have also exceeded the world average, which result in increased pressure in international negotiations. With the global greenhouse gas emission reduction trend, China has obviously no longer unlimited room for greenhouse gas emission that developed countries had in their industrialisation stage. Based on this, the Chinese Government has committed itself to the international community to decrease carbon dioxide emissions per unit of GDP in 2020 by 40-45% compared with 2005 levels, and reach the emissions peak of carbon dioxide around 2030. Non-fossil energy consumption will account for 15% and 20% in the primary energy consumption in 2020 and 2030 respectively.

EU-China – The proposal of increasing targets on global climate change requires from EU-China cooperation to take further action in the field of energy saving and emissions reduction. Decreasing high-carbon fossil fuels consumption can contribute to reducing CO_2 emissions, but emerging technologies such as carbon capture and storage are also expected to play a role, once demonstrated at large scale and commercially available, in order to achieve ambitious climate objectives. This constitutes a serious challenge for the EU and China considering the high-carbon energy structure of both China and European countries, and this since a very long time.

[1] COM/2014/015 final - A policy framework for climate and energy in the period from 2020 to 2030 and 23.10.2014 Conclusions on 2030 Climate and Energy Policy Framework SN 79/14.

1.2 Energy Security

Background – Energy security and energy-related environmental problems are global issues. Ensuring a balance between global supply and demand of energy as well as ensuring the security of energy use and the protection of the environment has long been a major task facing all countries in the world. In recent years, the international community worked at safeguarding global energy security through all kinds of efforts such as continuously deepening energy cooperation and strengthening global energy governance. The increasing regional imbalance of energy supply and demand, daily worsening energy environment problems and the increased geopolitical conflicts and frictions on energy have complicated the energy security problems and made it difficult to solve these problems. This results in obvious urgency of strengthening negotiations and cooperation on global energy security. As two of the world's major economies, China and the EU share these global energy challenges.

EU – Looking at Europe's energy production and consumption since the industrial age, most European countries have been historical large consumers of fossil fuel energy, yet with a low self-sufficiency rate due to a relative lack of such energy resources. As a result of insufficient fossil fuel supply of its own, Europe has become one of the most important consumption regions in the world. The EU therefore takes energy security very seriously and promotes infrastructure development, risk management for possible energy supply shortfalls as well as a diversified energy mix relying as well on sustainable energy sources. In terms of energy-related environmental issues, Europe's reliance on fossil fuels contributed to serious environmental problems such as air pollution. Both energy security and environmental issues have rendered the development of clean energy more relevant and urgent than ever.

China – China has become the world's biggest energy producer and consumer, with an energy supply system of all-round development of coal, electric power, oil and natural gas but also new energy and renewable energy. A universal energy service has also been largely enhanced together with the improvement of energy use conditions for people's livelihood and the development of clean energy have altogether achieved significant progress. The low energy resources endowment and exceptional increase in total energy consumption, creates a large pressure in the safe supply of energy; whilst large-scale development and utilisation of fossil energy has brought a series of ecological environment problems. China energy demand is forecasted to experience significant growth in the medium term (2020) as well as in the long run (2030-2050). At present according to estimations China's foreign dependency on oil has exceeded 57%, and it will reach over 70% after 2030. It is projected that by 2015 30% of China's natural gas consumption needs will be imported reaching over 40% by 2030. Drawing onto this, China energy supply security and use security is very serious indeed.

EU-China – Energy supply security and environmental problems resulting from fossil energy use are two major challenges facing both China and the EU. Promoting diversified energy supply and consumption of clean energy to form a diversified, competitive, clean and safe energy supply and consumption system is a shared pressing strategic key point to be commonly addressed.

1.3 Energy Transition

Background – From the perspective of both resource endowment and environmental constraints, the development and utilisation of fossil energy created increasingly larger challenges. Energy security has therefore become one of the significant security problems whilst the climate change issue has become an element understood to have restrictive effects for China's rapid economic development. These are all common challenges facing China and the EU both for their energy and economic development. If newly constructed energy facilities still rely on coal in the first half of this century, the energy development of China and European countries risks being locked in on the path of high-carbon and low energy efficiency. In order to achieve social and economic development goals in the future, both sides should actively promote the transformation of the energy system, fulfil the growing energy demand with clean low-carbon energy supply, accelerate the transformation of energy development modes and prioritise the restructuring of the energy field by seizing the opportunity offered by the global technological and industrial revolution as well as restructuring energy consumption away from fossils to focus on clean, low-carbon and renewable energy.

EU – The EU has made energy transition one of its core priorities and adopted a series of relevant measures and actions to promote the development of green low-carbon energy. The Europe 2020 Strategy proposed by the EU in 2010 and the "2050 Energy Roadmap" issued in 2011 both set the EU on the path to clean and low-carbon energy development for the future. Most recently, the EU further prioritised energy and climate change measures, demanding EU Member States to re-examine their own related policies, strengthen the coordination between policies, actively promoting green economy through green energy and green transportation, all by 2030. The EU Horizon 2020 Programme is supporting the development of new clean technologies with transportation, clean and high efficient energy listed as key technologies. The programme will invest public financial support of over EUR 4 billion in the key priority fields.

China – The Chinese Government also aims at promoting the establishment of new energy systems and makes of the promotion of energy efficiency together with clean and safe energy a priority focus. In 2014, senior Chinese government officials proposed changes in energy production and consumption modes in order to push forward the revolution in energy production, consumption, technologies and systems. This clearly indicates the sense of urgency for an accelerated pace in energy transformation. Recently, the Chinese Government further made a commitment to the whole world that by 2030 it would achieve the target of 20% non-fossil fuels in its primary energy consumption. China has also released the "Energy Development Strategic Action Plan 2020", and proposed the green low-carbon energy development strategy for energy development, which clearly defines that by 2020, non-fossil fuels should account for up to 15% in its primary energy consumption, 10% for natural gas and the proportion of coal consumption should be controlled within 62%. China's target of non-fossil energy is not merely a pure concept with numbers; it should also provide a better and faster economic development, which should be guaranteed without consuming more fossil energy by providing more ways and measures for clean energy, and establishing a series of systems and mechanisms and technical development measures. The realisation of development goals of non-fossil energy also indicates the formation of a new energy industry. In the foreseeable future, the non-fossil energy will develop into one of China's main energy industries. Therefore the strategic optimisation and adjustment of the energy supply structure is not only a development commitment, but also an issue relevant to China's overall political, economic and social development. The development of renewable energy is thus a necessary choice for improving China's energy security.

EU-China – Currently, the EU has accumulated experience in the technology innovation and management of low-carbon energy and has made the green economy and low-carbon energy development a long-term strategic focus. China already has favourable conditions for renewable energy development. Furthermore it is committed to continuously accelerating the development of renewable energy, pushing forward the energy transformation in accordance with its current industrial restructuring with the aim to promote the transition to a greener mode of development. China and the EU not only face the joint task of striving for global energy security, but also many similar problems and challenges in the energy transformation process. In the future, there are many common topics and cooperation opportunities in the dialogue by the two sides. Therefore, strengthening China-EU dialogues and cooperation in the energy sector, promoting the energy transition and promoting a larger role in global energy affairs is a strategic mission for the future of EU-China energy relations.

EU-China Energy Cooperation Review

2.1 Historical Perspective

Energy cooperation is an original feature of the EU-China relation and with time it has grown stronger and more complex to become strategic to the overall cooperation. Reflecting the ever-growing nature of the partnership itself, energy links have gradually become more institutionalised and perennial through a series of cooperation mechanisms. This has been the solid basis on which the mutual interest in sustainable energy and a low-carbon economy has been nurtured and enabled to reach a high level of mutual commitment. The flexible nature of cooperation also allows for forward-looking initiatives embodied by the latest Partnership on Urbanisation and the commitment to jointly working on the challenge of sustainable and environmentally friendly cities. Concretely the cooperation has grown to address the whole spectrum of sustainable energy including renewables, energy efficiency, clean coal and demand-side management but it is also mature enough to include energy security. A series of platforms and cooperation projects ensures the energy-related cooperation is fuelled by concrete results and continuously delivers through a series of events, exchanges and initiatives.

This summary presents the main achievements realised over the years for energy to become a strategic and fertile ground for future cooperation to thrive.

2.1.1 Early cooperation

Energy is one of the longest-running areas of cooperation in the overall EU-China relations, starting a few years after diplomatic relations were established. Early energy cooperation already spanned across policy making, technical assistance and sharing of best practices and was further encouraged under the 1985 Agreement on Trade and Economic Cooperation as one of the areas to develop. Even though at the time no dedicated instrument for energy cooperation existed yet, mutual interest in energy cooperation benefited from a variety of other programmes, which ensured the continuity of energy cooperation such as the SYNERGY programme or under technical cooperation assistance channels like the Asia and Latin America financial assistance tool (ALA).

Since then, the cooperation was stepped-up by means of several mechanisms, which enshrined energy links into stable and regular exchanges at the highest levels. They constitute the basis of the energy cooperation.

2.1.2 Providing durability - Cooperation mechanisms

Over the years, the EU and China have established various effective, long-term and strategic energy cooperation mechanisms contributing to the success of the cooperation in the field of energy. Currently the EU-China Energy Dialogue, the EU-China High-Level Energy Meeting and most recently the Partnership on Urbanisation constitute the three main institutional mechanisms around which the cooperation is articulated.

The EU-China Energy Dialogue – Building energy cooperation on a solid basis

The energy dialogue was formalised in 1994 and is thereby one of the oldest sector dialogues between the EU and China, which now total more than 55. The dialogue is carried out via two mechanisms, the EU-China Energy Conference and the High-Level Working Group on Energy.

The Energy Conference is a bi-annual event running since 1994 and provides a platform for energy businesses as well as government representatives to address energy-research related issues. The conference allows for exchanges to be held on a broad variety of themes and offers an enduring forum for discussing issues of relevance for both the EU and China.

In 2005 the dialogue was complemented and further strengthened with the High-Level Energy Working Group. This energy exchange and cooperation mechanism was established on the basis of the Memorandum of Understanding on EU-China Dialogue on Energy and Transport Strategies signed during the 8th China-EU Summit in September 2005. It was concluded between the National Energy Administration (NEA) and the EU Transport Energy Directorate General (DG) now DG Energy and was held for the first time in March 2006. Six priority areas were identified in which cooperation is to be deepened: renewable energy, smart grids, energy efficiency in the building sector, clean coal, nuclear energy and energy law. Currently, the two sides are specifically concentrating on energy industry development planning, the future of energy supply and demand situation as well as the orientation of energy policy, energy conservation and emission reduction goals and clean energy technology. The 6th China-EU energy dialogue was held in Beijing on November 20, 2013.

The EU-China High Level Energy Meeting – Broadening the cooperation's horizon

On the occasion of then Vice Prime Minister Li Keqiang's visit to Brussels, on May 3, 2012, the NEA and DG Energy held the first EU-China High-Level Energy Meeting in Brussels, bringing together over 100 people, including a large Chinese delegation with representatives from the Ministries of Foreign Affairs, Finance, Land and Resources, Housing and Urban-Rural Development, Commerce as well as the State Asset Supervision and Administration Commission, State Electricity Regulatory Commission, Legal Affairs Office of the State Council and other state bodies. On the European side, national Secretaries of Energy and representatives of the European Member States attended the meeting. The meeting focused on energy development strategy and energy security thereby expanding the cooperation to the crucial field of energy security.

The event saw the signature of the milestone Joint Declaration on Energy Security endorsed at highest level between the Head of the NEA and the Energy Commissioner on behalf of the Chinese Government and the European Commission, marking the formal establishment of strategic partnership between two of the world's main energy consumers.

The commitment to energy security cooperation was strengthened with the establishment of the EU-China Energy Security Working Group and the joint Energy Security Cooperation Roadmap, which both anchor close communication on global energy governance. The working group held its first meeting in 2013 in Beijing and officially launched the development of a China-EU Energy Security Cooperation Roadmap. The focus of actions has been preliminarily set on natural gas infrastructure, smart grids, the integration of renewable electricity to the grid, the safe operation and supervision of large-scale power grids, offshore wind power, solar thermal utilisation, incentive mechanism for renewable energy development and energy strategic modelling. As a result-oriented partnership, priority is given to turning energy security cooperation into practice.

Energy security has also become a topic of cooperation under the political High-Level Strategic Dialogue and in 2013 the 16th EU-China Summit saw a new Joint Declaration on Energy Security signed between NEA Administrator WU Xinxiong and Energy Commissioner Oettinger, further boosting energy security cooperation.

Energy as a key feature between the EU and China is also a regular fixture of EU-China Summits — the highest-level political EU-China event — held annually since 1998. Bringing together China's President, the European Commission President as well as the President of the European Council accompanied by EU High Representative for Foreign Affairs and Security Policy, the Summit establishes common priorities and guidance for overall cooperation. Energy and sustainable development being essential concerns to both the EU and China, they have been recurrently identified as strategic priorities of the partnership.

The Partnership on Urbanisation – Pioneering a new type of relations

The Partnership on Urbanisation is the third and most recent of the cooperation channels between the EU and China. Recognising the reality of China's fast urbanisation — with already 50% of its population living in cities and more than 70% forecasted in the future — and the huge challenges it gives rise to, the Partnership on Urbanisation offers to jointly promote sustainable and healthy urbanisation development. Lessons learned from the European experience and the synergies its predominantly urban population structure creates with the Chinese situation are at the core of cooperation.

Signed at the highest level by Commission President Barroso and then Vice-Prime Minister Li Keqiang on the occasion of the High-Level Conference on Urbanisation on May 3, 2012, the partnership provides an open political platform for EU and Chinese stakeholders to cooperate and share experiences on the economic, social and environmental challenges of urbanisation. The partnership takes a comprehensive approach selecting a broad range of urbanisation-related issues ranging from sustainable development of urban industrial economy, urban public services systems, urban housing, urban energy supply and demand, urban mobility and urban governance to cover a total of more than ten focus areas. This holistic approach to urbanisation cooperation demonstrates the partnership's real understanding of the urbanisation challenge's complexity and its ambition to tackle it from all main aspects. It is indeed expected to deliver on sustainable and low-carbon Chinese cities but also provide business opportunities for European companies as well as ushering closer city-level sub-national ties and supporting 'the respectful integration of immigrants'.

In practical terms, the Urbanisation Partnership is articulated around the annual **Urbanisation Forum**, the **Mayors' Forum** as well as the **Exhibition on Urbanisation**, which together ensure an innovative way of looking at China's urbanisation challenges.

The Mayors' Forum was launched as the flagship event of the EU-China Urbanisation Partnership in May 2012 and is a summit-level deliverable. As the first instrument of its kind in EU-China relations, it is thought to offer a natural framework for concerted actions between European and Chinese mayors. The first ever Forum took place in Brussels on September 19-20 and gathered an impressive 600 participants including 8 European and Chinese mayors and around 50 other local authorities' representatives. In an action-oriented spirit 14 Chinese and European mayors signed the EU-China Mayors Charter. Together they commit to sharing experiences with a view to developing sustainable and efficient cities.

The first Urbanisation Forum held one year later in Beijing 'took Europe and China to an unprecedented level of engagement on this strategic topic'. Urbanisation being a core priority of the Chinese leadership, the Chinese Premier Li Keqiang participated in the event as well as the spectrum of ministries involved in this very crosscutting cooperation area together as well with more than 500 Chinese experts and businesses working in the field. Topics discussed touched upon urban mobility, smart cities as well as the protection of cultural heritage and more. The event took place on November 21, back-to-back with the annual EU-China Summit. Five sub-forums on cultural city, innovative city, smart city, green city and urban mobility also complemented the event.

The Forum was also the occasion for 12 European and Chinese cities to sign cooperation agreements on urban sustainable development witnessed by President Barroso, President Van Rompuy and Premier Li Keqiang. The pairing of cities is one of the primary and most innovative delivery mechanisms of the Partnership as it brings together European and Chinese cities to foster exchanges and concrete results in low-energy buildings, clean mobility, water and waste treatments but expanding also to social inclusion and efficient public services. The first in a series of partnerships to come, the cities' pairing certainly lends EU-China relations with a new dimension and embodies a pioneering way of leading international cooperation and promoting sustainable development at every level.

The 2013 EU-China Exhibition on Urban Development complemented the joint efforts on urbanisation showcasing European and Chinese best practices in urbanisation on a large scale and giving more than 60 entities an opportunity to present their expertise on smart cities, urban planning and sustainable urbanisation in general. A series of workshops and seminars supplemented the event, which was held under the patronage of the National Development and Reform Commission (NDRC) and of DG Energy of the European Commission.

2.1.3 Further cooperation channels – A dynamic partnership

Beyond formal cooperation mechanisms, which bring structure to the partnership, the EU-China energy links also rely on a series of agreements and statements. These constitute the basis for dynamic and forward-looking energy connections because they provide a flexible way to increase the scope of the cooperation.

In 2005 two **Action Plans** were adopted in the 7th EU-China Energy Working Group meeting on **Clean Coal Technology and on Industrial Cooperation on Energy Efficiency and Renewable Energies**. The latter included cooperation projects on biofuels, solar energy and the identification of potential for offshore wind projects. In terms of energy efficiency fields the Action Plan suggested expanding on the compilation of energy audits to identify saving potential, improve motor and air compressor efficiency, replacing inefficient industrial boilers, identify potential for combined heat and power deployment and improving the efficiency of lighting. Both Action Plans went on to become part of the EU-China Partnership on Climate Change, which provides them with a follow-up process. In 2006 clean coal cooperation was boosted with the Memorandum of Understanding on Near-zero Emissions Power Generation Technology through carbon capture and storage cooperation.

The **EURATOM-China Agreement for R&D Cooperation in the Peaceful Uses of Nuclear Energy** was signed in 2008 laying a solid foundation for in-depth cooperation in this field. The agreement is implemented by a steering committee co-chaired by DG Research and Innovation and the Chinese Ministry of Science and Technology (MoST), the China Atomic Energy Authority and the National Nuclear Safety Administration. The Steering Committee met for the first time in 2011 and since then operates

under one sub-committee on fission-coordinated actions and a second one on nuclear security and safeguards and more recently a sub-committee on nuclear safety.

Building on a robust industrial cooperation with a 2003-established industrial policy dialogue between the Commission and the NDRC, DG Enterprise and the Chinese Ministry of Industry and Information Technology (MIIT) signed in 2009 a Memorandum of Understanding on a Dialogue and Consultation Mechanism on Industrial Sectors. This dialogue was supplemented in 2010 by a **working group on industrial energy efficiency and greenhouse gas emissions reduction** thereby expanding furthermore the field of energy-related cooperation between the EU and China. The key pillars of this dialogue include sector-based energy efficiency actions in industry, product policy (notably eco-design) and a sustainable industrial policy. In 2012 the third meeting of the working group was held in China and touched amongst other topics upon the measurement of CO_2 emissions, capacity for energy management and remanufacturing.

Since 2010 the EU and China have underpinned their energy efficiency cooperation with a dedicated **dialogue on energy performance and quality in the construction sector** and an annual technical conference between DG Energy and the Ministry of Urban Housing and Urban-Rural Development (MOHURD). The Framework on Energy Performance and Quality in the Construction Sector signed in 2009 opens the way for improving the energy efficiency of China's buildings and construction process working jointly on the management system of energy performance certification of buildings, energy standards for buildings as well as research and technologies.

In the same year, research cooperation on renewable and energy efficiency was enhanced thanks to the **2010 Joint Statement on Energy Research and Innovation** between DG Research and Innovation and MOST. The agreement 'aims to support the twinning of projects, joint programmes or joint calls based on mutual interest and equal partnership' with special attention to involving SME when appropriate. A project twinning with MOST on concentrated solar panels and innovative batteries has been successfully implemented.

Most recently in May 2012 the European Commission and the State Electricity Regulatory Commission of China (SERC) agreed in a **joint statement, to enhance cooperation on electricity markets and regulation**. The role of electricity markets and business operators in achieving the low-carbon economy transition is key. The document brings this issue into the remit of the energy cooperation and specifically targets the electricity market reform, technical standards for the integration of renewable energy to the grid, energy efficiency and demand-side management, pricing regulation and access to the electricity market.

2.2 China-EU Energy Cooperation Projects

As an action-oriented partnership, the energy cooperation has a strong record of concrete achievements to show for. These are the direct result of the combination of a robust cooperation framework and pro-active cooperation platforms together with numerous stakeholders involved in the cooperation. Reflecting the comprehensive nature of the cooperation, projects have touched upon the entire spectrum of energy cooperation with a strong focus on sustainable energy.

This section identifies the main types of cooperation initiatives between the EU and China emerging from government-led projects, research projects and business-to-business projects.

2.2.1 Government-led projects

Energy cooperation between China and Europe is not only economically beneficial, but it also consolidates and develops long-term stable, comprehensive and cooperative relations between both sides. The development of relations between Europe and China further provides a good basis for deepened energy cooperation and feeds back into a win-win cycle of relations.

A description of EU-financed and Member States bilateral projects with China is contained in Annex I (ec2.org.cn).

2.2.2 Joint research projects

Europe, its Member States and China share many synergies in the field of energy. A recent survey conducted by the European Delegation to China in Beijing confirms that energy is one of the very top areas of research cooperation between Europe and China with a majority of Member States stating energy as one of their priority cooperation areas with China. As a result, energy is a dynamic cooperation area between Member States and China, delivering agreements and projects.

A description of joint research projects can be found in Annex I (ec2.org.cn).

2.2.3 Business-to-business projects

Business-to-business cooperation in the energy sector is a source of active cooperation between the EU and China. Both the EU and China have some of the most innovative and active companies of all sizes in the sector, which over the years contributed to building a strong network of Sino-European energy relationships, solidly underpinning the overall partnership.

A description of the main business-to-business initiatives is contained in Annex I (ec2.org.cn).

2.3 Critical Issues in Energy Cooperation

This section outlines the main problems encountered in energy cooperation and provides suggestions on the measures to be adopted to face them.

2.3.1 Problem analysis

A number of issues have been identified in Europe-China energy cooperation.

Gaps in strategic vision on energy cooperation between China and Europe

Although both sides officially signed the China-EU Energy Security Joint Statement in May 2012, confirming the establishment of a China-EU energy strategic partnership, differences in vision on how to continue the cooperation potential into actions still exist between the EU and China.

On the one hand, in the view of global energy management, most European countries and China belong to the world's top energy consumers, highly dependent on imports. This creates common interests in the pursuit of security of supply in global energy governance. On the other hand, in most European countries, energy consumption growth has peaked in recent years, with further decline in fossil fuel demand influenced by the difficult economic situation. EU external energy cooperation priorities have evolved accordingly.

More importantly, there is a low degree of interdependence in the supply of energy commodities between China and EU. China and EU cooperation achievements could not be easily recognised by people outside government departments and expert teams. Therefore, communication and cooperation between China and the EU need to be enhanced in order to reach a harmonised strategic vision.

From the perspective of overall demand in future energy development of both sides, EU and China are the world's leading energy consumers with high import dependence. Similar interests exist in their relationship with energy exporting countries and in global energy market development. Therefore strengthening cooperation is a common strategic requirement for China and the EU. Based on this, the following major challenges should be tackled: i. how to strengthen China-EU energy cooperation, communication and exchanges, and explore focus areas and modes under the new situation; and ii. how to promote energy technology cooperation to enter each other's market, and jointly explore the third markets for energy products.

In short, questions have arisen in both China and Europe as to the strategic rationale for further energy cooperation. Acknowledging this questioning is useful for fine-tuning future energy cooperation between China and the EU as well as its Member States.

Climate change is one of the important justifications for energy cooperation

The EU and China are both prominent actors in the global search for effective mechanisms to respond to climate change and therefore China-EU cooperation in the field of energy is very important. At the same time, China and the EU see different priorities in effective strategy. The two sides have differed for example in the United Nations Framework Convention on Climate Change negotiation process. They differ also with each other on such issues as identifying responsibilities regarding greenhouse gases, setting a state's overall emissions reduction targets, finding climate funds for developing economies, using "measurable, reportable and verifiable" schemes for evaluating a state's performance etc.

That said, China and the EU have indeed made progress in cooperation on climate change. Gaps are narrowing. For example, China has committed to a reduction of CO_2 emissions, set up pilot schemes for carbon emissions trading and promoted the adoption of clean energy technologies. In terms of develop-

ment strategy, the EU sees low-carbon economy as a long-term strategy, which is conducive to its pursuit of energy security. China also sees low-carbon development instrumental for realising its economic transition.

Still, it is a major challenge for China and the EU to harmonise their respective development strategy through cooperation, to achieve mutual benefit, win-win, and to establish the strategic partnership for global climate governance. This is in part a component of the complex negotiations on the global climate governance mechanism, but also restricts the depth of global energy cooperation to some extent.

The paradigm of EU-China energy cooperation is shifting from development aid to joint partnership

In the past 40 years, the underlying logic for Europe (EC/EU) to conduct energy cooperation with China was providing assistance to China in line with European development strategy. Aid implementation helped the Chinese market become familiar with European energy equipment, technologies, and management know-how. This helped to lay the foundation for European companies to enter into and expand in the Chinese market.

For Europe, assisting China to make progress on such global challenges as sustainable development, environmental protection and climate change is in line with the promotion of its normative influence at global level. China is an important member among the emerging economies of the world. Progress in cooperation with China enhances spreading this normative influence worldwide.

For China the underlying logic in energy cooperation includes keeping track of the latest developments in energy and related technologies and importing applicable technologies in exchange for granting market access to European companies. China however only selectively embraced Europe's normative influence promotion. Through cooperation, China wished instead to secure European support for its own increased role in international energy institutions as well as for other developing countries.

Traditionally, the funds used for the implementation of China-EU energy cooperation projects came from one source. European funding covered expenses for energy policy dialogues, Chinese experts visiting European countries, European energy demonstration projects in China. China only provided limited funding for those activities.

Both China and the EU have issues in internal coordination

Throughout history the basic process of energy cooperation between China and Europe took place as follows: the EU provides the basic policy framework and uses its administrative funds to enable its energy, environment and trade agencies to negotiate with China's relevant government agencies in China. This negotiation process helps translating concepts into projects leading to their eventual implementation. EU Member States on the other side have their own bilateral channels of cooperation with China while selectively paying attention to the EU's initiatives.

In the process, China has not come up with a governmental mechanism to coordinate energy cooperation with the European side. Initially, the ministries of science and education played a leading role in relating to the European side. As European interests in China diversified, the relationship between the government and enterprises started to change in China and the National Development and Reform Commission and Ministry of Commerce have come to play a more active role.

The two sides also saw a multiplicity of non-governmental actors interested in governmental cooperation initiatives. Entities like the European Chamber of Commerce in China now play a more active role in identifying suitable state-owned and private Chinese companies for implementing cooperation projects. But the level of matching between Chinese businesses and relevant government agencies is not even. As a result, the process from the signing of memorandum of understanding by government agencies to actual project implementation is long and complex.

For European energy corporations, China is but one of the many choices worldwide. They are under no obligation to follow government-to-government cooperation agreements. In Europe, the nature of the relationship between the government and corporation is the free market, while in China the government sometimes has an important impact in corporate choice of action. As a matter of fact, in some of the EU Member States, surveys have found out that many institutions and experts do not see obvious benefits in government energy cooperation initiatives. Some even openly question the relevance of governmental memoranda of cooperation. On the Chinese side as well, more and more companies are choosing to relate to their European counterparts, without having to wait for government support or endorsement.

Difference in cooperation targets and methods between the two sides in business-to-business relationships

Some European entities find their Chinese counterparts solely interested in demonstration projects; whereas the European side is more interested in transforming demonstration into commercial projects, without which it is increasingly difficult to find domestic support. Over the issue of technology transfer, the Chinese side tends to favour acquiring the most advanced technologies, while the European side tends to focus on the level of applicability of certain technologies especially in second and third tier cities across China.

Width and depth of the cooperation remains to be developed.

Currently the most active areas for business-to-business cooperation are fossil energy development, nuclear energy development and management, equipment manufacture and trade. Cooperation in the field of renewable energy development remains relatively limited. Geographically, projects are mainly located in the Middle East, Africa and other regions. Projects which are within both sides' territorial scope — especially in Europe — are very limited. Central Asia has huge energy development potential yet very limited cooperation has been achieved.

Intellectual property rights issues still to be addressed

In the process of cooperation, European enterprises are focused on protecting their intellectual property rights and expect China to provide the same level of protection as they receive in Europe. Given that China is currently developing from a planned economic system to a market economy citizens are still lacking intellectual property awareness. Therefore the EU and China should strengthen communication and dialogue, in order to further improve China's intellectual property awareness.

Further structural issues

There are a number of **structural causes** for the state of affairs in China-EU energy cooperation.

Firstly, at the governmental level, both sides see the necessity to continue promoting energy cooperation between them. On the other hand, cooperation frameworks guided by rational thinking have to win support from a variety of corporate and societal actors to bear fruits. Inevitably, different actors evaluate the benefit of cooperation based on their respective self-interests, which in turn are not always in line with those envisioned in governmental-level cooperation frameworks.

Secondly, significant gaps, even fundamental differences continue to exist between China and the EU in cultural, economic and political systems, 40 years of continual, multilevel and intensive interactions notwithstanding. These differences are set to continue, as China and the EU both have a high degree of self-confidence in their respective choice of paths for social and economic development. However, the acknowledgement of such differences is not meant to invalidate the necessity for further cooperation. Rather, it should drive both sides to search for more smooth pathways of cooperation in the future.

Thirdly, sufficient funding is essential for the implementation of an energy cooperation project. In the past the European side contributed a larger share of the funds needed through its development assistance programmes. Now, with the aggregate size of the Chinese economy increasing, many in Europe believe it is time to graduate China from its list of aid recipients. As a result, the Chinese side needs to be more proactive in finding the funds so as to keep the momentum of energy cooperation with Europe going.

Fourthly, communication between China and European companies needs to be enhanced. Better communication mechanisms could help deal with divergences on targets and methods. This would enable reaching solutions commonly.

Finally, some projects fail to identify and work with appropriate partners. Some business-to-business cooperation initiatives take place under government frameworks and are therefore not based on several rounds of negotiations. In some cases this results in an unsuitable partner choice for the projects.

2.3.2 Suggestions

In consideration of the above-mentioned factors, the following measures are suggested:

1. Maintain the existent frameworks of China-EU energy cooperation at the governmental levels.
2. Set up a joint funding mechanism to enable the transformation of concepts of cooperation into specific projects.
3. Enhance inter-ministerial coordination, on both sides, to smoothen the process of cooperation.
4. The Chinese and EU sides should consider expression of interests from the non-governmental sector and produce a list of specific topics for the counterparts to select from.
5. Explore ways for commercial banks to partake in sharing the financial costs in technology demonstration and joint development of new energy technologies
6. Produce reports and analyses of China-EU energy cooperation. Publicise those reports and findings, as a way to address scepticism about the effectiveness of cooperation initiatives.
7. Work on cultural, social, political and economic differences, enhance communication and focus on a more appropriate choice of partners, especially on the impacts of market mechanism.

2.4 China-EU Cooperation Models

This section provides an overview of common EU and Chinese inputs on the various cooperation models identified together and including: Policy Dialogue, Capacity Building, Scientific Research, Technological Demonstration Projects, Market Development Projects, City Twinning.

The analysis provided in this section is based on a comprehensive data collection process carried out by means of a workshop[2] , a survey and interviews with Member States and European platforms[3].

The purpose of this exercise was to collect unique insights on how they assess the various strengths and weaknesses of specific cooperation areas. These areas have been pre-determined on the basis of their relevance for both the European and Chinese side.

The assessment of the cooperation models is based on stakeholders' experience and contributes to informing the formulation of recommendations for the future of the cooperation.

2.4.1 Policy dialogue

The EU-China energy and energy-related dialogues are one of the main pillars supporting EU-China energy relations. The dialogue provides for regular meetings between European and Chinese officials and relevant stakeholders. It is a key vector for political cooperation whilst a practical impulse to the relation by initiating common cooperation projects. Over the years, the energy dialogue has grown both in relevance and in substance, creating synergies between the most pressing challenges in Europe and China as the most recent example of the urbanisation and smart cities dialogue shows.

STRENGTHS

The dialogue is largely understood as a key **engagement and exchange mechanism.**

- The policy dialogue provides a platform as well as mechanisms such as periodic meetings to foster high-level contact and communication between Europeans and Chinese energy officials.
- The dialogue opens a channel for information and communication between high-level officials on energy and it also provides a framework for institutionalised cooperation based on common interest. It thereby constitutes an essential tool for political involvement, agreement and support on cooperation issues.
- The dialogue also provides opportunities for both sides to share and exchange at policy level on the implementation of policies.

[2] *EU-China Energy Cooperation, Doing better Together, Review Session* at EC2, 16th July 2014.

[3] In total around 36 stakeholders have been contacted - the 28 Member States and the 8 European platforms - with 11 returned questionnaires and 4 interviews conducted.

- It is also a "starter" for new areas of high-potential co-operation as well as raising awareness on specific issues of concern.
- For many years, the energy dialogue has played an important role in significantly expanding the energy cooperation and related sectors such as exemplified by the Partnership on Urbanisation and the cooperation on Smart Cities. In some cases, such as with the Industrial Energy Efficiency dialogue, the dialogue is even exclusive to the EU-China relation.

WEAKNESSES

The dialogue has been partially **lagging in realising its potential.**

- This includes the proliferation of sectoral dialogues, which is not always matched by financial resources; a lack of reactivity in grabbing arising cooperation opportunities and the difficulty in exploiting the closer links it provides in a strategic way. Also platforms are not used to their maximum potential such as being used as a jumping board to establish cooperation.
- In spite of the dialogue's key role in bringing both parties together, the dialogue does not always deliver on effectively facilitating the cooperation. It does not always bring in the best available expertise and it does not either always guarantee a sufficient sharing of information. This in turn prevents overcoming lacking agreement on objectives, as does the big difference in respective administrative systems

RECOMMENDATIONS

Reaching a common vision – The policy dialogue is a prime co-operation and communication channel, which is very good at establishing common cooperation interests and projects whilst ensuring the necessary political support. In order to improve this potential in concrete results, the focus should first be on ensuring each dialogue is based on creating a common vision and motivated by shared or compatible objectives.

Providing the means – Endowing the dialogues with adequate resources would enable them to be operational and deliver on practical results. Although not every dialogue is to be equally supported, some form of rationalisation should be accomplished.

Making the most of the dialogue – In order to remain relevant and have impact, more flexibility in being able to act upon co-operation opportunities arising would be crucial. This in turn would substantiate the political dialogue with relevant achievements further nurturing the political ties and creating a dynamic cycle of cooperation.

Creating appropriate conditions – Committing to the provision of the most relevant experts as well as tackling from the start issues of compatibility between European and Chinese administrative systems should be made a priority. Identifying the most relevant counterpart on each side to be the lead in charge of federating other relevant European or Chinese stakeholders would be one option as well as having a Brussels-based coordinator for sourcing the best expertise.

2.4.2 Capacity building

Capacity building is a central aspect of energy cooperation and especially in the field of low-carbon economy transition. Looking at past initiatives between the EU and China, capacity building is largely present in many of the common projects between Europe and China. It contributes to a partnership-based approach and more importantly it encourages the development of ownership of practices and knowledge.

STRENGTHS

Capacity building appears to be a particularly **active field of co-operation with reciprocal interest** and with a real **impact**.

- Capacity building cooperation with China has been conducted in a variety of areas such as policy formulation, industry regulation, construction and consumption, grid integration, energy efficiency standards and other aspects in the energy field with a batch of dedicated platforms, centres and activity projects conducted.
- These initiatives have not only promoted the transformation and practical application of advanced technologies on both sides as well as having improved the capacities and application level of professional tools by Chinese energy professionals, but they also contributed to spreading European expertise and experience in the field of energy.
- Capacity-building activities are also complementary and mutually reinforcing with policy dialogue.

- Altogether capacity-building cooperation has contributed to deepening the partnership.

WEAKNESSES

The success of capacity-building activities **needs to be better organised and followed up**.

- Organisation, timely tracking and feedback, follow-up of projects and providing adequate resources is very important for the success of capacity-building activities.

RECOMMENDATIONS

Mainstreaming – Capacity building appears as a clear strength in the Europe-China energy cooperation and calls for making — when appropriate — capacity building a more regular feature of cooperation projects, especially since it tends to further substantiate the political cooperation.

Building on the momentum – The relevance of capacity-building initiatives for the cooperation is to be acknowledged and acted upon with a more systematic follow-up. A possibility would be building up on the mutual interest for further cooperation and providing relevant resources for EU-funded projects to deal with the demand.

Understanding the impact – More systematic collection of feedback from participants would lead to a better understanding of the impact of capacity-building activities. Having such an overview would allow future activities to build on the results of past experiences and to offer relevant activities.

2.4.3 Scientific research

Research and development is to play a major role in developing cleaner and safer energy solutions and is therefore relevant for creating sustainable energy futures. Not only does the European Union and its Member States have similar priorities as China in this field but also they actively cooperate in this field. It can be concluded that energy is an area offering a high potential of EU-China R&D cooperation.

STRENGTHS

Scientific research is a very **active area of cooperation**.

- A majority of EU Member States and EU platforms have established research projects with China so as to contribute to joint energy technology innovation and development in China and Europe. Sustainable energy is the most developed area of cooperation together with nuclear energy.
- The positive record applies to the good level of research performed in laboratories as well. This applies in particular to the field of combustion and energy efficiency experimental equipment.

WEAKNESSES

So far, there has been in some instances a **limited use of potential** in scientific research cooperation with **changing participation conditions** to EU programmes affecting cooperation modalities.

- The energy research cooperation is relatively recent compared to other types of cooperation.
- The reduction of the financial support for Chinese partners in the Horizon 2020 Research Programme is a constraint for Chinese participation in the programme.
- Chinese partners participating in European calls tend to be appointed by the Government.
- In spite of the various cooperation initiatives created, in some cases this does not prevent from a poor record in scientific cooperation.
- The method based on setting up experts' teams under cooperation projects does not seem conclusive enough. Both China and the EU have leading energy research institutions. In China, the Energy Research Institute (ERI) of NEA is the NDRC responsible for energy research. It is believed that if the EU and China can establish a bilateral expert team this will help the two sides to strengthen cooperation in the field of energy.

RECOMMENDATIONS

Exploiting mutual interest more effectively – Energy is the second most important area of cooperation between China and EU Member States. Energy and energy technology is also a priority in the EU's research strategy. Making the most of the convergence of interest — especially in sustainable energy — would ensure exploiting best such strong mutual interest.

New permanent institution focused on energy research – An expert-led mixed institution focusing on energy issues should be established. It would be led by a European and Chinese director, in turn. Secondly, a China-EU energy cooperation research fund should be established.

2.4.4 Technology demonstration projects

Next to largely converging agendas and goals on energy, technological demonstration projects are key to bringing EU expertise and know-how to China by implementing it to the Chinese context. Such projects have been a regular feature of EU-China energy cooperation and have contributed to bringing together policy makers but also businesses on both sides.

STRENGTHS

Cooperation on technological demonstration is characterised by **practical, result-oriented projects**.

- Technological demonstration projects are relevant for EU-China cooperation as proven by the concrete projects taking place between Member States and EU platforms with China.
- The construction and implementation of such projects enable the EU to provide advanced experience and technologies to China and attract the participation of policy makers and businesses from stage one.
- Demonstration projects are appreciated because they enable to showcase the adequacy of a technology for the Chinese case whilst providing European expertise.
- In terms of outcomes, shared interest in co-creation leads to practical and useful results such as product co-creation, as is particularly the case in the Smart Cities project.

WEAKNESSES

- **Adequacy and common rationale** has sometimes been lacking together with achieving **impact**.
- Not always has the right technology been introduced to the right problem.
- Sometimes it is also difficult to move from a pilot to the industrialisation phase.
- Underlying some of these issues is a limited common rationale with the EU tending to stress the business opportunity whilst China is more drawn to going down the cooperation project path as well as a too strong focus on technology as opposed to performance.
- In terms of impact, the high cost of technology demonstration and the dispersed nature of demonstration projects are further limits to achieving tangible results together with the lack of systematic combination between technological demonstration projects and the relevant regulatory dialogues.

RECOMMENDATIONS

Mutually beneficial projects – Technological demonstration projects still need to prove mutually beneficial, with on the one side an emphasis on technology, which does not always match the focus on industrialisation and application on the other. Agreement from the start of a project on a fair exchange of technology against possible industrialisation would be a way to combine both approaches.

Combining with regulations – Technological demonstration projects need to be combined with regulatory dialogue to be impactful.

Optimised impact – For best results, linking when necessary technological demonstration projects to policy dialogue would be beneficial as well as up-scaling projects to match the Chinese context.

2.4.5 Market development projects

When talking about energy and sustainable energy in particular, the commercial aspect cannot be put aside. Both the EU and China are striving to be green economies, giving rise to a large potential for common market development projects. The EU is one of the world's front-runners in clean technology — with some of its Member States being world leaders in sustainable technologies — and China is seeking solutions to its low-carbon development path developing its large market and companies in the sector. Common opportunities are ripe and will become even more relevant to the EU-China cooperation in the future especially in view of the changes in the cooperation modalities.

STRENGTHS

There is a **positive record** in market development cooperation and **business involvement**.

- Business-to-business cooperation between European and Chinese businesses and state-owned enterprises is dynamic and multi-faceted.
- Member States make the most of their strengths in sharing professional knowledge and experiences. This is es-

pecially the case in the field of sustainable energy and nuclear energy.

- European platforms have also been active in engaging businesses and involve them in policy issues, reflecting the altogether more business-oriented trend of the cooperation.

WEAKNESSES

Access to the Chinese market is considered an issue for the EU.

- On the flipside, the European stakeholders have reported difficulties in entering the very large Chinese green product market.

RECOMMENDATIONS

Creating win-win partnerships – The convergence between European and Chinese agenda on sustainable energy development is striking. With EU and China's large and different offer of products and services and large demand market development, prospects are very good. There is yet a disconnect between the opportunities and the actual realisation, which would require better access to an open and transparent energy market. The shifting nature of relations towards a more trade-oriented partnership could be used to redefine some of these aspects of the cooperation.

2.4.6 City twinning

China has turned its current urbanisation challenge into an opportunity. China has developed an integrated approach to urbanisation and sustainability and shown political commitment to apply new sustainable solutions to the issue. Considering the EU own experience in the subject matter and both sides' highest commitment to the issue, urbanisation has become the latest of energy-related cooperation fields. Moving the action to the most relevant level, European and Chinese cities have been given centre-stage in this cooperation. European and Chinese cities cooperate directly together, exchanging experiences and best practices thereby redefining the way international cooperation is led.

STRENGTHS

City twinning creates **practical outcomes** out of their cooperation.

- The *EU-China Urbanisation Partnership* started in 2012 and provides a ground for cooperation of 12 pairs of cities on urban development and low-carbon planning. At present, both sides have conducted cooperation in the field of low-carbon city, smart city, new-energy cities, low-carbon planning, etc., created a batch of joint projects involved with enterprises, which indicates a good start for cooperation of a large scope in the future.
- The city matching provides short cuts in learning/implementing innovative procedures, through the exchange of good practices at local level, such as the methodologies for developing the Sustainable Energy Action Plans.
- This cooperation among cities (such as low-carbon cities, smart cities, new energy cities) offers more than the usual matchmaking and provides a sectoral basis model of cooperation.
- They also constitute a platform for companies, industries, clusters and universities to work together on realistic and practical outcomes.
- The perspective of a practical outcome and the platforms stimulates more dormant city partnerships.

WEAKNESSES

City matching is an **opportunity for European businesses and cities that still needs to be tapped.**

- In many instances, the lack of cities' capacities stands in the way. There is a lack of political and financial drive in some of the partners. In some cases, cities are more interested in the prestige of participating than in transforming the partnership in an active cooperation.
- European cities are directly confronted with sustainability problems and have long-lasting experience in tackling them, forcing them to look for the most innovative sustainable solutions. Sharing valuable European experience with Chinese cities should be used in a more business-oriented spirit as an entry point for European products and technologies in the Chinese market.

- In some cases, EU cities are interested in developing specific collaboration, in conjunction with their industrial systems, while Chinese cities are looking for European investments, more than solution oriented collaborations.

RECOMMENDATIONS

Building further on the results achieved

Incentivising cities – City twinning is an innovative approach to energy cooperation, which benefits of strong Chinese political backing as well as good institutional support. Opportunities to cooperate are therefore manifold yet the potential needs to be made clear to cities, which often struggle with their capacities and thus focus on their immediate day-to-day activities.

Cities platforms – Creating groups of cities with ambitions exchanging knowledge and experiences on policies implementation, infrastructure measures is a powerful tool for the EU-China collaboration and gain of experience.

A pathway for companies – Pointing at the benefits of involving local businesses and using city twinning as a channel for them to get in touch with each other and work on common products or solutions would serve as a clear incentive and associate the business communities at the same time. In addition, the cooperation on business clusters for low-carbon development in both sides.

Building on synergies – Europe's experience in coordinating 28 Member States could inspire future cooperation as it can be relevant to China and its regional diversity such as in the overall planning of grid infrastructure.

Key Areas and Goals of Future China-EU Cooperation

There are prospects for more wide-ranging energy cooperation between China and the EU with a view to strengthen the cooperation and improve its efficiency. Key areas for the future of China-EU energy cooperation have been identified in the fields of Energy Supply, Energy Demand and crosscutting aspects.

3.1 Energy Supply

3.1.1 Fossil energy

CHALLENGES

At present, with the continuous depletion of fossil fuels and changes in the global energy pattern, China and the EU face some same challenges in the field of fossil energy supply.

Firstly, the limited fossil energy supply capability results in general shortage in the supply of global energy, leading to an increasingly intensified energy competition. On the one side developed countries are locked in a high energy and resources consumption pattern whilst developing countries are industrialising and modernising at an increasingly rapid rate. This leads to the continuous increase in energy needs next to the tightened supply of global energy resource. The strategic and political nature of energy resources become more prominent, resulting in increasingly intensified competition on energy resources.

Secondly, fluctuations and risks of energy market are increasing. The tightening international energy resources in the long run affect international security, especially in the Middle East, which is one of the main oil-producing areas. In addition, the eco-environmental standards of energy production are continuously rising, leading the price of fossil energy to fluctuate in recent years. The continuous reduction in energy price during the present year further explains the scope of the fluctuation and the wide range of the influence.

Thirdly, China and the EU's high foreign dependence on fossil energy sources has influenced global energy security. China and the EU are important players of the world's energy consumption with a total amount of energy consumption accounting for a third of global consumption. Oil consumption of both the EU and China together accounts for about one quarter of the world's entire oil consumption. In 2013, it is estimated that China's foreign oil and natural gas dependence is up to 58.1% and 31.2% respectively[4]. In 2012 the EU's foreign dependence on solid fuels (including coal), oil and natural gas was respectively 42.2%, 86.4% and 65.8%[5]. For China and the EU such a high dependence results in risks. For example, the Strait of Malacca is an important channel for China to import oil, but the situation of the region is often in turmoil. For Europe the change of relationship with Russia bring also relatively large uncertainty to its energy supply.

OPPORTUNITIES

At the same time, China and the EU share a number of opportunities in terms of energy supply. Firstly, the development of new types of fossil energy such as shale gas has effectively expanded the scope of development and cooperation on fossil energy.

Secondly, America's "energy independence" will bring great change to the global energy pattern with China and the EU becoming the main buyers in the global energy market with an increased bargaining power.

Thirdly, the improvement in fossil energy utilisation efficiency and the development of clean technologies has greatly reduced the environmental pressure from fossil energy supply. This is however far from having been fully realised today.

Fourthly, cooperation on fossil energy supply is in the interests of both sides. Reducing damages to the environment by providing good-quality fossil energy and decreasing the mining of small coal mines is conducive to improving local environmental quality and obtaining public support.

COOPERATION GOALS

Energy crisis prevention and management

- Establish an energy crisis related management platform.
- Promote mutual understanding and strategy coordination.

Formulation of fuel standard

- Formulate common fuel standard and continuously improve it.

[4] Energy Research Institute of NDRC.

[5] Source-http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Energy_dependency_rate,_EU-28,_2002–12_(%25_of_net_imports_in_gross_inland_consumption_and_bunkers,_based_on_tonnes_of_oil_equivalent)_YB14.png.

Reduce the environmental impact of coal mining

- Conduct joint land restoration and cooperation on technology application
- Promote carbon capture and storage.

3.1.2 Renewable energy

CHALLENGES

Technologies and economic efficiency are still the most fundamental problem that needs to be solved for the development of renewable energy. In recent years, renewable energy technologies have experienced rapid advancement, with economic efficiency significantly improving. Nevertheless, the current technical level and industrial capacities of most renewable energy industries — apart from hydropower and solar water heaters — are still in a growing stage, with high development and utilisation costs, combined with uneven distribution of resources, small market size and difficulties achieving continuous production. As a result renewable energy may still lack competitiveness under current market conditions. Policies supporting further development should therefore be provided to make renewable energy the standard, competitive energy source.

With their development capacity increasing, renewable energy faces constraints in availability of resources, grid connection and energy storage capacity. Due to the expanded utilisation of renewable energy, the low-hanging fruits are usually exploited first leading to more difficult resources conditions in subsequent projects. The further expansion of scale can enable grid constraints to be enhanced and electricity infrastructures to become important for renewable energy. Further development of energy storage technologies may support the speedy utilisation of renewable energy.

OPPORTUNITIES

Both sides attach importance to the development of renewable energy and treat it as an important measure to improve energy security and promote sustainable development. Therefore cooperating in the renewable energy field is in line with the wishes and interests of both sides. China and the EU have proposed goals for renewable energy development and formulated a series of supporting policies. Chinese Government proposed that by 2020 the proportion of non-fossil primary energy should reach 15%. The goal of renewable energy development of the EU by 2020 is a 20% share of renewable energy in the total energy use.

Renewable energy has become a major part of energy investments in many countries. China and the EU therefore both face a broader international market. Other than China and the EU, some emerging countries in Asia, Latin America and other regions are also vigorously developing renewable energy. In this broad international market, China and the EU have extensive room for cooperation.

China and the EU have formed a good foundation for cooperation. Both have experienced a series of cooperation and exchange projects in the field of renewable energy, and the cooperation between China and European Member States has also been deepened.

Finally the cooperation is conducive for each other to open markets and increase competition leading to decreased costs for renewable energy technologies. This helps accelerating the introduction of new technologies and new processes in the equipment manufacturing and project development, thus promoting the development of renewable energy.

COOPERATION GOALS

Reduce the cost of renewable energy

- Explore market access through increased shares in each other's markets.

Develop distributed power generation

- Promote the development of distributed energy in less developed and undeveloped regions through cooperation.

Develop combined heat and power (CHP)

- Promote mutual learning between Chinese and European policy makers and implementers through exchanges of experience of CHP based on renewable fuels.
- Facilitate infrastructure and markets for district heating and cooling.
- Conduct CHP project through joint efforts.

Develop the transmission system

- Speed up the development of ultra-high voltage power transmission and expand the scope of the electricity market.
- Strengthen China-EU energy cooperation in Central Asia and Eastern Europe.

China-EU trade in electricity

- Carry out China-EU dialogue in the field of electricity trade and establish a platform and mechanism for exchange and cooperation of China-EU transcontinental electricity trade.

3.1.3 Nuclear power

CHALLENGES

Nuclear power safety problems are still some of the main issues as recently exemplified by the Fukushima accident. Nuclear power safety management is the top priority for nuclear power in the future.

The treatment of nuclear waste is not only a technical matter but also a social problem. With the continuing operation of nuclear power, the importance of nuclear waste increases.

Finally even though several European countries are reducing their dependence on nuclear power, some are likely to continue using nuclear power ensuring continued interest not only in waste issues but also in reactor safety development.

OPPORTUNITIES

Europe has the most mature areas of nuclear power development, and China has a vast market of nuclear power indicative of a bright future for nuclear power cooperation. Both in China and the EU nuclear power will continue to be an energy source in the coming years. Nuclear power has to evolve safely and efficiently. China plans to reach by 2020 an installed capacity of nuclear power of 58 million kilowatts, the same capacity as the EU by then.

Secondly, China and the EU have good foundation for cooperation with very active links between Chinese and European companies.

Lastly, the development of third-generation nuclear technologies improving the safety and economic efficiency of nuclear power will support the development of nuclear power, while providing room for China-EU cooperation.

COOPERATION GOALS

Nuclear power safety

- Carry out exchanges of ideas and experiences at multiple levels of governments, enterprises and the public between China and the EU.

Nuclear crisis management

- Establish a mechanism for communication on nuclear crisis management plans.

Nuclear waste management

- Hold seminars and strengthen publicity, to broaden the horizon for long-term management of nuclear waste.

3.2 Energy End-Use

CHALLENGES

China and the EU are facing a common challenge of being highly dependent on external imports of oil and natural gas, which is difficult to change in the short term and even more difficult to predict under the current world situation with existing uncertainties in global international relations. It can be predicted that once problems occur in the energy supply, i.e. a "gas break" in the EU, or China gets an "oil break" no doubt it will cause unbearable pressure on China's and the EU's economy and society in general.

The challenges faced by China in energy needs lie specifically in three major areas. First, the global climate change has unprecedentedly increased China's pressure on reducing carbon emissions. Second, the increasingly prominent energy security and energy environmental issues increase the difficulty in solving this problem in China. Third, the situation of promoting the energy transformation is very severe, aggravating the urgency of a solution. Thus, quickening the resolution of conflicts between energy demand and supply through innovation is a tougher, more arduous, and more imperative task, in particular for China.

The energy is not consumed but, instead, it is converted from some natural or primary forms (fossils or renewable) into other final or commercial forms until the final usage stage in which energy provides different services. Therefore, the impact of the use of energy is related both with the nature of primary energy and with final uses. For instance, the potential of solutions of 'district heating/district cooling' based on natural gas can be justified from the CO_2 emissions and the environment point of view at large as the technology of co-generation commonly used in those cases is obtained with the highest efficiency and therefore less pollution for the same final energy service. That is a matter of option among the different appropriate technologies bearing in mind the type of service and the energy sources available and the irrespective environmental impact.

Yet, many needs can be better focused and confined as the real ultimate needs either at the level of the design or of the use.

China and the EU are both facing that type of challenge. In the EU case (even if under different political authorities), there are different levels of economic development and climate differences among Member States.

China has considerable needs to cope with its expanding economic growth. Therefore, strengthening the management of energy demand is key in China energy strategy. This implies minimising the energy needs (sufficiency) focusing on urban and production activities planning, improving the efficiency of the energy conversion and utilisation from the energy resources to end use.

OPPORTUNITIES

The EU has a wealth of experience in the demand-side management of energy, promoting "energy sufficiency" and improving energy efficiency. Furthermore, Europe has long-standing experience on the recognition of the user role as the centre of the energy value chain, which allows linking the demand to appropriate energy supply and bottom-up decisions at different layers (citizens, urban planners, city managers, industry, transport and mobility operators).

China's energy consumption per unit GDP is relatively high, so it has great energy-saving potential in production, conversion and use of energy.

Learning the advanced demand-side management and energy efficiency management experiences from Europe is of great significance for China to reduce energy consumption and reduce emissions in the future, also it is a big opportunity for the future development of European companies to develop and apply the advanced European energy management concepts and technologies in China.

The EU is an important player in the world in promoting global greenhouse gas emissions reductions and the development of new energy technologies, with extensive experience in optimising energy structure and reducing greenhouse gas emissions and developing low-carbon economy, from which China has a lot to learn in promoting technological advancement, facilitating market development, establishing development goals, and building incentive systems, etc. For example, the EU aims at reducing greenhouse gas emissions by 80% by 2050, on the basis of that in 1990. The "Energy Strategy 2020" (2010) presented the "three 20%" programme objectives: reduce emissions by 20% and decrease the energy consumption level by 20%, meanwhile make the share of renewable energy to achieve 20% of the total energy consumption by 2020. To achieve this goal, the European countries actively promote energy sufficiency and efficiency innovation in the fields of transportation, building and industry. Practices, such as reducing the energy needs by improving sufficiency and efficiency, are definitely worth learning and adopting for China.

China-EU energy cooperation priorities are to reduce the energy demand and reduce carbon emissions and pollution discharge by strengthening the energy demand-side management, improving energy sufficiency and efficiency, through technologies and other measures.

They mainly focuses on the following three fields:

a. Transportation and mobility. It focuses on two approaches: a) the confinement of the logistic needs of transportation and mobility exploring the best options for lower energy demand in load transportation and for mobility, reducing vehicle emissions pollution; and b) promoting electric and soft mobility solutions.

According to China's "Energy-saving and New Energy Vehicle Development Plan 2012-2020", the cumulative production and sales targets consists of 500,000 new energy vehicles by 2015, and 5 million by 2020.

In view of this, China should strengthen with the EU its technical cooperation, research & development of key components, like batteries, motors, electric control, etc.; step-up pilot demonstrations, commercial operations and market promotions of pure electric vehicles, plug-in hybrid vehicles, fuel cell vehicles of both sides; strengthen cooperation on establishing electric vehicle charging infrastructure standards, such as cooperate with EU companies in the field of energy efficiency and sustainable energy development to jointly build the charging infrastructure, promote enterprises of both sides to open sales markets in the other side, in order to promote and popularise electric vehicles; strengthen the collaborative research demonstration projects on interaction between electric vehicles and smart grid, and jointly promote the research and development of smart grids, internet of cars and other technologies related to electric vehicles.

b. Buildings. China should fully take reference from the EU's advanced experience in building energy conservation. Statistics show that the energy consumption of buildings constitutes the largest share of the EU's energy consumption. The EU has approved the "EU Energy Performance of Buildings Directive (2002/91/EC)" in December 2002, and the EU Member States have implemented the new measures for building energy saving in January 2006.

China is in the acceleration process of urbanisation. In view of this the introduction of the EU advanced building energy technologies is meaningful to control the rapid growth of energy consumption in end-uses. China and the EU should strengthen cooperation in the innovation of market-oriented operation mode for building energy saving, including: strengthening the cooperation on building energy saving technology, such as technology exchanges and cooperation on synthetic utilisation of multiple energy sources of building, distributed micro power grid, key technologies on heat pump of air source, water source and ground heat source used for buildings, passive house technology, etc.; strengthening exchanges and cooperation on market-oriented energy-saving financing methods like building contract energy management, etc., as well as promoting the implementation of building energy efficiency projects in both sides, etc., so as to promote the building energy efficiency of both sides.

c. Industry. Iron and steel, cement, nonferrous metals, oil refining and chemical industries are the pillar industries of China's national economy, and their energy consumption accounts for 70% of the total energy consumption. Therefore, the acceleration of industrial energy efficiency improvements, the introduction of key industrial energy-saving technologies and the promotion of alternative fuels in industrial processes are the inevitable choices for China's industrial energy-saving strategy, which presents a great potential in market development in the future.

The EU has advanced technologies and management experience in energy efficiency in the industrial sector, and in other fields.

Based on this, the establishment of EU-China cooperation agencies should be encouraged to strengthen technology exchanges on energy saving; EU-China's joint research and development of internationally advanced energy-saving technologies should be supported to improve industrial energy efficiency.

Enterprises of both sides should be supported to apply the outcomes of China-EU's joint research and development, conduct feasibility studies, and promote R&D projects on the industrialisation of technological achievements. Enterprises of both sides should be supported to strengthen exchanges and cooperation on advanced technologies, and should be encouraged to apply technological innovation, to enhance the R&D levels of both sides, and to promote the development and application of promising R&D projects.

COOPERATION GOALS

The goal of the EU-China energy cooperation is to balance energy end-use and supply by improving energy demand management, while improving energy efficiency.

Energy demand-side management

- Share energy demand planning, management methods and tools, and promote the improvement of energy demand management related policies.
- Realise market-oriented energy performance contract development.

Improve energy efficiency

- Promote energy sufficiency targets and good practice through cross-fertilisation of the sufficiency concept implementation in various domains.
- Align energy efficiency standards for buildings with the EU's average levels, on the basis of building functions, climate and the comfort levels.
- Promote harmonisation of energy labels of equipment and appliances.
- Develop large-scale energy-saving projects, namely at the cities level, and establish new mechanisms for market and demand-side management.

3.3 Crosscutting Fields

3.3.1 Energy regulation

CHALLENGES

The European market-oriented reform of electric power is an important element in Europe's energy management. The EU leads the development of power market orientation and integration of power markets between countries. Several key measures have contributed to that. The EU successively enacted an electricity sector reform in 1996 and put forward a roadmap for the power sector reform. The EU also provided an institutional and regulatory background, introduced a mechanism for competition in power generation and sales, established a system of dispatching, set up institutions for energy cooperation, enacted transparent rules for connecting to the power grid, promoted the integration of the electricity grid and the opening and integration of energy markets among Member States. On February 4, 2014, 4 power exchanges and 13 electricity transmission system operators in the EU realised day-ahead market joint trading for the first time, covering a total of 15 countries and accounted for 75% the total European power demand. This signalled the achievement of the power market-oriented reform and the establishment of a unified power market. The European experience indicates that the expansion of market area increases the number of market players, enhances competition, increases the efficiency of resource allocation, promotes security of power supply and increases the ability of the system to integrate clean power.

OPPORTUNITIES

In recent years, renewable energy in China witnessed a rapid development of scale. The ability of the grid to integrate renewable energy has become a major bottleneck, limiting the development of renewable energy in China. The Chinese Government unveiled policies and measures to promote the uptake of renewable energy by addressing the bottlenecks in the power grid. However, further efforts could be made to ensure the scaling up of the development and utilisation of renewable energy in China. There is an urgent demand for cross-regional resource optimisation and allocation. China needs to establish a nationally unified power market as soon as possible. It is therefore an urgent task to promote the reform of the power market, to establish a market mechanism adapted to the development of clean power and to boost the development of renewable energy.

To promote the development of the energy management industry, the fiscal department of the Chinese central government established a financial incentive mechanism for energy performance contracting. In 2011 the NDRC released a registration system of energy-saving service providers. Under this system, only registered energy-saving service providers are eligible to apply for financial incentives for energy performance contracting. It is on this basis that the companies included in the registration list will receive support from the national subsidy policy for energy saving. By June 2013, 3,210 energy-saving service providers had been recognised by the state. Local governments and large state-owned enterprises had also made sustainable efforts in the field of energy management. However, it is generally believed that energy performance contracting and the energy management industry in China is still in its infancy.

In the past decades, energy management was one of the cooperation fields between the Chinese Government and the EU. Starting from 1984, as part of the scientific cooperation project between both sides, the EC/EU has established energy management training centres in cities such as Shanghai, Tianjin, Chongqing, Nanjing and Hangzhou. In the annual training class, most trainees are energy management personnel from large and medium-sized enterprises, government agencies and energy-saving service providers. The training class is held once each year, divided into two stages. In the first stage, namely training and learning stage at home, experts are sent from European side to China to give lectures. In the second stage, namely the inspection stage abroad, excellent trainees of the first stage are selected and sent to Europe for inspection. In 2009, the "European Energy Management Certificate" training programme of China was officially launched. All these trainings were an effective channel for knowledge transfer in the field of energy management between Europe and China.

Foreign investment involvement is one of the necessary channels for enhancing China's energy management. Especially in the medium and small cities and economic development zones and in sectors such as residential buildings, industry, transport and public buildings, foreign investment involvement is needed to establish more timely and effective energy management system and to avoid sunk costs in energy inefficient activities. This requires taking the interests of European enterprises into consideration to maintain the cooperation between China and Europe in the field of energy saving.

COOPERATION GOALS

Promoting mutual learning on energy regulation

- Build cooperation platform for energy regulation and comprehensively deepen the exchange between both sides. The focus would lie on promoting a power market structure and system adapted to the large-scale deployment of renewable energy and promoting cooperation and exchange on market-oriented energy price mechanisms, market supervision and regulation.

Exchanging policy experience on addressing energy security in a free market and fuel poverty in households

- Cooperate on tools and mechanisms to counter the undesirable effects of market forces, focusing in particular on issues of energy security and fuel poverty in households.

3.3.2 Energy and environment

CHALLENGES

In 1992, China introduced the concept of cleaner production for the first time and in 2003 enacted the *Cleaner Production Promotion Law* of the PRC. Though China has established a series of mechanisms beneficial to environmental management, including cleaner production auditing, ISO14000 certification and eco-labelling, further development of China's cleaner production through engineering design, investment and financing is far from being fully accomplished. Ensuring cleaner production would also enhance the operational efficiency of enterprises.

China and Europe have different approaches when it comes to environmental protection challenges. While Europe emphasises promoting China's efforts in its implementation of a series of international conventions relating directly to climate change, China is focusing more on receiving support from the EU in fields such as air pollution, water pollution, soil pollution and solid waste especially in the areas of equipment and technologies.

OPPORTUNITIES

Environmental protection will inevitably involve the energy industry with a specific focus on air pollution, water pollution, solid waste, and biodiversity protection. The process of exploitation and final use of energy directly influences the local environment and the industrial competitiveness as well as the national contribution to global efforts for the protection of the environment. Cleaner industrial production is an essential element for reaching the double goals of meeting energy demand and protecting the environment.

Eco-design is cultivated in the EU in all sectors of the economy. It provides a better quality of products and goods, avoiding waste and pollution. It leads to a better quality of life, with innovative and clean products, based on closed cycles: from materials, to goods, back to materials.

COOPERATION GOALS

Mobilise the market on environmental protection

- Pursue a feasible solution to enhance China's cleaner production capacity, mobilising the market for environmental protection, equipment and mutual standards for reducing energy consumption in all sectors.

Associate energy conservation and environmental protection

- Review previous environmental cooperation projects giving priority to energy efficiency projects involving extensive environmental protection and giving privilege to replicable policies.

Jointly promote pollution prevention

- Share tools and methods for tracking and monitoring environmental pollution.
- Pursue project development and policy tools to address air pollution.
- Strengthen scientific cooperation on prevention and control of air pollution.
- Jointly establish standards for emissions monitoring for industry and energy sectors.
- Promote air pollution tracking and monitoring pilot projects.

Develop energy standards in consumer goods

- Strengthen the cooperation on energy standards for consumer goods, establishing regulations for the mutual accreditation of energy consumption levels in consumer goods.
- Increase business cooperation in eco-design, systemic design and circular economy planning at the industrial level (manufacturing, packaging, awareness and communication), and at city level (building, transportation, energy, food, land use).

3.3.3 Energy and cities

CHALLENGES

Urbanisation has become a key potential of economic development of China in the future. The urbanisation process of China is faced with challenges such as urban and rural overall development, energy saving, emission reduction and environment protection.

China has made efforts to develop eco-cities, which include a sustainable approach to energy use. However, several challenges still exist in completing some eco-cities and in scaling up a sustainable urban development approach. The understanding gained by China in the process of urbanisation, the technologies and management experience in meeting the energy demands of cities is of great attraction.

In Europe, cities have often taken a leading role in developing efficient energy systems and eco-districts.

There's a promising future and mutual benefit in cooperation in low-carbon cities, green architecture and energy saving in industry and transportation.

OPPORTUNITIES

In 2012, leaders of China and Europe released together the Joint Declaration on Urbanisation Partnership between China and Europe. In the same year, both sides jointly released the Joint Declaration of China and Europe on Energy Security. Just as Mr. Li Keqiang, Vice Premier of the State Council of China at that time, pointed out, the huge potential of deepening the energy cooperation between China and Europe lay in the combination of urbanisation and renewable energies, energy conservation and environmental protection. With the issue of these two documents, the cooperation between China and Europe officially started with the mission of promoting energy efficiency in the urbanisation process of China.

In China, local governments of cities such as Beijing, Tianjin, Shenzhen, Chengdu, Wuhan, Changsha, Weihai, Changzhou, Luoyang, Chengdu, Foshan and Shenyang show active enthusiasm in the new opportunities that can be brought by the cooperation between China and Europe in urbanisation. Under the Urbanisation Partnership a declaration scheme was applied for cities and enterprises of China to be involved into the cooperation mechanism. Such a practice was an innovation to the traditional mode of getting experience and aid from Europe. Thus, relevant local governments and enterprises of China have to develop a necessary preparation for accessing into the cooperation mechanism.

In the last decade, the Ministry of Science and Technology implemented the China-Europe energy management cooperation programme, including local and urban development project. This programme put forward the "planning guide for local sustainable development of China", and selecting seven cities as pilot projects with distinctive achievements.

The EU has contributed to the international trend of local governments becoming more involved in climate change policy making and supporting national governments in this trend. The EU has developed new planning methods, criteria and indicators for urban development, sustainable transport infrastructure and other green infrastructure, lowering GHG emissions, tackling density and accessibility for a sustainable built environment and mobility. Europe has promoted networks amongst ambitious cities and exchange of knowledge and experiences on policy implementation, infrastructure measures, public involvement and business participation mechanisms through the initiative of the Covenant of Mayors, launched by the European Commission and that now collects more than 6,000 municipalities in all EU.

Enabling a platform between European and Chinese cities to share solutions for urban energy management with the involvement of business clusters from the EU and China is a major opportunity.

COOPERATION GOALS

Optimise the cities' energy consumption

- Through cooperation with Europe, find the internal energy for China to exploit its own potential and optimise the energy consumption of cities. Therefore, it is necessary to review and assess the already implemented project cooperation; sum up the experience and lessons and take them as the foundation for optimising further cooperation.
- Based on the EU experience, jointly roll out effective policies and measures to strengthen the energy management of cities and mobilise residents to participate in energy saving and emission reduction of cities in China, including establishing solutions for energy management of cities (such as building energy efficiency and

integrated renewable energy scheme, mobility planning and transport technology scheme, smart grid and urban public greening areas development scheme).

Energy action plans for cities

- Establish methods and standards for low-carbon urban planning, making action plans for urban renewable energy, establishing joint development of EU Covenant of Mayors and New Energy Cities in China, developing an EU-China cooperation platform on this topic.
- Promote soft measures for energy saving. China laid more emphasis on a joint study about how the EU can effectively mobilise citizens to participate in the "soft" measures for energy saving and emission reduction in cities, both in construction phase and management. In particular, the appropriateness of applying the experience of Europe in the Chinese context.

3.3.4 International cooperation

CHALLENGES

Nowadays, with the bulk of global fossil fuel consumption transferred to the Asian region and the rise of China in the global energy market, China and the EU both increased their fossil energy supply from Russia, Central Asia, the Gulf and Africa. However, the historic practice of China-Europe energy cooperation, characterised by enhancing China's energy efficiency and diversification of energy supply is consistent with the common interests of energy security of both sides.

With the development of its economy, China has shown several significant and irreversible shifts in its interests in overseas energy markets. Investment of Chinese companies in the exporting regions/countries of petroleum, natural gas and coal has led to competition with European companies. Facilitating constructive competition on equal terms on open markets is thus a prime objective.

Finally China still is not fully integrated in the field of global energy cooperation. EU-China cooperation may contribute to such integration.

OPPORTUNITIES

Dealing with the frequent energy crises in the international market, reaching a steady energy supply and reducing the corresponding economic fragility are key drivers underlying EU-China energy cooperation. However energy supply exchanges between China and the EU have generally been traditionally low. Geographical factors have restricted the possibility of power trade between China and European Member States. Energy cooperation with China however was one of the most active fields of cooperation. China thereby enhanced its own energy security through cooperating with European governments and companies in areas such as energy technology development and energy management experience. Besides, the EU has always been committed to playing the role of global leader in sustainable energy and China is an indispensable agent in the global efforts of sustainable development.

COOPERATION GOALS

Improve trade and investment conditions in the energy sector

- Improve such conditions according to the principle of reciprocity in order to reduce trade and investment barriers between parties. Such reciprocity is profitable for companies on both the European and Chinese market and benefits global sustainable development.

Step up China's involvement in international energy institutions

- Take efforts and effective measures to deepen China's involvement in institutions such as the International Energy Agency, the OECD and the International Renewable Energy Agency (IRENA).
- Cooperate within the framework of the Energy Charter Treaty (ECT) on the protection of investments in third countries.

Promote cooperation in third countries and regions

- Explore opportunities to cooperate with third countries and regions in order to stabilise global supply of fossil energy.
- Explore the possibility of joint investments in third countries.
- While improving China-Europe trade and investments, explore the channels for China to deepen its involvement in existing international energy management mechanisms.

Recommendations on EU-China Energy Cooperation

Against the background of multiple challenges in climate change, environmental degradation and energy security, it is in the interest of both China and the EU to promote low-carbon development, protect the environment, jointly addressing climate change and enhancing clean energy development.

Therefore, based on past cooperation initiatives and lessons learnt by both sides, a China-EU Energy Cooperation Roadmap should be formulated.

4.1 Proposed Targets of Cooperation

OVERALL TARGETS

- Recognise that energy cooperation is a key contribution to the overall strategic partnership between China and the EU.
- Enhance mutual trust in energy cooperation and coordination in the cooperation process.
- Build mutual trust on market-related energy issues.
- Contribute to energy structure transformation and to sustainable development of global energy.
- Enhance the collaboration on Energy Supply, Energy End-Use and Crosscutting issues based on commonly agreed goals.

4.2 Recommendations on a Roadmap

2015–2020 — INNOVATIVE MECHANISM AND EXPANDED AREAS FOR EU-CHINA ENERGY COOPERATION

1. **A China-EU energy exchange and cooperation fund** should be established as well as the operation mechanism of the fund.
2. **China and the EU should establish a China-EU energy cooperation mechanism** in charge of implementing the China-EU Energy Cooperation Roadmap.
3. **Under the China-EU energy cooperation mechanism framework, China and the EU should establish separately in its own respective side an overall coordination mechanism across own departments** to attract own enterprises and research institutions to conduct full research as well as proposing detailed project list of the exchanges and cooperation. Based on this, China and the EU would implement the cooperation Roadmap together.
4. Under EU-China overall **cooperation** mechanism, a **joint platform for China-EU energy cooperation** should be established to provide services for enterprises, research institutions and the public of both sides.
5. **China-EU energy dialogues should be actively maintained** with mutual visits process at all levels and in all fields.
6. **New energy cooperation agreements** should be established between China and the EU as well as between China and EU Member States.
7. **A common** investment and financing **mechanism for China-EU clean energy, low carbon, and infrastructure** should be established to facilitate **business matching in each other's market**.
8. **China-EU enterprise cooperation in third countries** for energy resource and market development should be encouraged.

4.3 Recommendations on Cooperation Mode

Both the Chinese and EU sides should pursue innovative approaches to their energy cooperation. An important underlining rationale is to let the market play a greater role than the traditional development aid does.

The following **principles** are recommended to innovate in the modes in which China-EU energy cooperation is conducted:

1. **Both China and EU should integrate cooperation into their own domestic agenda** of energy efficiency, carbon reduction and policy innovation.
2. Both the Chinese and EU sides should **fine-tune their respective policies towards enhancing trade in energy equipment and technologies, and investments**.

3 Both sides should continue **dialoguing on topics such as geopolitical changes** in the world's energy landscapes, improving global energy governance, and more effectively addressing impacts of climate change.

China-EU energy cooperation mode should include the following three **levels**.

Intergovernmental cooperation – Make full use of existent channels of dialogue and communication between China and the EU as well as between China and individual EU Member States. Governmental-level cooperation should produce roadmaps for cooperation, provide enabling policy frameworks for corporations and research institutions on both sides to deepen their interactions. There needs to be a change from government-led cooperation to synchronisation of corporate and government initiatives.

Business-to-business cooperation – There should be a joint platform for companies on both sides to pursue partnerships. Companies should be encouraged to integrate themselves into the entire energy industry chain of the markets on the other side. Chinese and EU energy corporations should be encouraged to form partnerships in markets around the world.

Cooperation between research institutions – Chinese and European energy research institutions should engage each other in long-term research projects. Sources of funding for joint research projects should diversify to include governmental and non-governmental support. Selection of joint research projects should aim for serving the societal needs of both China and those in the EU.

4.4 Recommendations on Roadmap Implementation

Develop the Roadmap Action Plan

The Action Plan will identify the key actions and appropriate cooperation mechanisms at intergovernmental, business-to-business and research institutes level, to fully promote a multi-level cooperation between China and the EU and its Member States.

The action planning exercise will enable the attraction of interests and resources on joint actions from European and Chinese actors both public and private.

The Action Plan should have the following sections:

i. Energy Supply

ii. Energy End-Use

iii. Crosscutting

iv. Implementation and Monitoring Arrangements

For each of the sections a number of activities should be identified, outlined as follows:

a. What (description)

b. How (process)

c. Who (actors and partnership involved)

d. When (timing)

e. How much (budget and financing arrangements)

A preliminary identification of the key actions should take place based on a series of meetings/workshops with key stakeholders. The actions should subsequently be formulated in consultation with potential and actual partners. Finally the Action Plan should be endorsed by the key stakeholders. The ownership of the Action Plan and the coordination task should be clarified.

Establish a guarantee mechanism

China and the EU should co-fund the establishment of an *Energy Development Fund*, to provide capital support for related enterprises involved in China-EU energy cooperation. The Fund would provide a guarantee of capital for enterprises of both sides on the construction of energy infrastructural facilities and energy development, etc., on the principles of joint contribution, joint use and joint supervision.

Establish a platform for China-EU energy cooperation

This would be in charge of implementing a common programme of China-EU energy cooperation. China and the EU should both specify a department in charge of the energy cooperation, to integrate the cooperation across all departments, and be responsible for the implementation of specific affairs of China-EU energy cooperation.

Conduct research on cooperation

This would continuously deepen the understanding and communication on China-EU energy cooperation. Based on the re-

quirements of the Action Plan: i. conduct research on cooperation; ii. explore new fields and new ways of China-EU energy cooperation; iii. formulate a China-EU energy talent training programme, so as to cultivate various kinds of professional personnel for China-EU energy cooperation; iv. promote exchange and communication at multiple levels, regularly holding workshops on China-EU energy cooperation; v. actively facilitate project cooperation and personnel exchanges between colleges and universities and research institutions of both sides; and vi. encourage cooperation between enterprises for studying new technologies and promoting the application of new technologies. A new permanent institution focused on joint energy research and training would be beneficial.