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Sino-Swedish Eco-Innovation Collaboration

Towards a new pathway for shared green growth opportunity

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Executive Summary

Emerging economies are of growing strategic importance for innovation and economic development in OECD countries. This strategic importance is explained not only by their sheer market size, but also by their growing research and innovation capacities, not least in areas related to sustainable development. Consequently, the fast changing global research and innovation landscape as well as the urgent and tremendous need for a global green and low-carbon transformation call for a more pro-active and creative innovation partnership with the emerging economies. However, in practice, policymakers in most OECD countries lack implementation experience on the ground as well as systematic and strategic thinking in terms of eco-innovation cooperation with emerging economies. The limited presence of relevant public agencies in emerging economies and/or the lack of public-private-partnership-based initiatives from the OECD countries to facilitate eco-innovation on a permanent and professional basis in these emerging countries could be another operational weakness in this kind of innovation cooperation.

Based on an analysis of a recent call for proposals by the Swedish Governmental Agency for Innovation Systems (VINNOVA) in collaboration with the Swedish Energy Agency (STEM) on the Swedish side and the Ministry of Science and Technology (MoST) on the Chinese side in 2013, we analyse the context for and potential outcomes from eco-innovation cooperation with China. Our key findings which are not unique to Sweden, but of relevance for internationalisation of eco-innovation in a broader context, can be summarised as the following:

- There is great potential for international cooperation with China to promote eco-innovation for mutual benefit and to contribute to addressing global challenges;
- Successful eco-innovation cooperation requires a combination of strategic assets and conditions – such as funding, competence, access to strategic actors and platforms, etc. – which often exceed the resources available to individual actors, in particular small- and medium-sized companies;
- There is a significant interest from stakeholder in government support of bilateral initiatives and the interest is not limited to SMEs or academic researchers, but also includes large multinational companies, as can be seen in their participation in applications to the VINNOVA call.
- The need to combine strategic assets and conditions poses challenges for many current government initiatives, since the requirements for successful implementation often exceed the scope or mandate of traditional instruments and public actors.

In particular, our analysis dispels some popular myths about the environmental technology sector in general and particularly regarding the promotion of environmental technology in China:

- ***Myth Nr. 1: The Swedish environmental technology sector is dominated by SMEs created around specific clean technology solutions*** – in fact, large firms which would not generally be considered environmental technology firms are some of the key actors in this field, not least in terms

of internationalisation-related activities and exports of environmental technology. This observation is also in line with the conclusions from VINNOVA's quantitative mapping of the Swedish environment technology sector. Furthermore, instead of being dominated by water, municipality waste treatment and air pollution companies, many of the projects have a direct or indirect connection to the manufacturing sector;

- ***Myth Nr. 2: The introduction of Swedish environmental technology in China is based on a one-way transfer of technology or know-how from Sweden to China.*** Many Chinese firms and research performers are becoming more and more advanced, and increasingly the cooperation with these actors allows Swedish actors to tap into valuable knowledge and talent pools. In addition, the development of successful solutions of relevance in the Chinese market will require the co-creation of innovation or what we call eco-innovation cooperation between Chinese and Swedish actors;
- ***Myth Nr. 3: Government efforts to strengthen the internationalization of Swedish environmental technology in emerging markets should focus primarily on export and investment promotion activities.*** Given both the complexities of the Chinese market and the diverse demands of buyers of environmental technology in China, government initiatives aimed at assisting Swedish companies mainly to sell existing products are likely to yield limited result. Rather, the successful introduction of environmental technology solutions in China requires policy and market competences, in terms of a deep understanding of both the Swedish and the Chinese systems, both at firm and public sector level. In particular, such competencies are a necessary prerequisite for public actors to carry out informed and targeted policy dialogues and other initiatives, in order to create receptiveness towards new ideas and innovative solutions as well as to argue for transparency and level playing fields in the Chinese market.

1 Introduction - about this report

Emerging economies, such as China, are of growing strategic importance for innovation and economic development in OECD countries, not least in the field of eco-innovation. Eco-innovation is defined as concrete solutions that offer new ways of addressing current and future environmental problems and decreasing energy and resource consumption, while promoting sustainable economic activity (OECD, 2011a). This strategic importance is motivated by the sheer market size for eco-innovation products and services in the Chinese market, but also the lead taken by the OECD countries in many key strategic areas related to sustainable development. Furthermore, the growing research and innovation capacities in the emerging economies have also changed these countries' role in the global eco-innovation landscape. They are no longer only "recipient countries" of technology and know-how, but also equal partners and future competitors. While recognising the strategic importance as well as the significant market potential, the key challenge, faced not only by the business sector, but also by the policy-making community in the OECD countries, is the great complexity of these markets. The complexity is rooted in the (unique) scale and urgency associated with the changes in the upgrading and transformation process, through which these emerging economies need to shift towards a more sustainable economic growth. More importantly, the complexity is deeply embedded in the highly complex institutional contexts and market environments - which are often fundamental and structural barriers to the real changes on the ground. In such a context, a meaningful and fruitful international cooperation on sustainable development can become more than a means to interact with these emerging economies on a technical and commercial basis. They can provide a deeper understanding of the governance structure and the decision-making mechanisms in these emerging economies. Such an understanding is vital for making a positive influence on and strengthening the enforcement and implementation capacity for the mutual and the global interests.

However, in practice policymakers and public sector actors in OECD countries often lack implementation experience on the ground as well as systematic and strategic thinking in terms of eco-innovation cooperation with emerging economies. Instead, there are some popular "myths" about the internationalisation of eco- innovation, e.g. in the environmental technology sector in general and particularly regarding the promotion of environmental technologies from OECD countries to emerging economies like China. For instance:

- The environmental technology sector in the OECD countries is dominated by SMEs created around specific clean technology solutions;
- The introduction of more advanced environmental technology in China is based on a linear one-way transfer of technology or know-how from OECD countries to China;
- Government efforts should focus on export and investment promotion activities.

In this context, Sweden is one of few OECD countries that have launched a specific **International Cooperation for Eco-Innovations Programme** with China and Brazil. The

programme, which is coordinated by the Swedish Governmental Agency for Innovation Systems (VINNOVA) in collaboration with the Swedish Energy Agency (STEM) and its Chinese counterpart, the Ministry of Science and Technology (MoST), is unique as being an early mover as well as because of its innovative implementation process. Instead of commissioning a programme evaluation in the "conventional and traditional" way after the completion of the programme, the monitoring and follow-up was initiated at an early stage, i.e. from the time of preparation of the programme launch to the completion of successful grantees being selected.

Through this innovative and unique approach, valuable first-hand information as well as rich insights have been – and continue to be – collected, which provide the data that this analysis is built on. Based on the observations and insights gained from the process, we aim to achieve the following specific objectives with this analysis:

- Obtain an overview of the "**collaboration landscape**" and "**collaboration capacity**", in terms of Swedish actors' organizational and competence profile as well as their interests in and potential for cooperation on eco-innovation with China;
- Carry out **a reality check of the popular "myths"**, based on this unique evidence-based Swedish experience;
- Provide inputs to initiate both **strategic and action-oriented policy discussions** with actors from both the public and the private sectors in the field of internationalization of eco-innovation.

The target groups of this report are policy-makers, implementation agencies as well as practitioners involved in the internationalisation of environmental technologies in Sweden as well as in other OECD countries and emerging economies. The topics discussed in this report address a wide range of stakeholders as well as many cross-cutting policy issues, such as environment, energy and innovation. Our ambition with the report is to contribute to the ongoing policy and implementation work – with a combined domestic and global perspective as well as some new strategic thinking closely related to the implementation needs on the ground.

The remaining sections of this report are organised as follows. In section 2 and 3, we provide the essential background information in two aspects, namely the Sino-Swedish science and technology ties and the domestic policy contexts in China related to eco-innovation. A detailed overview and analysis of different components of the Sino-Swedish Cooperation for Eco-Innovations Programme is given in section 4 - 6. Finally, the key conclusions as well as reflections over the current and future Sino-Swedish cooperation are given in section 7.

1.1 Methodology

For this report we have used a number of different source materials and inputs. Firstly, we have carried out a thorough analysis of two recent calls for proposals launched by VINNOVA for funding collaborative projects with China in the field of sustainable development. These calls are described in greater detail below. In addition to examining the call texts, we have studied the applications and the granted projects. Secondly, we have attended several seminars

organized by VINNOVA, MOST and the Swedish Energy Agency in connection with the calls. These events included the following:

1 A workshop organized by VINNOV and MoST in Qingdao in September 2012 which provided matchmaking and raised awareness about the upcoming call.
2 A seminar at VINNOVA in March 2013 at which grantees of A projects were invited to present their projects; in addition, VINNOVA and STEM provided information about the upcoming B call.
3 A seminar in March 2014, to which grantees of B projects were invited to present their projects; in addition, VINNOVA provided a presentation on the context of sustainable development in China.

The above mentioned events provided very useful insights to the projects, information about potential project partners and the interest for the call in China (particularly the Qingdao event), as well as contacts with Swedish project participants.

Thirdly, we have analysed Chinese policy documents, and other relevant sources to gain an understanding of the context of sustainable development promotion in China. We have also used a combination of desk research (web searches) and interviews to gain a better understanding of VINNOVA's and other agencies' programmes for promoting cooperation with China, about different actors' motivation for cooperating with China, and to obtain background information about relevant actors and initiatives in China and Sweden.

At the time of completion of our analysis, projects for both the calls for proposals had been approved and were in the process of being implemented. This analysis is thus not an impact evaluation but an attempt to provide a 'real-time' assessment of the Sino-Swedish Cooperation for Eco-Innovations Programme as it unfolds.

2 Background and Rationale: Sino-Swedish S&T and innovation ties

2.1 Sino-Swedish Science and Technology ties – an overview

A number of features characterize Sweden's science and technology (S&T) relations with China. Firstly, the Nordic countries were among the first Western countries to recognize the People's Republic of China and to establish diplomatic relations with it. Secondly, large Swedish companies were among the pioneers in establishing strategic research and development (R&D) operations in China. Thirdly, Sweden has one of the highest investments in R&D as a share of GDP in the world and – partially as a result of its research intensity – it ranks very high in international benchmarking of countries' innovative capacity and strength. This combination, in turn, makes Sweden interesting for China, which in recent years has pronounced the goal of becoming an 'innovation-oriented nation' and which is looking for inspiration from other countries on how to strengthen its innovation system for sustainable development.

From a Swedish perspective, in the 1980s and 1990s, S&T cooperation with China was largely a government-initiated phenomenon strongly driven by 'science diplomacy' motivations, in the sense of "using science cooperation to improve international relations between countries (science for diplomacy)" (Royal Society 2010). Since the mid-1990s, and in response to China's growing economy but also its rapidly increasing S&T resources, there is an increasing motivation in Sweden to strengthen S&T cooperation. This motivation is driven, firstly, by an interest to facilitate or promote Swedish firms' access to the rapidly growing Chinese market, and, secondly, by an ambition to enable and encourage Swedish academia and industry to tap into and link up with China's rapidly increasing knowledge resources. Furthermore, an underlying – if not always conscious – driving force has been the ambition to compensate for the absence of sufficient linkages with China in the form of mobility of students and researchers (Schwaag Serger forthcoming).

Several of Swedish multinationals, such as Ericsson and SKF, for example, already established operations in China more than a century ago. Furthermore, a number of Nordic companies were among the 'first movers' both in establishing R&D facilities and in locating strategic R&D in China. Today, Ericsson R&D site in China is one of 5 global R&D sites, the others being in Sweden, the US, Canada and Hungary.1 Intramural R&D expenditure of the biggest Swedish international corporations increased tenfold between 2001 and 2011, from 372 million SEK to 3986 million SEK (roughly 580 million US $).[2] As a result, in 2011, the largest Swedish firms' intramural R&D expenditure in China exceeded their R&D expenditure in all other countries outside Sweden, except for the US and Japan. Thus, Swedish firms invested more in R&D in China than in Germany, Great Britain and Ireland or France. Looking at the reverse

[1] http://finance.yahoo.com/news/ericsson-plans-strengthen-r-d-195502255.html
[2] http://www.tillvaxtanalys.se/download/18.5f097bc113eacc3d6d57da/1369901424259/Statistik+2013_04.pdf

phenomenon, a number of Chinese firms have chosen Nordic locations for setting up R&D activities. Examples include telecoms provider Huawei, with R&D centers in Stockholm and Lund, ZTE which has a research center in Stockholm and Beijing Genomics Institute (BGI) which has its European headquarters in Copenhagen. Following its acquisition of Swedish car manufacturer Volvo Cars in 2010, the Chinese automotive company Geely set up a research center in Gothenburg, Sweden in 2013.[3]

In terms of academic research, Sweden also has a high number of co-publications with China, compared with the other Nordic countries, but also compared with other European countries, when population size is taken into account. Between 2008 and 2012, for example, Sweden had the same amount of co-publications with China as the Netherlands even though the latter's population is 80% larger.[4]

Overall, Sweden's S&T ties with China can be described as a mixture of science diplomacy, globalization of large multinational firms' R&D activities and government initiatives aimed at increasing access and linkages to markets and knowledge resources. Today we see an increase of government efforts to strengthen S&T cooperation with China, but also a rapid growth of 'bottom-up' S&T ties between Swedish and Chinese firms and academic institutions.

2.2 Eco-innovation collaboration– beyond trade promotion and "North-South" labour division

In a more innovation-specific context, the fast changing global research and innovation landscape as well as the urgent need for a global green and low-carbon transformation call for a more pro-active and creative innovation partnership with China. Such a new partnership will go beyond the traditional trade relationship, with developed countries exporting advanced goods and services and transferring know-how in resource-, environment– and energy-related fields to these countries. It also goes beyond the conventional view of "North-South" innovation collaboration, i.e. the division between strategic research- and development (R&D) carried out by and often in the "North" and the market-oriented "adaption" and development work targeting markets in the "South", as well as between "disruptive" and "incremental" innovations. Put differently, in the face of common, but also differentiated, sustainable development challenges, the promotion of internationally successful eco-innovation needs a more integrated and inclusive approach than traditional trade and investment promotion. Instead, it involves institutional and innovation capacity development as well as two-way flows of brain power and financial investments. Consequently, international cooperation on eco-innovation will bring "the North" and "the South" together in an effort to join complementary strengths for enhanced and shared green growth opportunities. This implies that successful eco-innovations require international co-creation (i.e. research and innovation collaboration with international partners), demonstration and implementation. In particular, there is a need to revise the public sector's role in promoting internationalization of eco-innovation. Most developed countries allocate resources to export promotion with the aim of supporting

[3] http://www.goteborgdaily.se/volvo-cars-to-open-new-r-d-centre and http://www.cevt.se/
[4] Based on a search done on Web of Science, March 2014, articles only.

companies in their quest to enter foreign markets. According to this approach, companies first develop a product in their home country and then spend time and effort – with varying degrees of support from public actors – in trying to sell their products in foreign markets. Given, firstly, the increasingly diversified demand in foreign markets, secondly, the need to tap into local knowledge to develop suitable products, and, thirdly, significant barriers to market entry in institutionally complex countries, traditional export promotion has proven to be an increasingly obsolete and ineffective tool for companies' internationalization particularly in the field of eco-innovation.

Against the above background, moving beyond the image as "one of the most innovative nations in the world", Sweden has a significant potential and capacity to create innovative partnership and collaboration mechanisms with strategic countries in the global green race. In other words, Sweden can lead by example – through innovative and interactive partnerships.

3 Eco-innovation in China - Domestic policy context

3.1 China has embraced the "green rhetoric" and has many "eco" concepts…

Significant and impressive progress has been made to mainstream the policy agenda of "a green and low-carbon economy" in the international policy community, driven by the "Green Development Initiative" of the UNEP (2011a) and the "Green Growth Strategy" of the OECD (2011b). Being considered both a key challenge and a potential driving force, China has been a focal point for both **the scale and the speed** of the global low-carbon and green transformation. At the policy level, particularly at the national level, the Chinese government has attached great importance to the green transformation agenda. With the support of international experts (including Swedish policy experts), the Chinese policy experts have formulated their definition of "green economy", taking into account both the China-specific context as well as international policy trends (See Box 1 below).

Box 1 Definition of China's Green Economy

An economic development model that regards environmental protection and sustainable resource utilisation as essential conditions for sustainable growth. This new model gives priority to the health and well-being of citizens, minimizes harm of human activities to the environment, adequately recognises and values both natural and human ecosystems for their ability to supply services. It seeks to seize new green growth opportunities, through a combination of continuous innovation and efficient governance.

Source: "Development Mechanism and Policy innovation of China's Green Economy. China Council for International Cooperation on Environment and Development (CCIECD Task Force Report, 2011).

Given the "China-specific characteristics", the Chinese policy-makers have put forward their own vision of China's sustainable development, i.e. "ecological civilisation" and "Beautiful China", to name a few. But the reality is that both the domestic and international audiences are more or less "drowned" in a variety of "old", "modified" and "new" concepts, ideas and often slogans. At the same time, limited concrete and substantive discussions and debates are actually taking place to clarify what these concepts really mean and how to translate these "visions" into achievable actions.

3.2 China has comprehensive plans and clear targets – on paper

In the 11th Five-Year-Plan (2006-2010), binding energy-saving and emissions reduction targets were included in the national economic and social development strategies for the first time – but with significant "delivery gaps" by the end of the plan period. In the 12th FYP (2011-2015), China faces even more arduous tasks and daunting challenges. "**Green development**" has thus become one of the most important strategic policy themes in the 12th FYP, which aims to accelerate the structural transformation of China's growth pattern to achieve a **green, inclusive**

and competitive economy. As key policy and market signals, a total of 24 guiding (non-binding) and binding targets have been outlined in the 12th FYP. Key targets related to a green, inclusive and competitive economy are presented in Table 1 below.

Table 1 Selected targets in the 12th FYP (by 2015)

TARGET	SPECIFICATION*
GROWTH- AND STRUCTURE RELATED	Annual average GDP growth of 7%. Service sector value-added to reach 47% of GDP (up by 4% points). Urbanisation rate to reach 51.5% (up by 4% points).
ENERGY-, CLIMATE- AND ENVIRONMENT RELATED	Energy consumption per unit GDP reduced by 16%. Carbon emission per unit GDP reduced by 17%. Non-fossil energy as a proportion of primary energy consumption to reach 11.4% (from the current 8.3%). Water consumption per unit of value-added industrial output reduced by 30%. SO2 and COD emissions reduced by an additional 8%. NOx and ammonia nitrogen emissions reduced by 10%. Heavy metal from industry will also be regulated although no specific target is given yet. Forest coverage to reach 21.66% of the landmass and forest stock to be increased by 600 million m3. Arable land to be maintained at 1.8 billion acres.
COMPETITIVENESS RELATED	Percentage of R&D expenditure of GDP to reach 2.2% (from the current 1.8%).
INCLUSIVENESS RELATED	More than 45 million jobs to be created. Urban registered unemployment to fall below 5%.

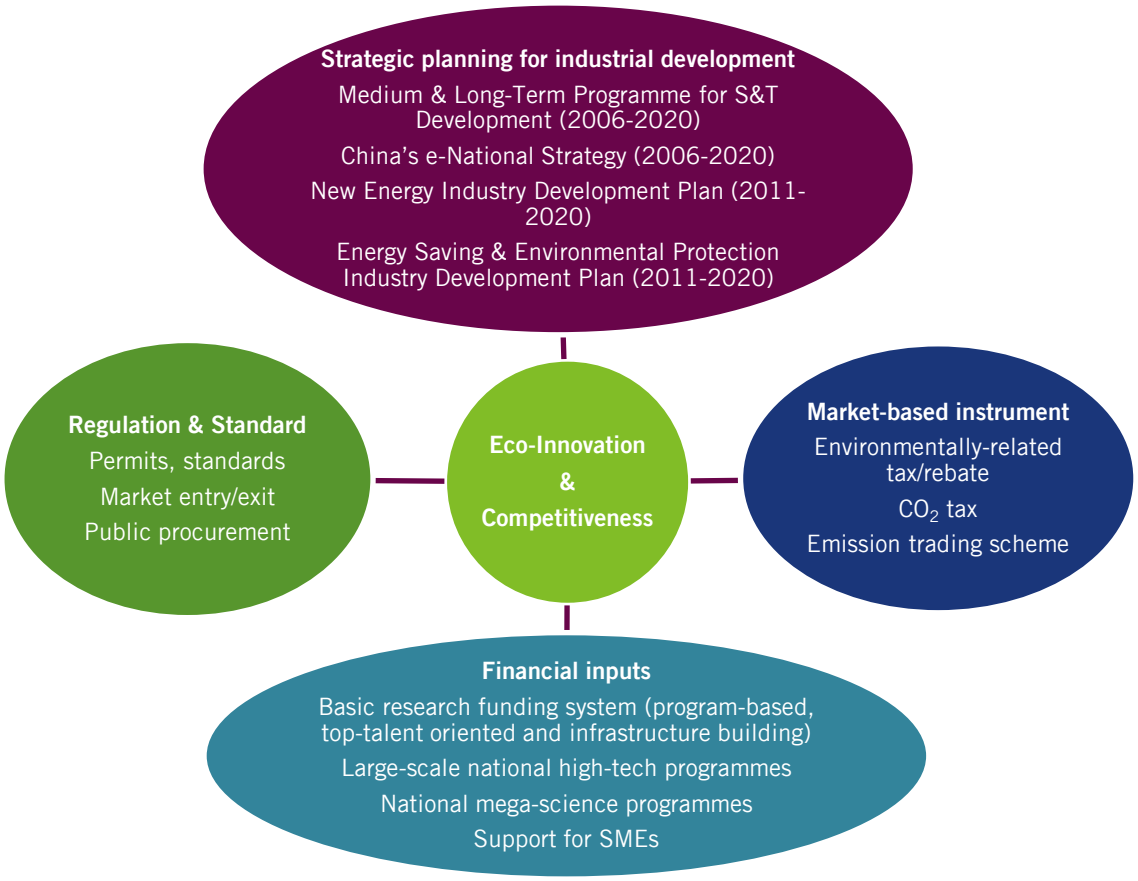
*Source: The outline of the 12th FYP for National Economic and Social Development 2011-2015 (in Chinese). State Council, March 2011. *Base year for the targets in the 12th FYP period is the end of the 11th FYP, i.e. by the end of 2010.*

In addition to the above environment- and energy-related targets, we can also see an emerging trend of creating comprehensive and combined "policy mixes", in which science, technology and innovation are assigned an important "leveraging" and pivoting role. For instance:

- Priority setting in science, technology and innovation development to create an accelerated low-carbon technology and innovation roadmap in order to avoid a high carbon lock-in;
- Creating new knowledge and skills in the fields related to sustainable development and facilitating knowledge sourcing and sharing;
- Enabling macroeconomic conditions and market-based instruments, including "smart" regulation and market creation for green and low-carbon technologies and services.

China is thus on the way to explore and create a comprehensive "Green S&T and Innovation Strategy" – in which various cross-ministerial and multi-sectoral initiatives have been or will be involved (See Figure 1 below):

Figure 1 An emerging Comprehensive Green S&T and Innovation Strategy



Source: the authors

In terms of investments, the Chinese government's expenditure on clean and low-carbon projects has been instrumental in advancing the development of clean energy and energy efficiency. According to some estimates, the central government's US$31 billion (RMB 200 billion) investment in energy saving and emission reduction projects under China's 11th FYP (2006-2010) was leveraged to generate a total investment of US$315 billion (RMB 2 trillion).[5] The Chinese central government will invest more than 2 trillion RMB ($316 billion) in promoting energy-saving and low-carbon projects during the 12th Five-Year Plan period (2011-15), according to the NDRC.[6] Underneath these big numbers, two caveats need to be taken into consideration: 1) Despite the large inputs, there is still a significant financing gap, particularly in relation to the long-term under-investments in sustainable energy- and environmental infrastructure in the past as well as the scale of the climate and environmental challenges faced by China; 2) the quality and the efficiency of the investments. Particularly, the large amount of investments during the financial crisis is considered to consist primarily of "high-carbon lock-in investments" or "green washing" rather than real green investments in system transforming solutions.

[5] Source: Financing China's Low-Carbon Growth. The Climate Group, 2011.
[6] See http://usa.chinadaily.com.cn/business/2012-05/21/content_15349034.htm

3.3 Significant "policy gaps" and "institutional gaps"

A policy narrative of having eco-innovation as a driver for sustainable development is emerging in China. Nevertheless, there are also significant **policy gaps and institutional gaps** in China's national (and regional) innovation system, which need to be addressed urgently:

- **The need to strengthen and (modernise) basic research to increase the responsiveness of the public research to the opportunities and the challenges in the green and low-carbon transformation**, i.e. responding to the novelty of green innovation and addressing weaknesses in China's basic research funding and supporting system;
- **The need to bridge the gap between research (both basic and applied) and technology commercialisation and industrialisation**. This will be key to increase the speed and scale of China's green and low-carbon transformation and to enhance the competitiveness in both the domestic and global markets;
- **The improvements required in incentive mechanisms and schemes**, in particular targeting "regulation-induced innovation", associated with environmental standard setting and the development of "green public procurement";
- **The balance between "indigenous innovation" and market openness (to enterprises of different sizes and ownerships)** will be crucial for creating market dynamics and efficient ways of dealing with the technology and investment uncertainties embedded in green technology and innovation.

In a broader institutional context, i.e. beyond the S&T and innovation policy, the key challenge faced by China's green transformation is **a clear role-definition of related ministries as well as efficient coordination and collaboration among various ministries** (See Table 2 below). In other words, China still lacks a clearly defined policy narrative and an effective institutional set-up regarding **how innovation can contribute to China's sustainable development – through long-term and holistic thinking and an integrated approach.**

Table 2 Examples of relevant Ministries in Sustainable Development related fields

MINISTRY	EXAMPLE OF MANDATES AND INSTRUMENTS
NATIONAL DEVELOPMENT AND REFORM COMMISSION (NDRC)	Climate related issues: Low-carbon city, low-carbon industry parks Regional carbon trading pilots High-tech dept. for large "top-down" national initiatives
NATIONAL ENERGY ADMINISTRATION (NEA)	Energy planning at both the national and the local levels New energy city and green county as two new national policy initiatives for demonstration
MINISTRY OF HOUSING AND URBAN RURAL DEVELOPMENT (MOHURD)	Urban planning and infrastructure development Building standards (e.g. green building, passive house etc.) Smart-city Low-carbon & ecological city and town (with 50 million RMB subsidy per project)
MINISTRY OF INDUSTRY AND INFORMATION TECHNOLOGY (MIIT)	Industry-specific initiative Key player of ICT-infrastructure for green ICT and Internet of Things (IoT)
MINISTRY OF ENVIRONMENT PROTECTION	Emission standards and environment quality Best-Available Technology based on international experience (e.g. from the EU) Circular economy pilots
MINISTRY OF TRANSPORT	Modernisation of transport and logistic system
MINISTRY OF WATER RESOURCE	Water resources management (e.g. water conservation, flood control and draught relief)
STATE ADMINISTRATION OF FORESTRY	Sustainable forest management Key actor for the resource part of bio-energy development

Given a large and "compartmentalised" institutional set-up related to S&T and innovation, significant barriers to efficient implementation remain. The fragmented approaches and "piece-meal" efforts need to be improved, particularly when it comes to bridging the gaps between research, demonstration and industrial/full scale uptake in the market. In an international cooperation context, the following issues are particularly problematic:

- **The division between climate and energy policy:** Instead of having an integrated energy and climate policy, the most hampering institutional factor is that energy policy is assigned to NEA while climate policy to NDRC. The policy narrative of "energy ***or*** climate" as well as the significant gap between China's position in international climate negotiation and actual domestic climate actions are seriously encumbering the realisation of the full potential of international cooperation with China.
- **The division between the supply- and the demand side of the energy system**: While NEA has the key responsibility on the planning for energy production (both fossil-based and renewable energy), the demand side management is split into several ministries that are in charge of industry, building and transport separately;
- **The separation between prevention-oriented measures and end-of pipe treatment**: Many environment- and resource-related issues have their roots in energy production and utilisation, such as air quality and water conservation. However, the "energy-water-environment nexus" thinking, which is at the heart of an integrated solution, is essentially absent in the current institutional setting;
- "Low-carbon city" and "smart-city" have become buzz words in China and a large number of ministries are competing against, rather than collaborating with, each other in these "green labelling" exercises. As a result, **most of the pilot/demo projects lack both substance and credibility** – which in turn have an adverse impact on the interest and commitment of the regional and local actors to engage in international cooperation.

4 The Sino-Swedish eco-innovation collaboration[7]

4.1 Overall objectives and programme design

This Sino-Swedish eco-innovation cooperation programme has been carried out in two sequential Calls for Proposals, i.e. 1) **a unilateral Call** for Proposals on the Swedish side offering a smaller amount of primarily planning grants (Type A project) and 2) **two parallel Calls for Proposals** by VINNOVA, in collaboration with the Swedish Energy Agency (STEM) on the Swedish side, and by the Ministry of Science and Technology (MoST) on the Chinese side (Type B project). For both types of projects, the Call is targeted at consortia that are driven by **research and innovation needs defined by industrial actors**. Environmental technology and sustainable urban development are priority areas defined in the Call (See Box 2 below for more details).

Box 2 International Cooperation with Actors in China for Eco-Innovation

The overall aim:

Strengthen Swedish actors' international networks for cooperation in research and development, leading to innovations for a sustainable development (Eco-Innovations).

Specific goals:

- **Build innovation partnerships and stronger networks with the new producers of knowledge and innovation;**
- **Increase the export of Swedish green technology to the global market by developing innovative products and services in cooperation with key actors in selected local markets.**

Target Groups/Consortia:

Consortia are typically driven by research and innovation needs which are defined by industrial actors.

Priority areas:

- **Environmental technology**
- **Sustainable urban development**

Cooperation with Swedish Energy Agency on energy-related projects: Energy in China-(ISMEK), as a bridge to national priority energy areas:

- **Fossil-free vehicle fleet**
- **Power systems handling renewable electricity production**
- **Energy efficiency in buildings**
- **Increased use of bioenergy**
- **Energy efficiency in the industry sector**

Type A projects - Cooperation-building and feasibility studies

Key requirements:

- **Identified areas or solutions with strong market potentials in emerging markets**
- **Partner or foreign group for implementation**
- **Active partnership**

[7] More detailed information about the Call for proposals can be found at http://www.vinnova.se/en/EU-and-international-co-operation/International-co-operation/International-Cooperation-for-Eco-innovations/. This section is based on an external analysis of the programme commissioned by VINNOVA and carried out by Nannan Lundin.

- **Past experience of successful results**
- **Implementation period 3-12 months**
- **Maximum of 750 000 SEK (for technical feasibility studies) and maximum of 250 000 SEK (for planning grants and other type of feasibility studies) in total per project**

Type B projects - Implementation of international research and innovation projects

Key requirements:

- **Identified clear needs and proposed solutions or a way to integrate existing solutions in a new concept.**
- **Proposed solutions should have a great market potential.**
- **Implemented by a consortium that is driven by research and innovation needs, which are defined by industrial partners**
- **Majority of the projects' budget will be spent on implementing a research and development project.**
- **Implementation period 2-3 years**
- **Maximum of 5 MSEK in total per project with a total budget of at least 10 MSEK (Swedish part).**

Source: Internal presentation by Ciro Vasquez and VINNOVA website: http://www.VINNOVA.se/PageFiles/75003198 9/Presentation%20ICE%20B%202013%2003%2004%20FINAL.pdf

4.2 Type-A project: An overview

The purpose of this "preparatory" call is not only to provide additional support for the potentially interested applicants for the Type-B projects. For a process development purpose, VINNOVA aims also to use this call to attract, understand and continuously enlarge the "stakeholder pool" of Sino-Swedish innovation cooperation. Therefore, it is not a requirement for the Type-B project applicants to have a Type-A project application or a granted Type-A project. It implies that Type–B and Type-A projects, can be two completely independent funding instruments.

The call for proposals for Type-A projects attracted a total of **35 applications** with the majority from universities (15 applications) and companies (13 applications). 106 applicants were involved in these 35 applications, of which a relatively large number, 52, were companies. In total, **15 applications were approved** for either planning grants (10 proposals) or technical feasibility studies (5 proposals). In terms of the distribution across thematic areas, most of the applications were in the field of **Environment** (See Table 3 - 5 below).

Table 3 Number of applicants – by type of organisation

	UNIVERSITY	RESEARCH INSTITUTE	COMPANY	PUBLIC SECTOR	SUB TOTAL
GRANTED PROJECTS	14	7	23	6	50
NOT GRANTED PROJECT	13	6	29	8	56
SUB TOTAL	27	13	52	14	Total 106

Table 4 Number of granted projects – by type of project coordinator and type of grant

	NO. OF PROJECT COORDINATORS	NO. OF PROJECTS GRANTED *(SUCCESSFUL RATE)*	NO. OF PLANNING GRANTS	NO. OF TECHNICAL FEASIBILITY STUDY
COMPANY	13	5 *(38%)*	4	1
RESEARCH INSTITUTE	5	2 *(40%)*	1	1
UNIVERSITY	15	8 *(53%)*	5	3
PUBLIC SECTOR	2	0 (0%)	0	0
TOTAL	**35**	**15**	**10**	**5**

Table 5 Number of Type-A project applications – by thematic area

THEMATIC AREA*	TOTAL NUMBER OF APPLICATIONS TO VINNOVA	GRANTED
HEALTH	1	0
ENERGY	2	2
INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)	5	2
ENVIRONMENT	21 (2 energy-related)	8 (2 energy-related)
TRANSPORT	3	1
WATER	2	1
PRODUCTION PROCESS	1	1
TOTAL	**35**	**15**

**The classification of thematic areas follows the "behovsområde" given in the submitted proposals.*

Key observations

- Universities and companies, particularly SMEs accounted for the largest portion of applicants. One of the key distinguishing factors of the granted projects is **the strength of the (planned) consortium.** Even in this early stage of project planning, the granted projects have demonstrated clear advantages in, and maturity of, partnership building.
- The applicants are **a mix of established actors and newcomers** in the field of Sino-Swedish innovation cooperation. Firstly, all participating universities have established research cooperation with universities in China – which could also be read clearly from their applications. On the other hand, the companies, which are dominated by SMEs, and the research institutes are mostly newcomers in the Sino-Swedish cooperation context. Consequently, there is a rather large variation in terms of quality among the applications from the SMEs. It is clear that many of SMEs are neither familiar with application drafting work to public funding agencies, nor with how to structure and articulate their "ideas" in a Sino-Swedish cooperation context.
- Among 21 applications in the field of Environment, a total of 5 were related to the second priority area, i.e. **sustainable urbanisation**. One shortcoming in some of these applications is the **weak relevance for innovation**. Thus, several of the applications proposed that both the companies and the municipalities were to assume a combined role of export promoter and facilitator of some kind of information and business platform between Sweden and a specific region in China while the role or existence of the innovation activities was largely unclear.

- Some applications have demonstrated a clear potential for developing promising innovation cooperation with their Chinese partners in the near future. Among the 15 granted projects, 10 projects have also submitted an application for Type-B project. Furthermore, two of these 10 projects have actually become final grantees of the Type-B projects. However, most of these B-Call applications provided little evidence that the activities supported by the funding from the A-Call had made a significant difference in terms of the maturity of the project ideas and/or the depth of the partnership. However, it is possible that based on the groundwork and experience achieved through Type-A projects, the grantees will be able to demonstrate a better developed project idea and a more mature partnership for this type of international cooperation in the near future.

To summarise, it is nevertheless important to note that the distance from a Type-A project to a Type-B project is significant. The most important and also the most time-consuming element of a Type-A project is not only to establish, but also to develop the partnership with the Chinese partners to gain access to the demonstration project. From the granted Type-A projects, as well as the applications for Type-B projects, it is clear that the project ideas and partnerships have been developed during a rather long time. Thus, one of the key conclusions of relevance for policymakers is that it takes time to develop the mutual understanding, trusts and commitments needed in order to undertake a complex and long-term cooperation project like the Type-B projects.

5 Type-B projects: an overview of the applicants

The call for proposals of Type-B projects attracted strong interests from both the Swedish and the Chinese sides, observed from the number of applications: ***69*** applications submitted to VINNOVA on the Swedish side and ***65*** to MoST on the Chinese side (See Table 6 below).

Table 6 Number of applications – by thematic area

THEMATIC AREA*	TOTAL NUMBER OF APPLICATIONS TO VINNOVA	ELIGIBLE	NON-ELIGIBLE
WORKING ENVIRONMENT	1	1	0
LIVING/RESIDENCE	1	0	1
FOOD	1	0	1
HEALTH	1	0	1
ENERGY	**16**	**12**	**4**
INFORMATION AND COMMUNICATION TECHNOLOGY	4	2	2
ENVIRONMENT	**28**	**20**	**8**
TRANSPORT	8	5	3
WATER	3	3	0
PRODUCTION PROCESS	6	4	2
TOTAL	**69**	**47**	**22**

**The classification of thematic areas follows the "behovsområde" given in the submitted proposals.*

Key observations

- A total of **47 applications** were considered eligible, i.e. having matched project partners on both the Chinese and the Swedish sides.
- The largest number of applications is found in the thematic fields of **Energy** and **Environment**, with 12 and 20 eligible applications, respectively. A closer review of the contents of the applications shows that the number of energy-related applications is actually larger. 4 applications (biogas, fuel cell, CCS and waste-to-energy) in the field of *Environment*, 2 (fuel cell and energy storage) in *Transport*, 1 (energy efficiency) in *Communication* and 1 (Solar capped landfill) in *Production Process* are related to energy issues with a focus on renewable energy production and/or energy efficiency through demand-side management. In addition, a number of applications (5 applications) in the field of *Environment* are related to **energy- and resource-efficient production process**, in which energy and environment issues are addressed through an integrated approach.
- While the applications are classified in these separate thematic areas, there are clear and systemic linkages across different thematic areas. This reflects the embedded cross-boundary nexuses and interdisciplinary nature of both challenges and opportunities associated with eco-innovation for sustainable development.

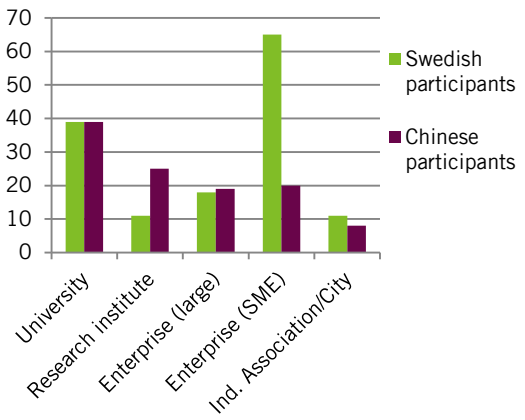
Distribution of project participants and coordinators

While universities are playing an active role on both the Swedish and the Chinese sides, the largest difference is that the **Chinese research institutes**, both policy-oriented and industrial research institutes, are playing a more active role than the Swedish research institutes. The difference is particularly clear in terms of the number of consortium coordinators (See Table 5.1 - 5.2 below). Based on both the applications as well as the observations from on-going bilateral cooperation between China and other EU-member states, Japan and the US, **Chinese research institutes (instead of Chinese universities) are playing an increasingly important bridging and pivoting role in innovation activities, demonstration and pilot projects in the pre-commercialisation and pre-competitive stage of international R&D and innovation cooperation.** The question, in both the strategic and operational contexts, is how to support the Swedish actors, both large enterprises and SMEs to establish the networks as well as to gain access to these strategic platforms and partners in China.

On the Swedish side, project coordinators are highly concentrated among a few large universities. A closer look at the personal data in the applications reveals that the concentration can be explained by the prominence of a few universities, having professors or researchers with Chinese background or links, such as the Royal Institute of Technology (KTH) and Lund University. These observations provide some important insights regarding the role of "mobility" in the international eco-innovation programme. Firstly, the faculty exchange, in the form of guest professorships as well as mobility of researchers with both Swedish and Chinese academic backgrounds in the higher education sector/universities is important. Secondly, the mobility advantage is heavily concentrated in the universities and very few mobility cases could be found in the business sector. One of the potential explanations is that the engagement of the Chinese enterprises in such eco-innovation cooperation projects is initiated mainly through the science-industry linkages, but not yet through the direct business-to-business contacts.

Table 7 Number of project participants – by type of organisation

	SWEDISH PARTICIPANTS	CHINESE PARTICIPANTS
UNIVERSITY	39	39
RESEARCH INSTITUTE	11	25
ENTERPRISE (LARGE)	18	19
ENTERPRISE (SME)	65	20
INDUSTRY ASSOCIATION / MUNICIPALITY	11	8
TOTAL	**144**	**111**



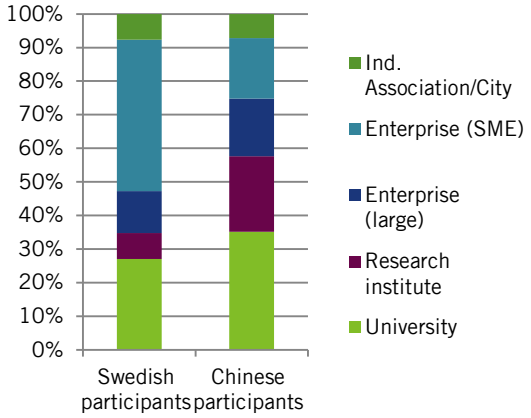
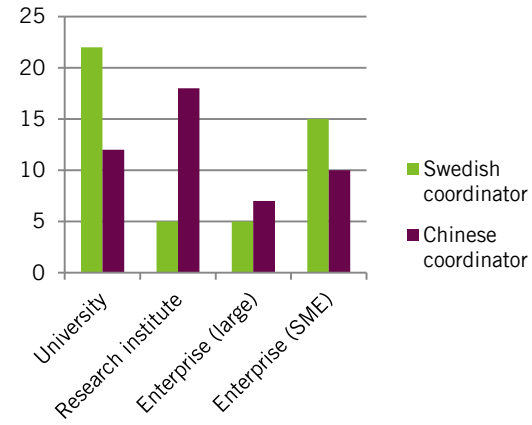
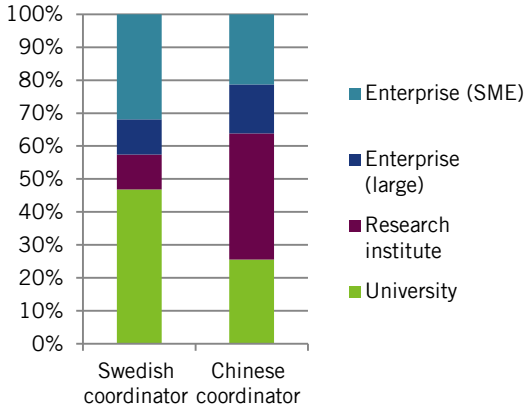


Table 8 Consortium coordinators – by type of organization

	SWEDISH COORDINATOR	CHINESE COORDINATOR
UNIVERSITY	22	12
RESEARCH INSTITUTE	5	18
ENTERPRISE (LARGE)	5	7
ENTERPRISE (SME)	15	10
TOTAL	**47**	**47**





In total, 64 Chinese universities and research institutes have been involved as project participants. It is interesting to note that many of the Chinese partners have a strong track record in international cooperation. One example/illustration of their engagement in international research cooperation as well as their experience in large and complex cooperation projects is their participation in the European Framework Programme, FP6 and FP7 projects. In both the **ICT** and **transport sectors** the Sino-Swedish eco-innovation programme has attracted some of the most "strategic and experienced" Chinese research partners.

The large number of SME participants, i.e. 65 in total, on the Swedish side is driven by the large number of SMEs involved in two projects. In total, 11 SMEs in the fields of sustainable forest management and cellulosic bio-fuel production and 6 SMEs in the fields of district heating and water treatment are involved in these two projects. Controlling for these "outlier effects" there is, on average, only 1 SME involved in each project on the Swedish side. It is interesting to observe the underlying differences between the two projects involving a large number of SMEs. The project on sustainable urban development can be described as a typical case of "platform building" where a few SMEs are gathered to deliver "system solutions". However, in the application, the capacity of system integration and delivery as well as the business case for such platform building were not clearly demonstrated. On the other hand, the bioenergy project is the result of a long-time and careful planning and consultation process for a complex, but a high-impact project. It is a genuine effort to create a science-industry linkage with an international dimension, i.e. not only a Chinese or a Swedish one, but a joint Sino-Swedish and interactive one. As an energy project it takes a unique approach to integrate bioenergy production, sustainable forestry management and sustainable transport to address both renewable energy production and its utilisation in the energy-intensive process industry (instead of getting stuck in grid-connection issues and passively waiting for the policy measures to be in place).

Regarding the participation of large Swedish enterprises, it is indeed striking to see **the broad spectrum of large Swedish actors** who are interested in the Sino-Swedish eco-innovation cooperation. There is a clear strategic thinking on how to translate their "sustainability edge" into a "competitiveness edge" in the global market – through collaboration with Swedish universities, research institutes and SMEs. In addition to the established actors in the Chinese market, there are a significant number of large enterprises from the **process and heavy industries**, as well as the **transport sector**.[8] These companies can be of particular interest and importance for future Sino-Swedish eco-innovation collaboration.

Concerning Chinese large enterprises involved, they are highly concentrated in the energy sector and are key strategic players in the fields of **solar energy** and **bio-energy**. In addition, it is also interesting to see that a few Swedish SMEs in the fields of renewable energy and energy efficiency have established promising partnerships as technology suppliers to large **Chinese manufacturing groups**, e.g. **in transport sector**.

[8] For confidentiality reasons, the names of the companies have been omitted.

The call generated considerable interest from industry which is reflected in the rather large number of enterprises from both the Swedish side (18 large + 65 SMEs) and the Chinese side (19 large +20 SMEs) that are involved in the applications. Furthermore, it is most likely that the Chinese "SMEs" are actually rather large companies, compared to the Swedish classification of SME. Independent of the size, most of the Chinese enterprises involved belong to the **"emerging and strategic industrial sector", i.e. environmental protection and energy conservation.** As a young and new sector in China, their business profile, as well as their innovation and collaboration capacity, are largely unknown to most international actors, including Swedish actors. On the one hand, they are often perceived as domestic competitors to foreign players in the Chinese market who have benefitted from the opaque public procurement procedures and/or preferential treatment by regional and local governments. On the other hand, plenty of good examples show that some of the domestic companies in these fields could also be valuable partners because of their knowledge about the local needs (and access to the domestic market) as well as their ambition and financial capacity of "going-out" to the global market.

6 The granted Type-B projects – who are the winners and are they the right winners?

6.1 Who are the winners?

In total, 9 projects were selected for the Sino-Swedish eco-innovation cooperation, of which 3 projects will be co-funded by both the Chinese and the Swedish sides (highlighted in green). The other 6 will be unilaterally funded by the Swedish side (See Table 9 below).

Table 9 Granted Type-B projects

PROJECT TITLE	AREA	SWEDISH COORDINATOR/KEY PARTNER	CHINESE COORDINATOR/KEY PARTNER
UPGRADE OF CELLULOSIC ETHANOL-BIOGAS INDUSTRY	Energy supply Bioenergy	Mälardalen Univ. SEKAB	Henan Tianguan Group
STABILIZING AND OPTIMIZING OF BACK-FILL MATERIAL IN MINING BY USE OF MINING WASTE	Production process Mineral and mining	Luleå University of Technology	Beijing General Research Institute of Mining & Metallurgy
GREEN CORROSION PROTECTION	Environment Composite material &technology	Royal Institute of Technology, KTH Biopolymer products AB	Xiamen University Sunrui Ship Coating Ltd. co.
NEW WINDOW TECHNOLOGY FOR CIGS PV CELL	Energy supply Chemical process	Uppsala University Solibro Research AB	Hanergy S&T
RAS-SYSTEM KEY TECHNOLOGY AND EQUIPMENT IN CHINA	Environment Water treatment	Wallenius Water AB Stockholm University	Tianjin Fishery Institute
SMART WIRELESS NETWORKING FOR GREEN ICT	ICT Transport	Chalmers Univ. for Technology Icomera AB Ericsson AB	Beijing Univ. of Posts & Telecommunication Datang Telecom Technology and Industry Group
HIGH ENERGY EFFICIENCY AND SMALL-SCALE BIOENERGY COMBINE IN JILIN	Energy supply Energy system	Swedish Univ. of Agricultural Science (SLU).	Chinese great resources Ltd.
CLEAN THERMAL SYSTEM FOR NEW ENERGY VEHICLES	Transport Chemical process	Reformtech Heating Technologies AB Royal Institute of Technology, KTH	Greentech Qiming Information Technology Jilin province high-tech electrical Co. Jilin University
EFFICIENT RECYCLING FOR ENVIRONMENT-FRIENDLY ALUMINIUM PRODUCTION	Environment Production process	Swerea KIMAB AB Acreo Swedish ICT AB Stena Aluminium Stena Recycling	Shanghai Jiaotong univ. Hubei Lizhong Non-ferrous Group Co. Ltd

Characteristics of three co-funded projects

- The areas targeted by two of three co-funded projects, **renewable energy** (**biofuel**) **and material science**, have been identified by both Sweden and China as important areas for cooperation and/or strategic development.[9] Both of these projects are **led by universities on the Swedish side,** "matched" by a strong **industrial partner for each project on the Chinese side**. On both the Swedish and the Chinese sides, there are well-established **science-industry linkages** to support the project implementation of both strong industrial relevance and high research intensity.
- The third co-funded project, **sustainable and resource-efficient mining industry** is highly relevant for both China and Sweden –given the importance and strength of mining sector in both countries.

Key observations on the unilaterally funded projects by the Swedish side

Regarding the unilateral financed projects, the Chinese side and the Swedish side have rather different "priorities":

- Green ICT and its application to public transport are of great strategic importance for Sweden. A solid and successful ground for Sino-Swedish collaboration is also in place, as a result of the previous MoST-VINNOVA cooperation in the fields of advanced ICT. Even without co-funding by MoST it will be possible to carry out the cooperation activities – given the national research funding available as well as the resources from the industrial partners on the Chinese side.
- A more worrying observation is that most of the Swedish coordinators and/or partners are largely unfamiliar to the people evaluating the projects on the Chinese side, which resulted in limited understanding of why they are projects of strategic importance from the Swedish viewpoint as well as for China.

6.2 Why did they win?

A Swedish "eco-innovation elite force"

While it is the 1st Sino-Swedish call on eco-innovation cooperation, the granted projects, to a very large extent present a Swedish "*eco-innovation elite force*". This can be clearly observed from the quality of the projects as well as the strength of the involved Swedish partners.

In terms of the **technological standard and the level of know-how,** the Swedish partners represent world-leading competence and performance, for instance:

- In the field of **liquid biofuel**, the Swedish industrial partner (SEKAB) represents one of the most established companies in this field in Europe. It brings system solutions for cellulosic-based ethanol and other "by-products" – with one of the highest profitability potentials in the European market;
- In the field of **biomass-based energy supply system**, drawing on the successful experience in the past two decades, the Swedish "bio-combine " consortium can deliver a system solution with one of the highest overall energy efficiency levels (i.e. above 90%) in the world;

[9] See, for example, the Swedish strategy for research and innovation cooperation with China where material sciences and energy were identified as two priority areas http://www.vinnova.se/upload/EPiStorePDF/vp-11-02.pdf . Regarding China's priorities for science and technology, see, for example, China's medium and long-term plan for science and technology and its 11th and 12th Five-year plans for science and technology.

- In the field of **Solar PV**, Solibro Research AB, a spin-off from Uppsala University Ångström Solar Centre, has the world-leading module technology and holds the world record in the efficiency of the sunlight/electric energy conversion.

Alongside with these "world records", the Swedish consortia contribute with state-of-the art solutions that are not only technically advanced, but also present an innovative and holistic thinking – which is the key weakness in China's current environmental technology development:

- Cutting edge technological components in integrated **ethanol-biogas-fertiliser production** (e.g. pre-treatment of cellulosic material, advanced production process optimisation and control system for multiple-outputs) adapted to a system perspective, i.e. production fits into market- and local conditions to make a viable business model and to reach profitability;
- High efficiency, low-emission and cost effective **bioenergy combine project** for multiple sustainability gains through integrated forest resource management, high-efficiency renewable production and utilisation as well as upgrading traditional manufacturing industries and creating green jobs;
- **Recirculating Aquaculture Systems** (RAS) for addressing multiple challenges, such as water shortage, water pollution, eutrophication and fish disease, caused by the rapid increase in industry fishery in China, which cannot be handled by the existing (and unsustainable) cultivation methods.

China is indeed making huge investments and impressive progress in promoting its "emerging and strategic industries". The methods and solutions provided by the Swedish consortiums will function as key "**enablers**" and "**accelerators**" – in that they require and provide a combination of strong methodology development capacity and industrial application experience. This combination is a strategic strength embedded in the Swedish innovation system. On the other hand, the gap between research-intensive methodology and solution development and practical industrial applications is still significant in China's emerging and strategic industries as well as when "greening" those traditional manufacturing sector. The key Swedish contributions in this context include:

- The laser method (Laser Induced Breakdown Spectroscopy, LIBS) for sorting of scrap aluminium for more efficient use of recycled aluminium;
- Environment-friendly green corrosion inhibitors and anticorrosion nano-composite films for industrial application in ship coating industries;
- The cutting-edge Swedish automotive heater with low emissions that will be integrated into China's new energy (hybrid and electrical) vehicle production platform.

To summarise, the Swedish consortia involved in the first batch of Sino-Swedish eco-innovation projects are not only **technical solution suppliers and research partners** in the bilateral cooperation. More importantly, they are also **mind-set changers and game-changers**, i.e. not only showing ***what*** the solutions are, but also show ***why and how*** these solutions can bring about **fundamental and transformative changes** when Sweden and China join forces to pursue sustainable development – more innovatively and efficiently.

Sino-Swedish win-win cooperation partners

A successful collaboration will not be possible without strong counterparts on the Chinese side. One of the common features of the granted projects is the strong **science-industry linkage** on the Chinese side. The strong research capacity is represented by well-known Chinese universities, such as Xiamen University, Shanghai Jiaotong University and Beijing University of Posts & Telecommunication and Jilin University etc. Even more encouraging, the Sino-Swedish eco-innovation cooperation has attracted large industrial and manufacturing groups on the Chinese sides. For instance:

- The key national bioenergy enterprise, Tianguan Group;
- The key actor in the coating industry, Sunru Ship Coating Ltd.
- The key national ICT enterprise, Datang Telecom Technology & Industry Group
- China's largest vehicles manufacturer (FAW) (annual production of 7 million vehicles)
- China's largest private energy enterprise Hanergy Holding Group and its subsidiary Hanergy Science & Technology Co. Ltd.

While both sides involve strong partners, the win-win partnership is also embedded in the well-developed working relationship and in many cases, well established and "mature" partnerships. This can be observed from several aspects:

- In many of the proposals it is clear that the project idea for the eco-innovation collaboration arose from the **rich market experiences in China**, in terms of both the potentials and barriers in the Chinese market. As a result, the project proposal reflects both a careful elaboration of the collaboration idea and planning for implementation. At the same time, both sides are committing considerable resources to make the collaboration possible. The bioethanol-biogas project in Henan and the bio-combine project in Jilin all have this strength.
- For the more research oriented projects, the consortia on both sides have **a long-standing research partnership through previous cooperation**. This strong research partnership also functions as useful linkages to identify key industrial partners on both sides. The most illustrative example is the green ICT project. Chalmers University of Technology and Beijing University of Post and Telecommunication were partners in the previous IMT-advanced and Beyond project (2008) financed by VINNOVA-MoST and the cooperation was very fruitful. A similar pattern can also be observed for the projects on green corrosion protection, bio-combine and biofuel projects.
- There is a **strategic "organisational" /"institutional" linkage** between the Chinese and the Swedish consortium. One of the most interesting cases is the project on new window technology for CIGS PV Cell. The research and innovation links as well as the cooperation on market exploration are further strengthened through the cross-board acquisition of Solibro Research AB by Hanergy. One policy question of strategic importance will probably be: how to use this kind of "deep-rooted" organisational relationship to explore the maximal strategic values for the development of the Swedish innovation system in the future?
- Another new type of, but also strategically interesting, partnership is the "**SME-driven and venture-capital-backed**" cooperation. Behind the cooperation between a Swedish SME who has a unique and cutting-edge technical solution and some of China's largest manufacturing groups, are venture capital firms, with knowledge of both Chinese markets and Swedish technology and act as a "facilitator". In these cases, VINNOVA-grants serve as

both a bridge and a lever, during the pre-commercialisation stage and before the venture capital is "taking over" to move into scale-up and expansion phases.

Sino-Swedish win-win collaboration mechanism

From the Swedish perspective, one of the key questions is why Sweden should collaborate with China on eco-innovation. As a matter of fact, in areas where Swedish industrial partners take an "absolute lead" and are used to operating in the "comfort zone" in the European market, it has been more or less "unthinkable" to collaborate with Chinese partners and/or enter the "high-risk" Chinese market.

Based on observations from the 9 granted projects as well as from the other applications of good quality, the drivers behind the Sino-Swedish eco-innovation collaboration are manifold, but two common objectives can still be clearly identified:

- For the industrial partners who have already entered the Chinese market, this Sino-Swedish eco-innovation cooperation will be an important opportunity to **spearhead and accelerate their** (**relatively slow**) **business development** in the Chinese market in the past years. This will be achieved through both strengthened cooperation with Swedish research partners on the one hand, and further deepening of their established cooperation with their Chinese partners on the other. It is a huge step between introducing innovations/solutions to the Chinese market (which is the focus of most of the so-called "environment technology promotion activities") and reaching a quick scale-up in the market (which is so far a neglected policy issue when the promotion has been "accomplished" or could not be achievable due to the lack of access to market- and policy networks in China as well as the institutional and the "facilitating" capacity).
- For those industrial partners who are still in a pre-commercialisation stage, this Sino-Swedish eco-innovation collocation will be a vital strategic step to move from **lab/pilot-scale that is already mature in Sweden and even in Europe towards a full- and industrial scale in China.** In this context, China is probably the only market with both market size and available funding today that can make such a commercial leap possible – not least given the market, financial and policy uncertainties lingering in the European and the U.S. markets. For instance, in the field of solar PV, despite their technology advantages, thin film PV companies in Europe and US are facing tough market conditions – due to overcapacity, slow market uptake and not least rapid decrease in and/or phase-out of government support schemes.

In both processes, the strong science-industry linkage between the Swedish companies and their research partners on **both** the Swedish and the Chinese sides – is indeed the key success factor in the cooperation. Put differently, both the acceleration of and the preparation for the commercialisation phase in the Chinese market are highly **innovation-intensive processes** because:

- For these "ready-made" or "turn-key" Swedish solutions that have successfully been implemented in the Swedish and European markets, the adaptation of the existing solutions to the Chinese market to solve the "Chinese problems" is a highly complex process. It goes far beyond only showing the advantageous features, it must also be verified for the local needs and conditions. In practice, the Swedish solutions are de facto a "partial solution" in the face of both the high and new complexities involved in the Chinese problems. For instance, while Swedish biomass-to-energy is largely based on dry and clean

cellulosic feedstock, the substrates in China are far more complex and diverse; while the RAS-system used in Sweden and Europe deals largely with water-saving in fish farming, the severe water pollution in China requires the system to handle not only water efficiency challenges but also fish diseases.

- The scale-up from the lab/pilot scale to the full- and industrial scale is *not* a simple "scale-up by size". Instead, it involves research-intensive testing, verification methods and process development – which can simply not be handled by the Swedish companies alone. As a matter of fact, it is a win-win collaboration between the industrial and the academic partners. While the companies receive knowledge and research support for reaching their business goals, the researchers obtain market and industrial inputs to enhance their future research. In other words, this is indeed a mutually supporting and strengthening process – which is of great importance for both the immediate market success of the Swedish business sector in the global market as well as for the long-term capacity and competitiveness of the Swedish research and innovation system as a whole.

It is also important to see that both types of cooperation are **win-win cooperation between the Swedish and the Chinese sides** – based on complementary strengths and comparative advantages. This can be motivated by the following observations:

- At a more general level, China's current environment protection and energy saving as well as renewable energy development are still largely built on an investment-driven strategy. However, to build an innovation-driven mind-set and innovation capacity require both a genuine understanding of what a sustainable development is for China as well as long-term and hands-on experience of applying innovative solutions to effectively address the challenges faced by China. The Sino-Swedish eco-innovation cooperation is a unique opportunity to introduce such an innovation-driven mind-set as well as demonstrate a broad range of innovative solutions to China on the ground. The image of Sweden as "one of the most innovative nations in the world" has been promoted for a long time in the Chinese market. The eco-innovation cooperation is a concrete attempt to move from words to actions – with both real substance and a long-term strategic thinking.
- While Sweden has advanced small(er)-scale demo plants, China provides unique opportunities of large-scale implementation. The Chinese companies in the fields of environment and energy are indeed interested in the know-how of the Swedish demo plants, which requires long-term learning-by-doing experience as well as thorough system-thinking and expertise. In other words, these "intangible assets" take time to absorb and do not follow simply by making huge investments. To make use of the know-how from Sweden and integrate it with China's full/larger scale production will be a true accelerator and game-changer for China's environmental protection and energy saving measures. This is particularly true in the fields of advanced bioenergy and biofuel.
- While Swedish companies do have advantages in high efficiency at either product or system level, the high efficiency needs to be combined with low-cost (both material and production costs) and supported by the collaboration with their Chinese partners. Furthermore, when the Chinese counterparts have their own competitive edge, typically in production technologies, this will indeed generate a win-win outcome and involve not only mutual learning, but also a clear "know-how" transfer from the Chinese to the Swedish side. One good example can be found in the field of solar PV. Through the Sino-Swedish cooperation it will be possible to combine the improvement in module technology with the improvement in production, which could lead to further enhanced competitiveness for the thin film solar cell technology both in China and in Europe.

A Sino-Swedish "high-ambition coalition"

Hand in hand with the cutting-edge research and innovation capacity as well as the long-term experience in industrial applications, there is a long-term "**platform thinking**" embedded in several applications on the Swedish side. In other words, these projects represent a high-ambition coalition – through which the project-based cooperation will be further developed towards a more comprehensive and sustainable "platform-based" long-term cooperation mechanism.

Unfortunately, the term "platform" has more or less become a "buzz-word" in the context of international cooperation, often described as publicly funded or supported networks or networking activities with limited innovation outcomes. The question is therefore why these projects want and need a "platform"? First of all, the type of "platform" described in the proposals is different from many of the exiting "promotion" platforms. Through this concrete eco-innovation cooperation on the ground, the Swedish and the Chinese sides will be able to develop a joint foundation for a future platform, having a "real-life-case" demo plant in China (and also in Sweden in some cases) as a tangible and visible base. It is a completely different process, i.e. building a platform from a concrete project, not starting with an "empty" platform then look for projects as is the case with many existing "platforms". The motivation behind the needs for such platform building is based on:

- **Skill and knowledge gaps:** It is of great importance to realise one of the key, but largely neglected, barriers, namely **the low skill and knowledge level** in the Chinese market when Swedish companies are introducing and applying their system solutions on the ground. Even "state-of-the-art" systems and solutions do not guarantee the best and desirable outcomes – they need to be transferred and operated properly. This has been a hard lesson learned by many European technology suppliers in the Chinese market. Nevertheless, the comprehensive and long-term capacity building and training issues cannot possibly be managed on a project-basis only and performed by companies involved in the on-going projects alone. Instead, the skill upgrading for shifting backward "black" and "grey" jobs to "green" and more skill-intensive jobs need to be addressed as a horizontal policy issue.
- **Institutional barriers and needs for policy support:** when moving from a "lab-scale" and a demo plant towards a full industrial scale, one the key success factor is to overcome various technical, commercial and **institutional barriers**, particularly in the fields of energy and environment. While the institutional barriers are indeed rooted in protectionism at both the local and the national levels, the low knowledge level and the limited understanding of business cases for sustainable development are equally important hindrances at the policy level in China. In such a context, a platform as a "neutral" place to bring both project-level best practice and policy dialogue together will be the most efficient vehicle to remove the institutional barriers for project implementation as well as to make a real difference – in terms of policy impacts.
- **Networks for building up project pipelines and rapid diffusion:** The Chinese market is not only a large, but also a fast-moving one. While several projects in this eco-innovation cooperation are only in their "initial" research-demo-stage, strong technical and commercial interests are already emerging in the Chinese market. Consequently, a "bottleneck" appears immediately on the Swedish side, particularly for SMEs, namely how to meet the strong and fast-growing interests with limited human resources and organisational capacity? This should also be taken into serious consideration in a (fierce) competition context – when the "best solution" cannot be delivered by the Swedish system

suppliers, there are plenty of good enough "second bests" around in the market. To seize the emerging and growing business opportunities, there is a clear interest, and actually an acute need from both the Swedish and the Chinese sides to extend the project-based approach towards a platform-based approach.

A common "weakness" in the best applications...

It is noteworthy that very few applications contain thoughts or plans for the future comercialisation stage, even though it is clearly stated in the Call, as one of the "performance targets and impact goals", that the result of the project is expected to include an explicit commercialisation strategy. Furthermore, in most of the applications, the risks involved in both the market and institutional environments, including IPR-issues as well as scaling-up strategies are not sufficiently addressed in this "early innovation and /or demonstration stage". To some extent, this could reflect a lack of market and institutional knowledge of the applicants as well as the need for such capacity building on both the Swedish and the Chinese sides.

7 Preliminary conclusions and reflections over the current and future cooperation

As a policy effort to link the Swedish eco-innovation to one of the most strategic emerging markets, the programme of "International Cooperation with actors in China" has achieved a successful start and laid a solid foundation for future cooperation. It has also provided valuable implementation experience as well as useful policy insights regarding how OECD countries can establish a fruitful exchange and cooperation with strategic partners from emerging economies, such as China. In other words, most of the observations and the outcomes from this analysis are hardly "Sweden-specific". At the same time, it is also important to underline the fact that eco-innovation is indeed a new and complex area, in which the cooperation between Sweden (and other OECD-countries) and strategic emerging economies, such as China, is at its beginning of being enlarged and deepened. Our analysis, based on a careful scrutiny on a total of 82 applications (i.e. 35 for A-Call and 47 for B-Call) is a first step to bring this important initiative into a strategic and a broader policy context. However, one important caveat is that these "successful" projects have just started their implementation on the ground and much will remain to follow up and be discussed. With the preliminary conclusions below, we attempt to outline some of the useful lessons and insights to contribute to a deeper understanding for enhancing the internationalisation of eco-innovations as well as the policy discussions in a broader context.

Preliminary conclusions on the outcomes

- **A successful start and a solid foundation:** This is clearly and strongly supported by two key observations: 1) the strong interests on both the Swedish and the Chinese sides; 2) the high quality of the majority of granted projects. These projects represent a strong profile of **"Innovated in Sweden"** and at the same time, demonstrate a clear potential of being "**empowered by Sino-Swedish eco-innovation cooperation**", not only for the Chinese, but also for the global markets.
- **Focus on industrial needs, but still challenging for SMEs:** The industrial-needs-driven focus as well as the "science-industry-linkage" approaches are the keystones for the success of applications and future implementation. But it is also clear that such requirements are still difficult to meet for most Swedish SMEs, not least in an international cooperation context and in particular for the newcomers. The few exceptions are often the outcomes of 1) A long-term support by previous innovation programmes or other public funding schemes; 2) An embeddedness in the local industrial environment 3) An established partnership with academic partners, through personal linkages.
- **Few applications in sustainable urbanisation and weak participation of public sector actors.** "Sustainable urbanisation" is one of the most important areas for Sino-Swedish cooperation (and many other OECD countries) and in Sweden. The public sector – particularly municipalities and provincial governments – play an important role driving demand for the provision of 'green solutions' in energy, waste, transportation and construction, among other things. But there were very few applications in the A or B calls which involved public sector actors in a leading role and many of the applications

submitted by the public sector focused on stand-alone technical solutions and "system solutions" of a narrowly defined scope. In general we discern a tendency of public sector applicants to focus on driving promotion activities rather than innovation processes. Perhaps most importantly, there seems to be a lack of strategy and of involvement of relevant partners (particularly among Swedish companies) for transferring local know-how to a (highly complex) international market. Instead, the cooperation is still at a premature level, consisting primarily of general introduction and information exchange, instead of concrete- and implementation-oriented collaborative efforts.

At the same time, it is also important to note that, the "weak" applications from the public sector may well be a result of the effect of a "self-selection". The public sector actors who are working with technology- and innovation issues at the operational level are still facing various "institutional barriers" that prevent them from engaging in international cooperation. As a result, only the activities associated with general information exchange and promotion activities could be involved in such international cooperation.

Dispelling the popular myths by the observed evidences

Based on the observations from both the large number of applications and applicants as well as the final granted projects, our analysis has, to a large extent, dispelled some popular myths about the environmental technology sector in general and regarding the promotion of environmental technology in China in particular:

- **The Swedish environmental technology sector is dominated by SMEs created around specific clean technology solutions** – in fact, large firms which would not generally be considered or labelled as environmental technology firms are some of the key corporate actors in this field, not least in terms of internationalisation-related activities and exports of environmental technology. This observation is also in line with the conclusions from VINNOVAs quantitative mapping of the Swedish environment technology sector.[10] Furthermore, instead of being dominated by water, municipality waste treatment and air pollution, many of projects have a direct or an indirect connection to the manufacturing sector as well as energy-intensive industries. In other words, they are "enablers" of a green transformation, even though they are not necessarily labelled as "environmental technology companies".
- **The introduction of Swedish environmental technology in China is based on a one-way transfer of technology or know-how from Sweden to China**. Firstly, many Chinese firms and research performers are becoming more and more advanced, and increasingly the cooperation with these actors allows Swedish to tap into valuable knowledge and talent pools. Secondly, the development of successful solutions of relevance in the Chinese market ***and*** in the global market will require the co-creation of innovation or what we call eco-innovation cooperation between Chinese and Swedish actors.
- Government efforts to strengthen internationalization of Swedish environmental technology should focus on export and investment promotion activities – given the complexities both of the Chinese market and the diverse demands of buyers of environmental technology in China, government initiatives aimed at assisting Swedish companies to sell existing products are likely to yield very limited result. On the other hand, it requires policy **and** market competences, in terms of a deep understanding of both the Swedish and the Chinese systems. This is a necessary prerequisite for the public actors on

[10] See e.g. " Företag inom miljötekniksektorn 2007-2011", Vinnova Analys, VA 2013:06, 2013.

the Swedish side, to carry out informed and targeted policy dialogues, in order to create receptiveness towards new ideas and innovative solutions as well as to argue for transparency and level playing fields in the Chinese market.

A few reflections over the current and future cooperation

This bilateral cooperation programme has indeed the potential of filling some important missing links in the current internationalisation strategy for environmental technology as well as the development of the Swedish innovation system. For example:

- The missing link between the general **export promotion of Swedish environment technologies** in China on the one hand, and the **capacity development and competitiveness enhancement** required to secure the current and future success in export markets;
- The missing link between the track record in the home market of the Swedish innovators and the possibility of demonstration and further development in international markets. The trust and the deep understanding of the local conditions that are generated through close collaboration in forms of "co-creation" and "co-innovation" processes can effectively shorten the distance between a Swedish company or know how and the Chinese market, but also prove valuable in joint efforts to explore global markets. R&D-and innovation projects on the ground can be one of the **most effective means of "opening the door**" to the Chinese market – compared to matchmaking, academic research cooperation or trade promotion. In other words, R&D-and innovation activities in a strategic market, such as China, are not only important for gaining credibility and providing an opportunity to display superior features of Swedish products and solutions, but also for developing and tapping into technical and market-related know-how which in turn enables a faster market adaption and uptake – with further improved solutions and increased cost-effectiveness. Furthermore, jointly building up and developing R&D and innovation -projects with Chinese partners is **an excellent way of creating a long-term and sustainable partnership**.
- The missing link between **a triple-helix driven innovation environment** in Sweden and its interaction with similar **innovation environments in international markets, particularly involving SMEs and public sector actors on both sides**.

Given the strategic importance and long-term impact, it is even more important to recognise the needs to deal with the immediate capacity issues as well as to explore the possibility of leveraging the future potentials and new opportunities. For instance:

- Given the limited **exposure and success of SMEs and the public sector actors** in this programme, how can support mechanisms for a stronger participation of these actors be established? Or is this funding scheme simply not fit for these actors and, if so, what possible alternatives can be developed? These are key issues to expand and strengthen a "stakeholder pool" for future international cooperation on eco-innovation;
- **Combining and strengthening the project-based approach with a platform-based approach.** This combined approach in itself, if implemented on a substantive basis and with institutional supports on both sides, could be an innovative approach for international eco-innovation cooperation. Through platform-building, the key issues for eco-innovation, such as institutional, policy and market framework as well as long-term capacity and skill development will be communicated and developed on a continuous and sustainable basis. Nevertheless, it is of great importance to underline that, for the viability and the success of

the "platform", it needs to be built on and materialised from the concrete results, actor commitments and established operational networks from the project implementation process. If centred around concrete initiatives and clear buy-in and commitments from relevant stakeholders, a two-way platform-building process, i.e. a platform not only for Swedish actors driving eco-innovation projects with China but also for Chinese actors driving eco-innovation projects with Sweden, could be a useful tool for enhancing both competitiveness and attractiveness of Sweden's innovation system. Moreover, the platform-building is directly or indirectly, related to the discussion of the need for the presence of public agencies and/or public-private-partnership based initiatives from the OECD countries to facilitate eco-innovation on a permanent and professional basis in these emerging countries. This has been an important institutional and operational weakness in this kind of innovation cooperation for most OECD-countries.

- The ultimate success of the eco-innovation cooperation project lies not only in the completion of research and demonstration projects. Instead, it needs to **pave the way and ensure a smooth transition from research and demonstration to market introduction and up-scaling – on large scale and quickly.** In this context, the eco-innovation international cooperation programme can be part of a concerted effort to make a fundamental change, i.e. contributing with strategies, approaches and implementation actions needed for a real sustainable development outcome and with a strong green business case.

Finally, we would like to underline, as we have mentioned before, that this is not a formal programme evaluation, or evaluation of the impact of the Sino-Swedish Cooperation for Eco-Innovations Programme. Thus, this report should not be seen as a definitive assessment of the effects, or success or failure, of the initiative under scrutiny. Rather, our analysis is an attempt to provide an early assessment of the programme as it unfolds, and which at this early stage seems a promising attempt to promote mutually beneficial and sustainable cooperation with China in the field of eco innovation. Carrying out the analysis at this early stage of the programme provides valuable opportunities to 'learn as we go along' and thus for continuous improvement of the initiative as it is being implemented, but also for future international cooperation programmes that are currently being developed. Our hope is that the report will provide useful insights into how to design policy initiatives in the rapidly changing field of sustainable development cooperation with China.

References

Lundin, Nannan (2014), "Sino-Swedish Eco-Innovation Collaboration – An overview of and reflection over the implementation and strategic development in the future", internal report for VINNOVA, March, 2014.

OECD (2011a), "Better Polices to support eco-innovation", Paris, 2011.

OECD (2011b), "Towards green growth", Paris, 2011

CCICED (2011)," Development mechanism and policy innovation of China's green economy". China Council for International Cooperation on Environment and Development (CCICED) Task Force Report, November, 2011.

Schwaag Serger, Sylvia (2014), "Sino-Nordic S&T ties: is everybody satisfied?", draft paper presented at conference on China's international S&T relations, Tempe, Arizona, April 3.

The Royal Society (2010), *New frontiers in science diplomacy. Navigating the changing balance of power*, The Royal Society, London https://royalsociety.org/~/media/Royal_Society_Content/policy/publications/2010/4294969468.pdf

The State Council of China (2011), "The outline of the 12th FYP for National Economic and Social Development 2011-2015" (in Chinese). March 2011.

UNEP (2011)" Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication", Geneva, 2011.

VINNOVA (2013), "Företag inom miljötekniksektorn 2007-2011", VINNOVA Analys, VA 2013:06, 2013.

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