How Entrepreneurship Can Drive Low Carbon Development

International Good Practice

WP12

Low Carbon Future Cities

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Executive Summary

The Business Challenge of Low Carbon Development.

China´s economic growth has followed a resource-intensive path similar to many developed countries. This rapid development constitutes an increasing concern for the Chinese government due to the high increment in the demand of energy and resource use and respective price effects, as well as negative environmental and social impacts that business-as-usual generate. These challenges demand a fundamental change of development path in the country, in the upcoming years. Low-carbon and less energy and resource intensive business strategies will play an important part in levering this paradigm change.

Approach of this Report

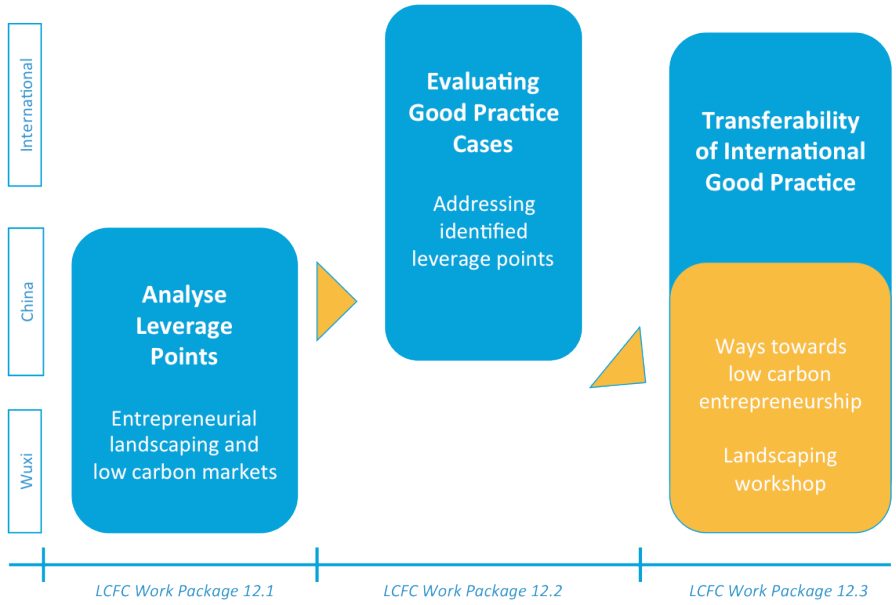
This study builds upon the outcomes of a previous report entitled *"Leverage Points for Low carbon Entrepreneurship in Wuxi"* (Philipps, Grossi, & Coles, 2012) as part of the Low Carbon Entrepreneurship Work Package of the Low Carbon Future Cities (LCFC) Project.

While the previous report analysed the leverage points and low carbon markets that form the Entrepreneurial landscape of Wuxi (revisited here in Chapter 3), the focus of this paper lies on the identification, description and evaluation of good practice that illustrate how framework conditions enable successful low-carbon entrepreneurship – and how entrepreneurs can operate within them. In doing so, the study provides an initial overview of major economic, environmental and social potentials of innovative low carbon business strategies and models and their interconnectedness with surrounding socio-economic systems.

The report provides an analysis of policy frameworks and market-based instruments for Entrepreneurship (Chapter 2), together with 20 innovative international case studies (Chapter 4), identifying examples for where, how and why low carbon business can successfully drive low carbon development and bring added value. These insights are intended to contribute directly to the LCFC project funded by Stiftung Mercator.

The approach and selected good practice cases were already tested through a workshop of relevant actors from policy, business and academia during the 2nd LCFC Stakeholder Forum in Wuxi, China, with positive feedback and generation of several ideas for collaborative action. The relationship between these research activities can be seen in the diagram below.

The embedment of good practice selection and evaluation in the overall workflow



Source: Collaborating Centre on Sustainable Consumption and Production (CSCP), 2012

Key Outcomes

The report allows for a better understanding of the current situation and possible future perspectives on the utilisation of entrepreneurship for low carbon development in Wuxi, China. In order to maximise learning for Wuxi and other cities with low carbon aspirations, transferability criteria and key learning(s) for each case are also presented. A comparative table identifying the key low carbon dimensions and markets as well as the relevant actors to drive change in each case is provided on page 57. Further observations on the case set have been made in three key fields (Chapter 5): economics and policy, technology innovation, and consumer and market trends. Two main recurring themes emerged, namely the need for multi-stakeholder cooperation on the local level and for systemic thinking beyond the company and organisational boundaries and isolated impacts.

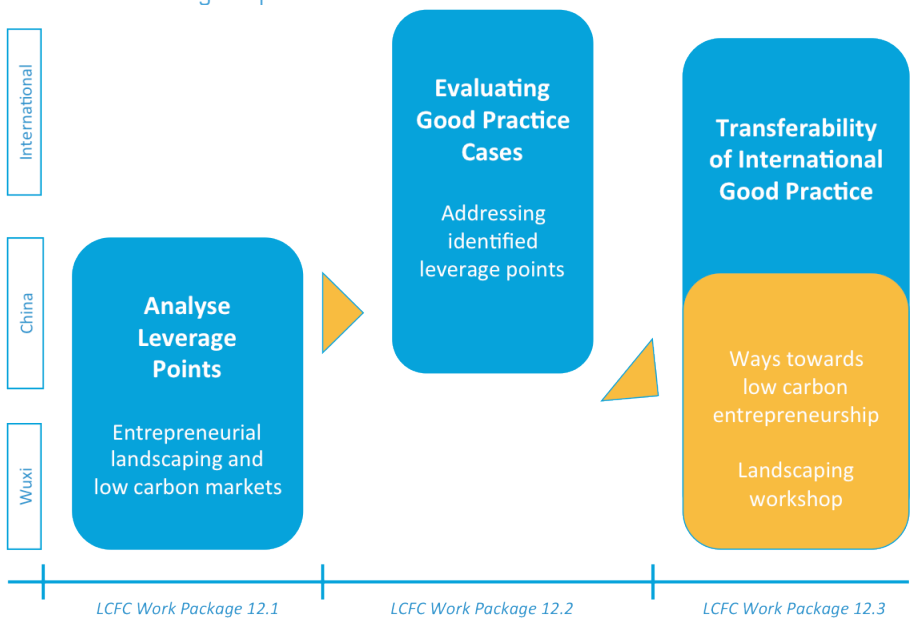
Specific Measures for Enablers of Low Carbon Entrepreneurship

Finally, the conclusions (Chapter 6) address enablers of low carbon entrepreneurship in Chinese cities, including key recommendations for policy makers, administrators, academia, civil society and business actors in terms of concrete actions. This overview provides these groups with specific measures in order to support them in actively shaping an environment that makes low carbon business a rewarding option for entrepreneurs and society alike.

1 Introduction

Entrepreneurs stand for a major potential with regard to innovation and local solutions for China's current and future challenges in the economic, social and environmental realm. Hence, a low carbon future city strategy should systematically include and make them a pillar of a future low carbon economy. This study supports a diversified range of Chinese actors in tapping the potential of entrepreneurship. It provides concrete good practice examples of how entrepreneurial activities can contribute to low carbon development. In addition, it makes the link between these successful cases and the conditions that have enabled their launching in the local context.

Figure 1: The embedment of good practice selection and evaluation in the overall workflow



Source: Collaborating Centre on Sustainable Consumption and Production (CSCP), 2012

1.1 A Systematic Approach to Content Selection and Analysis

This study builds upon a previous report entitled "Leverage Points for Low Carbon Entrepreneurship in Wuxi" as a reference for systematising the context of low carbon entrepreneurship. Philipps, Grossi and Coles (2011) define a model for grasping and assessing an entrepreneurial landscape and apply this landscaping framework to the city of Wuxi in China, to identify leverage points for enabling low carbon entrepreneurship as a driver of low carbon development.

The report presented here compiles, analyses and evaluates cases that address exactly these leverage points. In a first step, the study discerned good practices following the main dimensions and markets identified in the previous report. Case study analysis encompasses the cases' economic, environmental and social impacts as well as market barriers and drivers, hindering or supporting their mainstreaming. The report also looks into transferability criteria, in order to account for diverse local conditions.

The results of both studies have served as basis for an interactive stakeholders workshop in Wuxi, including representatives from the local government, financial actors, civil society organisations and business associations. The workshop focused on testing the methodology of entrepreneurial landscaping and only included selected cases.

1.2 Formulating Concrete Recommendations for Enablers

Companies – in particular small and medium-sized enterprises (SMEs) – have limited time, skills, and resources to identify and develop low carbon business solutions. This makes them highly vulnerable to systemic barriers. From the perspective of low carbon development, their innovative capacity is at stake. Therefore, this report targets also the wider audience of enablers who shape the landscape for entrepreneurship in cities and can also directly support SMEs. This includes business and industry associations, large enterprises, private consultancies and financial institutions as well as governmental actors.

1.3 Three Steps Towards Actions for Low Carbon Entrepreneurship

The analysis proceeds in three steps. Section 1 pinpoints current gaps for mainstreaming low carbon business models in Wuxi and China. First, it gives an overview of current policies and market-based instruments in China that affect low carbon business strategies and models.

Section 2 gives an overview of the current entrepreneurial landscape in Wuxi. The third section introduces the analytical framework adopted to scrutinize 20 international good practices of innovative low carbon business models and provides summaries of case study protocols. Case analysis encompasses economic, environmental and social impacts including current market barriers and drivers to the implementation of the low carbon business strategies.

Section 3 provides a comparative review of the case studies against the backdrop of gaps named by section 1. It gives an overview that enables readers to navigate the case set. The conclusion turns framework and international good practice into concrete recommendations for capitalising on the business case for low carbon business strategies and models in China, and Wuxi in particular.

2 China's Low Carbon Landscape: Institutions and Incentives

This section pinpoints gaps that enablers of low carbon entrepreneurship need to close, in order to drive the transition to a low carbon future. It outlines the underlying general trends, which demand the utilisation of entrepreneurial potentials to, then, give an overview of top-down and market-based approaches already in place in China.

2.1 Underlying Trends Demanding Low Carbon Solutions in China

China´s economic growth has followed a resource-intensive path similar to many developed countries. Between 2000 and 2009, China moved from using half as much energy as the United States to surpassing it. It also became the second largest user and importer of oil and the world's largest producer and consumer of coal, consuming twice as much of the fossil fuel as the United States. It has the third largest coal reserves in the world (Global Market Institute, 2012). The International Energy Agency (IEA) expects China's demand for energy to grow about 75% by 2035 according to business-as-usual development paths. This accounts for approximately 36% of projected growth in energy demand around the world (CISIS, 2011).

As the country's economy continues to expand and energy demand rises, minimal changes within China's energy and industrial sectors have resulted in ever-growing social and environmental impacts placing additional pressure on already scarce and unevenly distributed resources. Sustainability concerns have been growing due to periodic but widespread energy shortages, persistent high levels of pollution, poor safety management, and an increasing reliance on imported supplies.

The Chinese government has long recognised the necessity to decouple energy related greenhouse gas (GHG) emissions from the country´s economic growth as well as the fact that addressing sustainability issues can bring deep economic, social and environmental opportunities. Current policies are heading towards fostering energy efficiency, renewable energy development, and climate change adaptation measures in line with national strategic economic interests. For instance, the introduction of fiscal policies and market-based instruments - such as environmental taxation to address emissions and pollutants mitigation – highlights the change in government's attitude aiming at a better use of cost-effective market instruments to tackle environmental problems. The following subsections present an overview of the main political and economic tools supporting the transition towards a low-carbon economy in China.

2.2 Low Carbon Top-Down Instruments

Since 2005, China regained its focus on promoting energy efficiency and launched mandatory energy intensity reduction goals as part of the 11th Five-Year Plan (2006-2010) (CISIS, 2011).[1] The target was to reduce energy intensity by 20% from 2005 levels by 2010. During the mentioned time period, China was able to reverse the trend of increasing energy intensity (defined as energy use per unit of economic output or GDP) and achieved a 19.06% reduction in energy intensity against the 2005-energy intensity baseline (see Figure 1) (Climate Policy Initiative, 2012).

Within the 11th Five-Year Framework Programme, the government employed a number of innovative instruments to reach the targets, such as the *Top-1,000 Energy-Consuming Enterprises Program*, the *Ten Key Projects for Energy Savings*, and the *Small Plant Closure Programme*. In April 2006, a broad alliance comprising of the Department of Resource Conservation and Environmental Protection of the National Development and Reform Commission (NDRC), the National Bureau of Statistics (NBS), the State-owned Assets Supervision and Administration Commission, the Office of National Energy Leading Group, and the General Administration of Quality Supervision, Inspection and Quarantine launched **The Top-1,000 Energy-Consuming Enterprises programme** through the issuance of a notice and implementation plan (UNIDO, 2011). They set energy-saving targets for China's 1,000 highest energy-consuming enterprises. The implementation plan provided guidance to the enterprises, calling on them to significantly improve their energy efficiency (UNIDO, 2011).

The Ten Key Projects for Energy Savings were launched in 2004, earmarking roughly 740 million euros to provide financial incentives for industry to pursue a wide range of energy saving projects (coal industrial boilers or kilns, waste heat recovery/waste power recovery, petrochemical conservation or substitution, electrical machinery energy saving system and energy system optimization). The aim is to save the equivalent of some 250 million metric tons of coal (Mtce), preventing emissions of over 600 million tones of CO_2 (World Resource Institute, 2009).[2]

[1] Over that period of time, state investment in energy efficiency was reported to be around 14.4 billion euros extracted from China.

[2] NDRC reported that 136 sub-projects were supported by central budget funding in waste heat and waste pressure utilization, energy system optimization and building energy conservation with estimated energy savings of 5.2 Mtce (NDRC, 2008c).

In Shanghai, there were 243 energy conservation projects in 2007 with a total investment of 355 million euros. The savings were estimated at about 870,000 tce, which were largely based on energy system optimization, waste heat and waste pressure utilization and renovation of coal-fired industrial boilers (furnaces) (NDRC, 2007f).

Figure 2: Key energy and emissions goals in China's Five-Year Plans

KEY ENERGY AND EMISSIONS GOALS IN CHINA'S FIVE-YEAR PLANS				
	12TH FIVE-YEAR PLAN		11TH FIVE-YEAR PLAN	
Key indicators	Mandatory targets	Guiding targets	Targets	Actual
Energy intensity reduction	16.00%		20.00%	19.10%
Carbon intensity reduction	17.00%		not set	n/a
Non-fossil-fuel energy share	11.40%		not set	8.3%
Annual GDP growth rate		7.00%	7.50%	11.20%
R&D investments as share of GDP		2.20%	2.00%	1.75%
Urbanization as portion of total population		51.50%	47.00%	47.50%
Major pollutant reductions:				
Sulfur dioxide (SO_2)	8.00%		10.00%	14.29%
Chemical oxygen demand (COD)*	8.00%		10.00%	12.45%
Nitrogen oxides (NOx)	10.00%		not set	n/a
Ammonia nitrogen (NH_3-N)	10.00%		not set	n/a
Total forest coverage	21.66%		20.00%	20.36%

Source: Climate Work Foundation, 2011

The 2007 Small Plant Closure Programme: China's State Council announced a *Comprehensive Working Plan of Energy Conservation and Emission Reduction* to accelerate the closing of small plants and phasing out out-dated capacity in 14 high energy-consumption industries. The Economic Commission in a county or municipality identifies enterprises that violate national and provincial guidelines on industrial equipment and production capacity standards. After receiving the approval of the mayor, the Commission publishes a list of small plants that are old and inefficient, and lists time frames for "voluntary" closure. Some closed enterprises or enterprises that shut down out-dated production equipment receive compensation of around 20% to 30% of the closed enterprise or production line value, but the majority does

Xi'an, the capital city of Shaanxi Province, has received 13 million euros from both central and provincial energy conservation funding. Of this amount, 3 million euros was to be primarily used to support building energy efficiency, green lighting and other Ten Key Projects in 2009, and to encourage key energy using companies to implement coal saving, electricity saving, waste heat utilization and industrial boiler renovation projects (Shaanxi Provincial Office, 2009).

Hebei Province has set targets for their Ten Key Projects: by the end of 2010, to build the capability to save 23 Mtce annually through 62 key energy saving projects (Hebei Provincial Government, 2008).

Weifang City of Shandong Province implemented 66 projects in 2007, with a total investment of 1.03 billion euros. By June 2008, 26 projects had been completed with an energy saving capacity of 173,000 tce per year (Weifang News, 2008).

not. In 2010, the number of targeted industrial sectors was increased to include 6 additional industrial sectors (copper smelting, zinc smelting, lead smelting, leather manufacturing, textile printing & dyeing, and chemical fibre industry).

In addition to the above-mentioned initiatives, programmes, such as the upcoming Special Energy Conservation Plan (developed by the National Development and Reform Commission (NDRC)) and a new **Climate Change Law (CCL)** supplement the main governmental program addressing sustainability concerns by fostering more effective cooperation among institutions and standardize the functions of existing ones (such as coordination amongst ministries, planning mechanisms and the creation of industry standards) (CISIS, 2011).

Finally, the ambition of reforming the economic system and transforming the nation's growth engine has been clearly strengthened in the top priorities of the 12th FYP (2011–2015)[3] for socio-economic development (see Figure 2). The plan targets an energy intensity improvement of 18%[4] by 2015 and non-fossil fuel energy increment up to 11.4% of total generation. The new plan aims to stimulate expansion of the high-tech sectors that will be pivotal in the future, including renewable energy, electric vehicles, and energy efficiency.

2.3 Low Carbon Market Mechanisms

In order to complement existing policy regulations and standards directed at its energy systems and carbon emissions, the Chinese government has also introduced a range of market mechanisms. Specifically, the term *'market mechanisms'* refers to policies where the price structure is used to optimize the behaviour of energy users. The key market mechanisms proposed in the 12th FYP (see Figure 3) include carbon emissions trading, tax reform for resources and environmental goods, energy and electricity price reform and an energy-services company (ESCO) financing model (The Climate Group, 2011).

Energy Pricing turns out to be a powerful instrument to re-orient investments and induce gradual change in consumption behaviour (i.e. use more public transport instead of driving private cars, buy energy saving products). For instance, small changes to align energy and electricity prices have been gradually put in place, to improve the efficiency of electricity supply. A proposed *'price ladder'* approach (NDRC et al. 2009), addressing the demand of

[3] The plan calls for energy intensity to decline by a further 16% and it is China's first to include compulsory target for carbon emissions per unit of gross domestic product—to be reduced by 17% in 2015 relative to 2010.

[4] On March 28, 2011, China's Ministry of Industry and Information Technology announced more aggressive targets of 18% reductions by 2015 for both energy intensity and carbon intensity. These reductions represent greater degrees of improvement compared to the 16% and 17% targets, respectively, delivered by Premier Wen Jiabao on March 5, 2011.

electricity consumers has been developed - which is under consideration by the NDRC - would set consumer prices for different levels of energy consumption. The government hopes to use this approach to regulate residential energy demand and encourage consumers to take up efficiency measures (CCDIC 2010).

Figure 3: Overview of market mechanisms proposed in China

TARGET / MECHANISM		PROPOSED EFFORTS TOWARDS PRICE REFORM		
	REGULATION	FIXED RATE PRICE	VARIABLE RATE PRICE	MARKET SET PRICE
INDUSTRIAL CARBON EMISSIONS	Carbon and Energy-Intensy Target	**Proposed: Carbon Tax Resource Tax Reform**	Tiered Pricing	**Carbon Trading Energy Management Business support**
INDUSTRIAL ELECTRICITY USE	Carbon and Energy-Intensity Target **DSM Regulation**	**Proposed: Carbon Tax**	Tiered Pricing	**Carbon Trading Energy Management Business support**
RESIDENTIAL ELECTRICITY USE	Fixrd number of days with heating	–	Price Ladder	**Energy Manaement Business support**
RESITENDIAL FUEL USE	Vehicle License Limit-Stage **3 Fuel- Efficiency Standard**	Clean Energy Vehicle Subsidy	–	–
UTILITY NEW-ENERGY MIX	**New energy quota implementation**	Wind Subsidy	...	–

Source: The Climate Group, Delivering Low Carbon Growth: A Guide to China's 12th Five-Year Plan, 2011.

Taxation: diverse sets of resource, energy and electricity taxes are currently under discussion. Tax rates for energy resources like coal are being altered. Instead of taxation per unit of product manufactured, there will be an ad valorem tax on the energy resources used to create the product, to address the need to reduce energy used rather than reducing the amount of goods produced (The Climate Group, 2011).

Energy-Efficiency Services: The Chinese government also has encouraged the provision of energy-efficiency services to industry through ESCOs. The ESCO sector is still nascent in China and dominated by a handful of companies that have hitherto been unable to meet the needs of small and medium enterprises (SMEs) in the energy-intensive industries. An ESCO policy was established in April 2010, setting out tax breaks to encourage growth in the sector (The Climate Group, 2011).

Carbon Trading Schemes: The Chinese government is currently assessing the relative benefits of sector-specific and economy-wide carbon trading schemes through an examination of European Union´s experiences and other regions as well as through domestic pilot programs

(The Climate Group, 2011). In October 2010, the 17th Central Committee of the Communist Party of China (CPC) approved proposals to establish a carbon emissions trading market over the next five years.

Quota System: Finally, a quota system, already included in the *Renewable Energy Law,* is expected to be fully implemented during the 12th-Five Year Plan (FYP) period to meet the new-energy targets. The quota will be based on regional development and require energy intensive industries to acquire a certain percentage of electricity from new-energy sources as well as power companies to meet a percentage of generation capacity from 'new energy sources' (Climate Work Foundation, 2011).

These policies and mechanisms show a quite positive and proactive attitude of the Chinese government towards the achievement of a low-carbon economy. Nonetheless, the country is still facing several challenges in its efforts to move towards low carbon production and consumption patterns.

2.4 Challenges and Gaps for Low Carbon Entrepreneurship

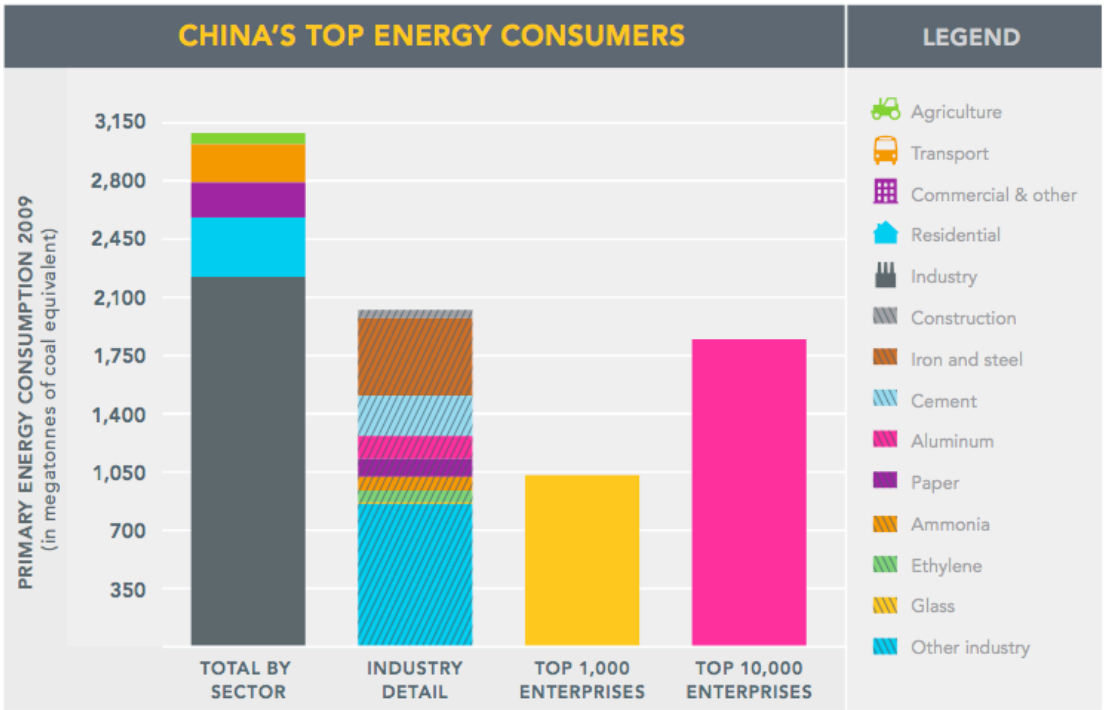
Presumably, few developing countries have promulgated as many laws, policies and other economic measures to support low carbon development as China. These regulations and instruments though partially successful have failed to exploit their full potential due to a variety of obstacles. Among others, limited integration and coordination of policies among sectors and regions and related weak institutional management; poor coordination between national, regional and local levels of policymaking; inadequate capacities at the regional and local levels; insufficient mechanisms to monitor and enforce implementation and the lack of public awareness about the economic, social and environmental benefits of determined sustainable actions and business measures (Ma & Ortolano, 2000; Van Rooij, 2006a, 2006b). Additionally, a vast range of thorny issues, such as the rapid pace of industrialisation and urbanisation, or the attitude of many local and provincial governments which appear to view rapid GDP growth as a more important goal than the national targets for energy and carbon intensity, hinder an effective implementation of low-carbon economic and social measures (Climate Policy Initiative at Tsinghua, 2012).

China is in a **process of industrialisation,** with rapid development in heavy and chemical industries such as machine building, steel, building materials and chemicals. The proportion of energy-intensive industries in the economy continues to rise. China's industrial sector accounts for over 70% of the nation's energy use. The 1,000 largest enterprises consume al-

most half of the energy used by industry; the top 10,000 manufacturers burn over 80% of industry's energy use, or almost two-thirds of China's total energy consumption (European Commission (EC) Joint Research Centre, 2012).

Urbanisation and work migration act as strong drivers of China´s continued economic and industrial growth, higher incomes, and better quality of life. **Population growth** and the need to make on-going improvements in human development are exerting great pressures on efforts to control and reduce greenhouse gas emissions. China's future population growth is expected to peak in around 2030 (UNDP, 2009/2010). The demand for improved living standards will continue to grow, with a concomitant desire for consumer goods, more transportation services, more per capita housing space and more food consumption. All these trends will result in more energy consumption and higher per capita emissions.

Figure 4: China's top energy consumers



Source: The China Sustainable Energy Program, The Climate Works Foundation, 2011

Thus, China faces not only economic competition rising from neighbouring countries, but also growing **natural resource scarcity,** ecological degradation and increasing pollution, all factors calling for a significant industrial restructuring and technology upgrading. Finally, China still has a relatively low level of **science and technology know-how** in several key areas critical to a low carbon economy, implying that the replacement costs for existing facilities

and infrastructure would be immense. The country could therefore find it difficult to switch quickly to a low carbon economy and rely entirely on its own technology development.

Despite these challenges, China is making efforts to build a low carbon economy that will boost economic growth and job creation, increase capacities for independent innovation, and achieve energy and environmental goals. Shifting to a low carbon economy will depend on gradually changing the pattern of regulations and economic investments, so that energy consumption is decoupled from growth and policies are implemented to encourage sustainable consumption and production patterns. Investments and market tools should be guided by the criteria that they are both crucial for human development and can pay off in opportunities that can benefit the economy and society as a whole.

In the face of limited public management capacities, fragmented authority and selective policy implementation, local-level initiatives and bottom-up solutions in the market are of immense importance. On the one hand, the central government will expectedly struggle to micro-manage more than few aspects of the economy also in future. Local administrative initiatives and businesses could step in here – and often receive encouragement from Beijing to fulfil this role (Heilmann, 2011). On the other hand, Beijing will hesitate to implement stark changes top-down, as long as local economies are not ready for them with non-compliance and selective implementation as a likely result (O'Brien & Li, 1999). Here, the bottom-up development of low carbon business models can enable further regulation by making local economies ready for stricter carbon prices and tighter guiding boards for development. In other words, pioneers will pave the way for national-level regulation, as has been the case in other public policy fields in the past. Cities will probably play a crucial role as interfaces between old state and new market solutions and blends of the two of them (Hurst, 2006).The following section offers concrete examples of business-based solutions and refers to enabling contexts with the help of an analytical framework.

3 Where, How and Why Low Carbon Business Succeeds

By 2020, the global markets for environmental products and services will double, reaching up to 2.02 trillion Euros compared to their current annual value of 1.01 trillion Euros (UNIDO, 2011). Chinese companies could find opportunities to increase their standing in the international market, boost their innovation and competition capacities, and explore new business pursuits. Small and medium entrepreneurs represent a major potential with regard to inno-

vation and local solutions for China's current and future challenges in the economic, social and environmental realm. Many enterprises responded to the new government policies and market instruments by improving their production efficiency and using equipment upgrades, mergers, and reorganization to reduce energy consumption.

3.1 The Analytical Approach to Entrepreneurial Landscapes

Nonetheless, the entrepreneurial landscape in China is deeply shaped and influenced by local contexts. Accordingly, to better understand entrepreneurial landscapes in China in general and that of selected cities in particular, a previous report entitled "Leverage Points for Low Carbon Entrepreneurship in Wuxi" developed an analytical framework for the identification of leverage points[5] for low carbon entrepreneurship. The framework does not claim scientific robustness and rather serves as a heuristic for practitioners. It proceeds in three steps:

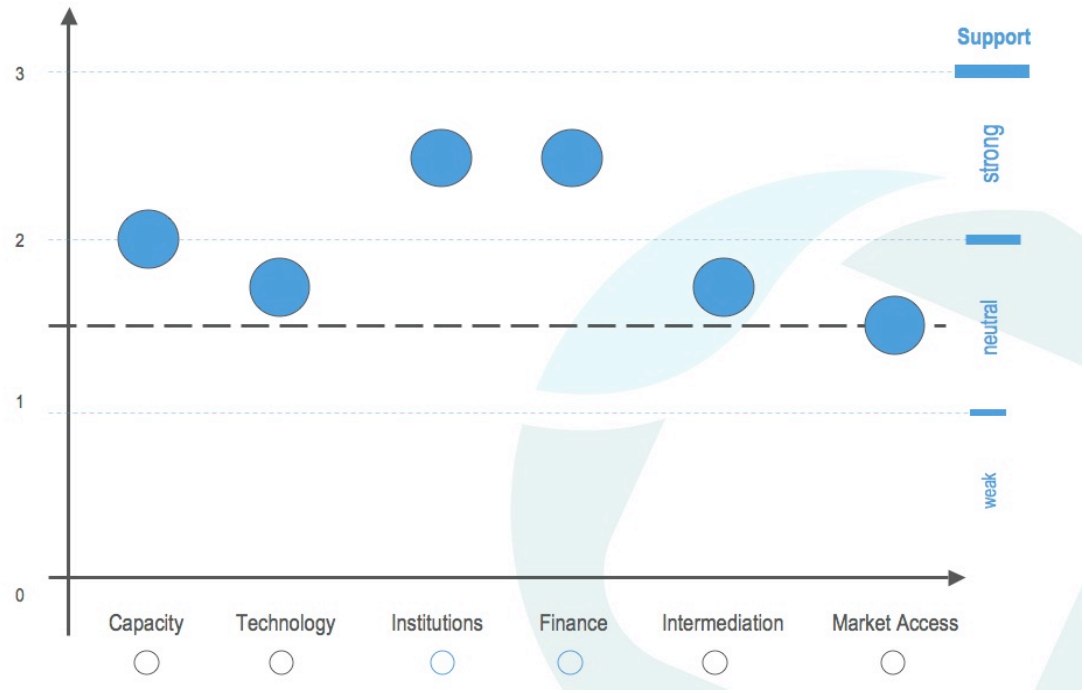
- First, the report analysed the systemic conditions for low carbon entrepreneurship in East China – and particularly Wuxi. The objective was to identify and describe the main dimensions characterizing the entrepreneurial landscape in Wuxi.
- Secondly, the analytical section of the study focused on concrete examples of so-called low carbon markets in Wuxi. The objective was to get an initial overview of major market potentials for low carbon entrepreneurs.
- The final section combined landscape and markets within a hot spots framework. This enabled the identification of focal areas for enabling more low carbon entrepreneurship in Wuxi. These leverage points for low carbon entrepreneurship represent the basis for the selection of international good practice cases presented in the following section.

3.2 The Entrepreneurial Landscape of Wuxi

The aforementioned landscaping exercise combined different research methods, such as desk research and qualitative interviews, as well as primary data provided by Chinese partners and public data. The study does not claim to maximise scientific rigor or potential for scientific generalisation, but rather serves as an efficient scoping approach. The identification of dimensions shaping the entrepreneurial landscape built on (Wickham, 2006) and previous work by the CSCP (2010). It yielded six dimensions assumed to be particularly relevant for entrepreneurship in East China and Wuxi in particular: (i) capacity, (ii) technology, (iii) institutions, (iv) finance, (v) intermediation and (vi) markets (see Figure 5).

[5] Leverage points are defined here, as aspects that combine a particular need for action and a major potential impact.

Figure 5: The entrepreneurial landscape of Wuxi



Source: Philipps, Grossi, & Coles, 2012

The study analysed these dimensions with regard to their potentials for nourishing the development of low carbon entrepreneurship in Wuxi. Obviously, support differs across dimensions: strong dimensions like finance, norms and institutions could be utilised to drive low carbon entrepreneurship; neutral ones like capacity might deserve further analyses; and relatively weak dimensions like technology, intermediation and market access should be actively strengthened by the local administration and stakeholders.

Table 1: Key Markets

Push Markets / High Local Impact	**Low Carbon Transportation** New mobility; city logistics **Collaborative Consumption** Sharing and swapping schemes **Efficient Consumption** Long-life and efficient products; consumer information	**Energy infrastructures** Services for system integration, analyst services, energy services **Building and Construction** Urban mining; smart buildings **Circular Economy and Eco-Design** Eco-design services; business consulting
Low Local Impact	**Conventional industries** Scaling-up existing production capacities in saturated markets	**Investment in additional production** Scaling-up of existing production also in emerging industries
	Low Margins	Pull Markets / High Margins

Source: Philipps, Grossi, & Coles (2012)

Subsequently, the analysis focused on singling out specific markets in the local context of Wuxi, which ideally fulfil two criteria: I) products and services sold in these markets should contribute to the aim of a low carbon city (or at least support adaptation); II) market conditions should allow for self-reliant profit and non-profit activities of providers. Table 1 shows most promising low carbon markets for Wuxi (upper right field of the matrix), in which the bold lines represent the general market dimension followed by specific examples.

Finally, the report combined most promising low carbon markets and landscape dimensions in a hotspot framework. Local experts in Wuxi verified certain strengths and weaknesses. Altogether, the analysis suggests the following market segmentation and relative hot spots.

Table 2: Entrepreneurial Hot Spots for Wuxi

Dimensions of Low Carbon Entrepreneurship and Particularly Relevant Markets						
Dimensions	Capacity	Technology	Finance	Institutions	Intermediation	Market Access
Markets						
Services for energy system integration e.g. flexibilities and storage capacities for renewables		●	●	●	●	●
Energy Analyst and Energy Services e.g. energy contracting or optimisation of production		●	●	●	●	●
Urban Mining e.g. re-use/cycling of materials from dismantled buildings		●	●	●	●	●
Smart Buildings e.g. centralised cooling systems; passive cooling etc.		●	●	●	●	●
Ecodesign services e.g. enable producers/architects to design cradle-to-cradle		●	●	●	●	●
International business consulting e.g. help SME to enter international markets		●	●	●	●	●
Caption: Yellow = potential hot spot; blue = potential strength; Grey = rejected hot spot / strength						

Source: Philipps, Grossi, & Coles (2012)

4 Learn From Your Peers – Case Study Analysis

Business today is adapting to diverse operating environments in which environmental and social aspects are increasingly influencing business activities. There is no magic formula for

or no “one size fits all” business model how to conduct a successful business. Generally, a business model can be defined as a plan implemented by a company to generate revenues and make profits from its activities. It is the architecture and description of products, services, information flows, and business actors involved in the whole life cycle.

As a result, a decision by an enterprise to adopt a given business model depends on many factors, including the size of the organisation, its share of a given market and customer base, internal resources (e.g. management system, corporate culture and human resources), and external factors that affect the businesses or organisation – here subsumed and systematised with the help of the entrepreneurial landscaping approach developed in WP12.1 (e.g. financial system, government regulations, stakeholders´pressure etc.).

4.1 The Good Practice Case Study Set

The following section introduces innovative low carbon business models that address the weaknesses and play to the strengths depicted in table 2. The six dimensions of the entrepreneurial landscape in Wuxi serve as structure for the case set. The absence of cases under the capacity dimension stems from the focus of leverage point identification. The section presents the results in a condensed form. Each case study features a short description and highlights the economic, environmental and social dimensions. Care has been taken to only include direct social benefits such as job creation or awareness rising and reduced energy use and emissions that improve society, but are viewed as environmental dimensions.

The market barriers and drivers identified are intended to be those relevant to the solution or sector concerned. They are likely to be common factors wherever the case is replicated and also indicate underlying market attractiveness. The transferability aspects that follow should be viewed as some of the key framework conditions required for applying this model in other areas or countries. These are not exhaustive but emphasise that good practice is that which is appropriate to the conditions and resources available when transferred. Some of these are prerequisite of available policy, financing and infrastructure, others can be solved through collaboration and partnership to provide necessary know how.

Each case finishes with one or more key lesson learned from the case that contribute to the overall knowledge on Low Carbon Entrepreneurship, expanded upon in the actor based recommendations in chapters four and five. The majority of the analysed case studies stems from China; however some European good practices are also presented due to their relevant low carbon entrepreneurial activities and strategies in the local context of Wuxi.

4.2 Technology

The access to technology is a fundamental prerequisite for low carbon business solutions. This includes not only access to technology products but also access to technology information in terms of market stability and liquidity.

Case Study 1: Tsingtao Beer Stock Company - CHINA

Market: Service for Energy System Integration

Industrial Sector: Food Sector

Low Carbon Business Solution: Low Carbon Research Agreement

German settlers in Qingdao, China, founded the Tsingtao Brewery in 1903. In order to actively cope with current environmental challenges, the Tsingtao Beer Stock Company Limited has undertaken resource efficient measures. In 2008, the company has signed a low-carbon research agreement, the first of its kind in China's brewing industry. Signed in conjunction with the China National Institute of Standardization and China Quality Certification Center, the research agreement aims to find out how much greenhouse gas is produced in brewing beer and to help the company work out a more environmentally friendly production model. Also, in order to actively cope with climate change, Tsingtao Brewery has taken measures such as energy conservation, recycling of carbon dioxide and greenhouse gas emission reduction.

Environmental, Economic and Social Impacts	
Economic	A new method of waste heat cooling and recovering waste heat of condensate has been implemented in order to produce cooling ice water, reducing power consumption of the refrigeration system. Doing this, more than 900 million Euros have been already saved.
Environmental	Since 2009, the company has implemented 51 energy-saving technologies, such as heat recovery, boiler operating control optimization and carbon dioxide energy saving modules, helping to reduce CO_2 emissions.
Social	When promoted, the improved environmental impact of beer production helps consumers to consider the impact of their consumption, encouraging more responsible shopping choices in other areas.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
There is still a large gap between brewing technology in China and that in developed countries, particularly in the area of energy consumption.	• The provision of environmental friendly products is likely to encourage consumers for purchasing and increase the company's market competitive advantages over competitors. • Developed countries are increasingly looking towards carbon tariffs and trading to limit China's beer exports, which affects the international competitiveness of Chinese beer products.

Transferability Aspects
• Market demand from distributors, retailers, or consumers for lower impact products. • Development of an integrated supply chain. • High-level of technical innovation required. • Initial financial investments needed.

Key Learning
Adopting higher levels of energy and resource efficiency technologies as well as a improved compliance with environmental regulations enables Chinese companies to successfully compete on the international markets.

Case Study 2: Gold HongYe Paper - CHINA

Market: Service for Energy System Integration

Industrial Sector: Paper Production Sector

Low Carbon Business Solution: Low Carbon Production Processes

Gold Hong Ye Paper (Suzhou Industrial Park) Co., Ltd., located in Suzhou Industrial Park in Jiangsu Province, was founded in March 1996. Due to the usage of biological latex, biofuels and other alternative materials, the company has been able to reduce production costs as well as the use of resources such as oil, and carbon dioxide emissions. The company has been awarded with the ISO14001 international certification (Environment Management System). In addition to preserve its production process, the company aims at improving the carbon footprint of its products as well. For example, it adopts ultra-high temperature treatment to ensure safety and hygiene of products, uses 100% virgin wood pulp to guarantee hygiene of raw material, and avoids adding any fluorescent reagent to ensure that no harm is caused to human body. Wuxi has more than 50 papermaking and paper products factories. Therefore this low carbon business model represents a strong economic opportunity for the paper sector and its improvement in sustainability and reduction of carbon emissions.

Environmental, Economic and Social Impacts	
Economic:	By taking up a low carbon supply and production model, in addition to local resources purchasing, the company was able to significantly reduce its use of resources and thus its production costs.
Environmental:	Gold HongYe has implemented the concept of sustainable development in order to reduce CO_2 emissions and resource consumption, by using biological latex, biofuels and other alternative business solutions. It also contributes to re-forestation projects in order to offset its carbon emissions by improving plantation productivity. In 2008, about 300,000 hectares of forest were planted in China, with a total carbon stock of 6.48 million tons, with an average annual carbon sequestration of 2.17 million tons, and average annual oxygen emission of about 5.79 million tons.
Social:	Gold HongYe has changed its business strategy and actually purchases local resources in order to reduce resources consumption linked to transport processes as well as to improve local living conditions by creating employment opportunities. As a result, the local sourcing rate has increased up to 94.16%.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
The highly polluting processes implied in standard production processes need to be replaced, requiring investment and changes throughout the supply chain	• Opportunity to access international market segments due to the implementation of energy and resource efficiency production processes as well as increased market-share due to environmental friendly products. • Stricter Chinese government regulation on deploying low carbon measures is now being applied. These not only constitute a means to enhance revenues streams but also force local businesses to comply with stricter environmental standards.

Transferability Aspects
• Specific market conditions and significant market demand created by resource dependency. • High-level of technical innovation. • Policy support for the implementation of low carbon business solutions (i.e. stricter environmental regulations, financial incentives) is needed.

Key Learning
Company action to integrate and protect key resources in the supply chain and investments to keep ahead of legislation protects future market share and productivity

Case Study 3: Daikin Air-Conditioning - CHINA

Market: Smart Building

Industrial Sector: Building sector

Low Carbon Business Solution: Low Carbon Remote Energy Control System

Daikin Air-Conditioning (Suzhou) Co., Ltd. (Suzhou, Jiangsu Province) sells residential air conditioners and light commercial air conditioners. Since December 2011, the company is 100% owned by Daikin (China) Investment Co., with annual production of 1.5 million units or 142 million Euros.

In order to optimize this usage, Daikin has developed a remote energy tuning service. Besides offering and coordinating maintenance services, it integrates a remote tuning. The Remote Monitoring Centre collects performance data of the connected air conditioning systems and optimizes their energy efficiency. The main goal is to cut energy consumption while maximizing convenience for the users by adapting the system to their needs. High efficiency is achieved in three ways: by keeping electricity consumption below the set peak electricity demand; by preventing excessive cooling or heating of rooms; by automatically controlling air conditioning.

Environmental, Economic and Social Impacts	
Economic:	The air conditioning market in China is approximately 225 billion Euros in 2010 (occupying 18% of global demand according to Daikin estimates). Daikin's business in China has rapidly expanded and surpassed the rate of market growth.
Environmental:	First tests and calculations assessing the service revealed that it cuts energy consumption for air conditioning by about 20 % (Daikin Industries 2010). At Katsura campus of Kyoto University, on average 23% of building energy use have been saved during summer
Social:	In addition to the main goal of cutting energy consumption, Daikin also endeavour to ensure a maximum convenience for end users by adapting the system to their needs.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
Lack of knowledge/information (e.g. lack of knowledge among planners and technicians) and social factors (e.g. risk averse attitudes in the construction sector and the lack of awareness of home owners) are among the most significant barriers of eco-innovation in the construction sector.	The revised “Rationalization in Energy Use Law” provides companies with a window of opportunity to further enhance their markets share. This law aims to contribute to the sound development of the national economy through implementing necessary measures for the rational use of energy in factories, buildings, and machinery and equipment, and other necessary measures to comprehensively promote the rational use of energy. "Energy" in this law means fuels such as oil, flammable natural gas, and coal, as well as heat and electricity produced by using such fuels (excluding electricity generated by the renewable energy such as photovoltaic cells, wind power, etc.).

Transferability Criteria

- Need of raised consumers’ awareness in terms of service.
- Market demands for specific smart energy saving systems.
- Increase governmental support through tailored market-based instruments such as taxes

Key Learning

The combination of company expertise with government support enables entrepreneurship beyond supply of products into services to foster energy management services, improving energy in use from the private to the public sector. The air conditioning market in China has been rapidly expanding and it is seen as the second market in scale with a market share of approximately 225 billion Euros in 2010. Nonetheless, to effectively seize this market opportunity stronger governmental support is needed

Case Study 4: ENN Group Co. Ltd. - CHINA

Market: International Business Consulting

Industrial Sector: Energy Sector

Low Carbon Business Solution: Low Carbon Energy Efficiency Solutions and Consulting Business Services

The ENN Group was founded in 1989. By 2009, the company counts 25,000 employees and total assets of 3.9 billion Euros. Its activities include technical devices and services, such as renewable energy installations, clean fuel supplies and recycling systems, as well as capital financing and consultancy services (i.e. assessment of project design; policy requirements; data logging etc.). ENN has a very broad portfolio and thus does not solely depend on the potentials or market penetration of a single technology. In general, the company strongly benefits from the combination of China´s growing energy demand and its scarce natural resources, resulting in a high demand for energy- and resource- efficient solutions.

Environmental, Economic and Social Impacts	
Economic:	ENN group has witnessed a massive growth in the last years and plans to expand its business. In September 2011, the corporation announced that it will invest a total of 5.9 billion Euros in clean energy projects in the United States over the next 10 years making ENN an important market player, not only in China, but also internationally.
Environmental:	ENN is involved in a broad range of fields related to clean energy solutions. Besides carbon emissions, the company's business activities contribute to other environmental purposes, such as alleviating air pollution by designing technologies for clean burning fuels.
Social:	ENN contributes to an improved social performance through helping to reduce environmental degradation, for instance, by improving air quality due to the market penetration of high quality fuels, leading to improved living conditions for local communities.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
In the short-term, innovative energy solutions often imply higher investments, operating and maintenance costs, in comparison with mature, long-time established technologies.	The company strongly benefits from the combination of China's rapidly growing energy demand and its scarce natural resources. As a consequence, there is a high demand for energy- and resource- efficient solutions.

Transferability Aspects
• Expertise in the policy framework for renewable and alternative energy technologies needed. • Knowledge about the potentials of technology solutions. • Industrial sectors with high-untapped energy saving potential and lacking internal knowledge to implement changes.

Key Learning
The development of market-based instruments, ideally with direct government support can speed up the adoption and implementation of resource efficiency and cleaner production measures and tools within companies 'strategies

Case Study 5: LowExNet - CHINA

Market: International Business Consulting & Smart Buildings

Industrial Sector: Energy Sector

Low Carbon Business Solution: Low Carbon Energy Efficiency Solutions and Consulting Business Services

The LowExNet has been founded as a result of the work of the Energy Conservation in Buildings and Community Systems (ECBCS), a collaboration activity within the general framework of the IEA (International Energy Agency). The general objective is to accelerate the use of cost-effective and environmentally sustainable energy sources for the heating and cooling of buildings. Besides the reduction of fossil-based energy, another approach that is becoming more and more popular is called low exergy. The exergy of a system is the maximum of useful work possible during a process that brings the system into equilibrium with an existing heat or cooling potential. When the surroundings are the reservoir, exergy is the potential of a system to cause a change as it achieves equilibrium with its environment. Exergy sources are usually solar radiation, tidal forces, ground water and geothermal heat. Ground source heat and geothermal energy have huge potential in the building sector, and there are many new methods of capturing passive solar energy as heat, as well as passive wind energy for more efficient ventilation.

Environmental, Economic and Social Impacts	
Economic	Renovation represents great energy and cost saving potential. For instance, in Germany alone, the energy consumption of an existing house has been cut to 10-30% of the level before renovation or at least under 50 kWh/m^2a.
Environmental	Implementing these kinds of low carbon business solutions to the whole building stock would imply a significant reduction in CO_2 emissions.
Social	The requirements of the social housing have to be taken into account, which limit the economical burden for the tenants, through government support or innovative long-term financing

Market Drivers and Barriers	
Market Barriers	**Market Drivers**
• To benefit from some low and zero carbon energy sources, implies a change of the supply philosophy from an individual building approach to a collective district approach. • Additional development is needed at the level of the network infrastructures, namely pipe material, configuration, installation and optimized operation, including demand management. • Innovative solutions are still needed to realize the whole potential in renovation, like new types of insulation, construction details and ventilation systems.	Low Exergy sources constitute a new approach in District Energy Supply (DE). In the future, renewable and thermal storage will play a greater role in DE systems, which means more crosscutting between different low-carbon energy.
Transferability Aspects	
• Support of energy services company • Consumer awareness raising activities • High-level of information flow among key business actors • Integration in land development criteria and neighbourhood design	

Key Learning
The Low Exergy Approach needs a strong collaboration at the community level as well as among different planning partners: housing association, architectural and engineering consultants, research institutes, and governmental agencies.

Case Study 6: NingXia YinXing Energy Co/ Mitsubishi Heavy Industries Ltd - CHINA

Market: Services for energy system integration

Industrial Sector: Power generation

Low Carbon Business Solution: Wind Power generation Technology

Ningxia Yinxing Energy Photovoltaic Equipment Manufacturing Co.,Ltd was established in 2006. It is a part of the Ningxia Electric Power Group, which develop integrated coal-fired power plants, wind power, coal chemistry, wind turbine manufacturing, wind power plant construction, PV module manufacturing, PV plant construction, automatic instruments manufacturing, etc. Ningxia Yinxing is also a Chinese state-owned enterprise that focuses on PV modules production and provision of PV power generation solutions. In 2010, Mitsubishi agreed to transfer its 2.5-megawatt wind turbine technology to NingXia YinXing Energy Co., which has enhanced NingXia YinXing's wind turbine production volume.

Environmental, Economic and Social Impacts	
Economic:	The transfer process has enhanced revenue streams of both Ningxia Yinxing and Mitsubishi. From the transfer contract, NingXia YinXing should pay Technology Permit Fees to Mitsubishi. Mitsubishi gains certain percentage of the profit of this technology.
Environmental:	This process has contributed to replace traditional energy supply with innovative wind power technologies, which in turn significantly reduces greenhouse gas emissions.
Social:	NingXia YinXing is promoting public awareness, while working on creative solutions to ease the inevitable transition for the customers.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
The overall process requires close cooperative strategies or intermediates to connect actors and secure clear patent agreements.	Higher compliance with national and international environmental standards and regulations, as well as significant reduction in operating costs for the companies.

Transferability Aspects

- Producer and technology provider operate in the same market.
- Experience in product design and production process required.
- Market penetration takes long time. There is a risk of low market acceptance.
- Patent negotiation is a sensitive issue.

Key Learning

The development and implementation of energy efficient technologies and production processes can be further enhanced by setting up tailored partnerships between the technology and energy provider, which leads to higher leverage on the national and international market scene.

Case Study 7: GEA Heat Exchangers - GERMANY

Market: Services for energy system integration, smart buildings

Industrial Sector: Heating

Low Carbon Business Solution: Energy Efficient Heat Exchange Technologies and Measures

GEA Group Aktiengesellschaft is one of the largest system providers for food and energy processes with about 5.4 billion Euros revenue in 2011. As an internationally operating technology group, the company focuses on process technology and components for sophisticated production processes in various end markets, such as design, production and installation of heat exchangers. The group generates about 70% of its revenue from the growing food and energy industries.

GEA Heat Exchangers extends from air conditioning systems to cooling towers. The compact finned-tube heat exchanger systems offer environment-friendly and cost-effective solutions to cool air or liquids involved in refrigeration processes or industrial machines and engines.

Their combined experience enables them – in close collaboration with engine manufacturers and plant-systems contractors – to develop dedicated, customer-oriented, and economical concepts for optimization of the complete charge air modules on an engine. As result of the use of special materials, advanced coating technology, and new finned-tube systems.

Environmental, Economic and Social Impacts	
Economic:	Reduction of long-term energy costs per unit of output increase the competitiveness of the companies using heat exchangers.
Environmental:	Reduction of CO_2 emissions in the residential, industry sector and tertiary sector due to energy saving in cooling and air conditioning devices.
Social:	Energy efficient residential products can contribute to affordability of solutions to improve local community living conditions

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
• The initial investments costs are quite high and not easily affordable without financing options. • Market penetration takes long time. There is a risk of low market acceptance.	Increment of fuel prices increases the incentives to install energy efficient heat exchangers, since fuel cost plays an important role for national and international competitiveness of companies.
Transferability Criteria	
• Experience in product design and production process required. • Awareness raising and financing infrastructure required establishing the market.	

Key Learning
Close interaction among research and development, manufacturing, and sales & service within an extensive corporate network can be a driver to establish new markets for low carbon solutions.

Case Study 8: China Glass Holdings Limited - CHINA

Market: Energy efficiency

Industrial Sector: Glass market sector

Low Carbon Business Solution: Reduce Energy Use in Buildings

China Glass is dedicated to Research & Development (R&D) manufacturing and selling of a variety of coated glass, energy-efficient and environmental-friendly glass, and new-energy products. China Glass owns dozens of national and world-class glass patent technologies. Being one of the three companies in the world owning LOW-E glass[6] and online TCO glass

6 Low emissivity (low e) - actually low thermal emissivity - is a quality of a surface that radiates, or emits, low levels of radiant thermal (heat) energy. All materials absorb, reflect and emit radiant energy.

technology[7], it is the only one that has a full set of independent intellectual property right of such products and the leader in the R&D of online coated-glass technology in China. Its activities and production processes enhance energy and water efficiency, reduce emissions, and develop coated glass products that reduce energy use in buildings.

Environmental, Economic and Social Impacts	
Economic:	In 2008, International Finance Corporation (IFC) provided a 22.1 million Euros loan for a 33.2 million Euros project to help China Glass to achieve its low carbon targets. Manufacturing costs can be reduced by over 39.8 million euros /year. The complete line is now among the most profitable of China Glass' 14 lines.
Environmental:	Annual greenhouse gas emission of China Glass is expected to decrease by over 22,000 tons. China Glass has one of the first installations of waste heat recovery systems for electricity generation in the glass industry in China.
Social:	Coated and energy efficient glass products can improve domestic living conditions.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
There are already national and multinational glass companies in China, which makes competition and market penetration harder.	Considering the current glass production system in China, companies bringing in innovative and energy efficient technologies and products could diversify themselves from the mass market and gain significant competitive advantages over competitors.

Transferability Aspects

- Existing facilities or subsidiaries to ease the implementation of such energy efficient products in a competitive glass market (China Glass had many across the country)
- Higher-quality and coated glass products diversification is required.

Key Learning

In the competitive glass market, innovative efficient products reducing energy demand can offer a company a unique selling point and differentiation from generic competition.

4.3 Market Access

Low carbon business models face harsh competition from established solutions. In addition, they need fair market access to at least enter competition locally, nationally and on the international stage. Showing the real value of low carbon solutions brings about various valuation challenges. Enabling market access and fair competition, therefore, needs the support of various actors and enablers.

[7] TCO glass is also called transparent conductive oxide coating glass. Using physical or chemical method to form uniform and transparent conductive oxide thin film including In、Sn、Zn and Cd oxide and its composite multi-oxide thin film materials. TCO glass was originally used in flat panel displays; the conductive glass of ITO type is still the mainstream glass electrode product of flat-panel display industry. In recent years, the price rise of crystalline silicon has greatly promoted the development of thin-film solar cells.

Case Study 9: Verbraucherzentrale NRW - GERMANY

Market: Local Consulting and Smart Buildings

Industrial Sector: Housing & Living

Low Carbon Business Solution: Consulting Households on Improving Energy Efficiency

Verbraucherzentrale NRW offers energy modernisation for private owners of flats and residential buildings (up to a maximum of 12 housing units) in the Ruhr region, where the proportion of un-renovated houses is higher than the national average. The project of individual energy consultancy was designed to bridge the gap between climate protection and strengthening the regional economy. The consultancy for private owners of flats and residential buildings was designed to increase the individual motivation of private households to invest in energetic modernization and to provide them with necessary technical information.

The measures recommended during an individual consultancy help to save energy on a long-term basis and improve the quality of buildings. The reduction of heating energy consumption and the improvement of thermal insulation contributes to decrease the contribution of private households to greenhouse gas emissions. House owners employ local and regional craftsmen to carry out the energetic upgrading. For more comprehensive projects - such as carrying out combinations of several measures - the house owners also assign architects and planners. This shows that private modernization of buildings is a sustainable investment in climate protection and strengthening the regional economy.

Environmental, Economic and Social Impacts	
Economic:	To further support the energy modernisation of private owners flats and residential buildings the Verbrauchertzentraler NRW can count on a budget of approx. 35.1 million Euros per year which is provided by the government of the state of North Rhine-Westphalia, further supported through project funding, donations and own revenue streams.
Environmental:	With the private energetic measures from 2006 until the end of 2008: • Saving of 75.000 MWh / year in primary energy (ca. 17 MWh / year per building) and • Reduction 23,3 Kilotons of CO_2 / year (ca. 5.5 kt per building) have been realised.
Social:	More than 50% of all advised house owners have energetically upgraded their homes according to the recommendations of the energy consultancy

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
Reluctance of homeowners to allow energy consultants to evaluate their living spaces.	Most German supports the view that Germany should take a leading role in international efforts to mitigate climate change and projects such as this present an opportunity to do so.
Transferability Criteria	
• Provision of legal assistance support to households and private owners of flats and residential buildings. • Available support for sustainable projects to improve living conditions and a combination of public/private funding.	

Key Learning
Renovation of residential building stock can be used as a driver for job creation as well as improving living conditions for the people.

Case Study 10: Shenzhen Institute of Building Research (IBR) - CHINA

Market: Smart buildings

Industrial Sector: Construction

Low Carbon Innovative business solution: Sustainable Buildings

The Shenzhen Institute of Building Research (IBR) is a comprehensive science & technology research institute for buildings and urban development. They designed their own office building, which deploys 40 passive, low-cost, and soft energy efficiency technologies. By employing both simple design tactics and complex technological systems, the building reduces about 1,622 tons of carbon dioxide emissions per year. IBR's performance has enabled a 58% reduction in CO_2 emissions compared to conventional buildings and has the potential for an 80% reduction if the building is able to produce excess energy which can be fed into the power grid.

Environmental, Economic and Social Impacts	
Economic:	The IBR building can deliver an annual saving of 0.17 million Euros of expenditures for electricity supply and 6,394 Euros of expenditures for water supply. Additionally, the construction cost of IBR Building is lower than that of a typical office building. It is certified as a 3-Star Green Building, the highest level in Chinese certification system.
Environmental:	According to actual measurement, annual power consumption of IBR Building saves more than 60% compared to typical buildings. The total power saving per year is 117.57 kWh. The utilization ratio of water recycling is 49%, and the water savings per year is 4,760 m^3. The CO_2 equivalent emission reduction per year is 1,097.85 tons.
Social:	The wide spreading of such a model in China enable to improve the living conditions of local communities enabling them to lower their energy costs

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
• Trade barriers on imported technologies (in this case agreement was made with the Chinese authorities).	• Increased competition on the international and national markets through the provision of tailored energy efficiency technologies and products • Continuous increase in international building codes raising building design standards.

Transferability Aspects

- Appropriate sectors (such as the photovoltaic industry branch and the passive cooling energy systems in Wuxi) to be served by such a centre as leverage points for the future development of the smart building construction.
- The participatory approach and the availability of high-tech technologies are important pre-conditions for the success of energy efficiency driven projects. In other consortia or regions, such an approach and availability of technologies might be difficult to realise.
- Investment: the project received substantial donations from corporations from Italy and China. Without these donations, implementation of the project would have been difficult.

Key Learning

The process of low-carbon architecture involves the joint exercise of ownership rights through the whole process, the sharing of rights and resources and the joint participation of stakeholders in the building design. This participatory approach is an important condition for the success of the sustainable buildings. It demands a lot from all involved actors and might be most transferable to regions with high concentration of high-tech industry and science sectors as well as international cooperation.

Case Study 11: Wuxi Reatgreen Energy Efficiency Co., Ltd - CHINA

Market: Energy Analyst and energy services, smart buildings

Industrial Sector: Energy Services

Low Carbon Business Solution: Low Carbon Campus in Jiangnan University

Wuxi Reatgreen is an ESCO and offers a variety of services, such as Community Energy Management including tailored consultancies for public buildings and companies, as well as for social community concerning energy and water saving. The company has implemented two pilot projects in: 1) Jiangnan University; and 2) the Ministry of Education of China. Additionally, the company has started a pilot project at Wuxi government's office building. So far there are many universities that have copied its ESCO services all over China. About 20%-40% energy and water can be saved by Reatgreen ESCO system. According to Jiangnan University's annual report of electricity and water consumption, the total cost has been halved since Reatgreen's ESCO started.

Environmental, Economic and Social Impacts	
Economic:	Reatgreen's business can reduce 20%-50% electricity and water consumption for its clients.
Environmental:	The electricity consumption reduction results in significant CO_2 emission reduction, given that 1 kwh electricity is associated with almost 1 kg CO_2 in China.
Social:	Reatgreen promotes low carbon lifestyle for residents of its projects, like campus, offices and so on. Reatgreen's employees also have training on energy and efficiency saving measures

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
The ESCO market is highly competitive and represents a high risk to new entrepreneurs, such as strategic failures in business management and in R&D cost control, together with a lack of financial and policy support	Higher and improved compliance with international and national measuring, reporting and verification methodologies (MRV) is a great driver for more than 4,000 ESCO companies, contributing to enhance their market share and access
Transferability Aspects	
Local government support, and Venture Capital or Public-Private Partnership financial support are necessary conditions to successfully replicate this business model	

Key Learning
Growing demand for ESCO system is enormous, but a general platform to support clients such as universities, industries, communities and owners or operators of public buildings is needed. Small entrepreneurs cannot meet this demand because of the high costs it implied.

Case Study 12: Shenzhen Vanke Real Estate Co. - CHINA

Market: Smart Buildings

Industrial Sector: Construction

Low Carbon Business Solution: LEED Platinum Rated Building

The Vanke Center is a multi-functional building including a hotel, offices, service apartments, and a public park. The Vanke Centre is a striking example of energy efficiency. It employs passive and active energy efficiency technologies, including an optimized building envelope, controllable shading devices, day lighting, natural ventilation, under floor air conditioning, heat recovery, ice storage, demand control ventilation, and scheduled lighting. It is China's first Leadership in Energy and Environmental Design (LEED) platinum rated building as well as a demonstration project by China's largest real estate group showcasing eco- technologies and concepts. The project utilizes photovoltaic technology, grey water recycling, rainwater harvesting, green roofs, and dynamically controlled operable louvers, which maximize natural light and provide solar passive cooling.

Environmental, Economic and Social Impacts	
Economic:	Sales revenue at China Vanke Co. increased by the 8.3% year-on-year up to 1.34 billion Euros in 2012. The company's sales revenue totalled 9.98 billion Euros after selling 8.03 million m^2 of housing space.
Environmental:	The centre is provided with a rainwater harvesting system with a capacity of 1,200m^3. A grey-water treatment plant incorporated into ecological wetland can save up to 150m^3 of water every day. The design also uses waterless urinal and low-flow water fixtures, reducing portable water use by 51%. Secondly, the man-made temperate micro-climates inside the building, greatly reduce the need of air-conditioning systems to an annual carbon footprint of 137 kg CO_2/m^2. Thirdly, 1,400 m^2 of photovoltaic panels installed on the roof of the building meet 12.5% of the total electric energy demand for the Vanke Headquarters.
Social:	The scheme boasts a multi-functional community playground and sustainable technology showroom – providing leisure facilities and a platform to educate on sustainable living.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
In this context initial capital costs are normally higher than the average of conventional buildings	• A growing number of Chinese companies are committing to sustainable design. • Substantial life-cycle energy and water savings may successively outweigh the costs of intelligent building technologies.

Transferability Aspects
• High upfront costs of building technologies could constitute an important economic barrier for market penetration. • Creative and modern designers/architects required.

Key Learning
Market opportunities exist and consumers demand is increasing with respect to energy efficient technologies, products and services. To remain competitive in the long-term, companies need to reshape their business models and start providing energy and resource efficient products and services.

4.4 Intermediation

With increasing complexity of technology and economic organisation in the globalised economy, intermediation has gained more and more importance. This includes knowledge brokerage, matchmaking, representation of interests and so forth. The following case is an example of how intermediation could support companies to enter new market segments and stay competitive on the international level.

Case Study 13: Material ConneXion - CHINA

Market: Eco-Design Services

Industrial Sector: Product development

Low Carbon Business Solution: Innovative Processes in the Areas of Materials Science and Environmental Science

Founded in 1997, Material ConneXion is a global materials consultancy that helps companies to innovate through smart materials thinking. Located in the U.S., Europe and Asia, it offers access to membership-based materials libraries with more than 6,000 advanced and sustainable materials and consulting services - from strategy development to materials sourcing, manufacturing support and workshops. With a 360-degree view of the world of materials, its competencies can be used in every area of design, from products, packaging and architecture to interiors, transportation and fashion. Committed to increasing awareness of the invaluable role materials play in design and sustainability, its public and academic programming has played a key role in educating hundreds of thousands of designers and students through exhibitions, lectures and, increasingly, the development of material libraries within academic institutions.

Environmental, Economic and Social Impacts	
Economic:	In the context of economic performance, ecological material design is one of the main opportunities for differentiation. The differentiation strategy should concentrate on achieving superior performance in an identified customer benefit area valued by a large part of the market.
Environmental:	Design solutions that take into account the human and ecological impacts of the product's materials as well as the ability of that product, to be truly recycled or safely composted.
Social:	A broad definition of sustainable design implies that companies incorporate environmental and social factors into product development throughout the life cycle of the product, throughout the supply chain, and with respect to their socio-economic surroundings (from the local community for a small company, to the global market for a transnational company.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
From a market point of view, most of the solutions are in a premium segment. That could be a barrier for their economic-wide diffusion.	The interest in product innovation has grown rapidly during the past decades. Industrialization, open markets, higher (quality) requirements of customers, and an increase in competition between companies locally and globally have created a serious demand for a structured process for product innovation within industry.

Transferability Aspects
• Knowledge of specific market conditions and operating processes
• Knowledge of consumer behaviour
• Extensive information on government policies and environmental legislations

Key Learning

External expertise on material design could become an engine for modernization among companies, product developers, local designers and manufacturers to increase the level of innovation and creativity in products and services.

4.5 Finance

Investment and finance remain crucial enablers of start-ups. In particular, innovative approaches usually take time until they meet the requirements of conventional financial instruments. On top, even established SMEs fail to obtain loans for low carbon investments, in China and other Asian countries. Therefore, a better understanding of low carbon concepts on the side of financial institutions and new instruments are keys to a low carbon future.

Case Study 14: China Merchants Bank - CHINA

Market: Services for energy system integration

Industrial Sector: Finance

Low Carbon Business Solution: Green Financial Innovation for the Chinese Market

China Merchants Bank was founded in April 1987 and it is headquartered in Shenzhen, China. The bank primarily focuses on the Chinese domestic market. It offers a range of corporate and retail banking products and services to its clients, including: granting loans; issuing financial bonds; insurance agency services; foreign exchange; letter of credit and guarantees; and underwriting and trading government bonds. Additionally, China Merchants Bank (CMB) has been committed to green development and to actively explore innovative financial operations for green businesses and projects, and thus contributed to the construction of a ”resource-saving and environment-friendly” society.

China Merchants Bank is obliged to guide the optimized allocation of resources through its business operations, and to restrict loans for enterprises out of the line of sustainable development standards through adjustments in its credit policy. In 2011, China Merchants Bank formulated the Green Credit Plan in the industry, setting up a goal of “building the first-class credit bank in China."

Environmental, Economic and Social Impacts	
Economic:	CMB actively explored green financial product innovation, actively strengthened their cooperation with domestic and international environmental agencies, and explored the development of green finance.
Environmental:	CMB in recent years actively practiced the concept of low-carbon and credit policy and financial services to curb the costs of its production operation as well as of high pollution.
Social:	CMB implemented the card program on the notion of "working hours for public welfare", which integrated the low-carbon notion with the employee behaviours. CMB encouraged the "cardholders" to participate in at least eight hours of low-carbon public welfare work and to join the low-carbon campaigns.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
Many entrepreneurs still face substantial challenges to obtain funds mainly due to lack of information, technological innovation leading to uncompetitive sustainable products and services.	Green financial product innovation, actively strengthened by the cooperation with domestic and international environmental agencies.

Transferability Aspects
Governmental support in terms of fostering green credit policies and the development of environmental-friendly industry is needed to successfully replicate green financial development.

Key Learning
The transition in the global industry chain has increased the opportunity for start-ups to enter the market through innovative business strategies and models. The finance industry needs new products and approaches to address these.

Case Study 15: KredEx - Estonian Credit and Guarantee Fund - ESTONIA

Market: Smart Buildings

Industrial Sector: Housing & Living

Low Carbon Business Solution: Consulting Services for Households on Improving Energy Efficiency and Financing Options

KredEx - Estonian Credit and Guarantee Fund, was established in 2001 by the Ministry of Economic Affairs and Communications with a purpose to improve the financing opportunities of small and medium-sized companies, manage credit risks connected with export, enable people to build or renovate a home or apartment house and develop energy-saving way of thinking, thus change their behavioural habits towards improved energy efficiency. The Energy Efficiency Consulting Centre is a specific programme of its kind, which has been created inside of KredEx with the aim to help housing associations to improve their energy efficiency performance. The direct target is to reach, in fact, the real energy savings in block-houses, to

improve the quality and comfort of the inhabitants' living environment. The indirect aim is to save local fuels and thus also alleviate the climate warming. Saving fuel in the heating sector allows combating climate change through reduction of CO_2 emissions. The programme is also oriented to reduce the resource consumption, promote sustainable lifestyles through enhanced awareness of energy saving and efficiency. ESK was founded in January 2007 on the initiative of Estonian Credit and Guarantee Fund KredEx.

Environmental, Economic and Social Impacts	
Economic:	In year 2010, the total amount of 2 billion kroon (127 million Euros) was issued to 400 enterprises with the help of KredEx loan guarantees and subordinated loans. The guarantee and loan portfolio of KredEx grew by 40% during the year, reaching 1.8 billion kroon (114 million Euros) by the end of the year.
Environmental:	The majority of energy in Estonia is produced with oil shale, which accounts for 80% of CO_2 emissions generating 21% of the energy needed to produce heat. Therefore, more energy efficient apartments require less energy for heating and less demand for oil shale, which results in reduced emissions of CO_2.
Social:	Financing helped to create 90 new enterprises and 1,200 jobs, and preserve about 10,000 jobs. The direct results are real energy savings in multi-store apartment houses, improved living environment of the residents and apartment owners. The indirect result occurs via saving of fuels needed for heat generation.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
• The biggest barrier could lay in the lack of sufficient financing for complex refurbishment works. • The housing associations in general are rather heterogeneous, thus not able to start costly and complex renovation projects on their own.	• Based on the Directive 2002/91/EC of the European Parliament and the Council from December 16, 2002, on the energy performance of buildings, European countries have the obligation to develop and implement measures to make the use of energy more efficient in existing buildings in 2009. • In addition to financial payback and reduced CO_2 emissions, the less tangible benefits of improved energy security increased system reliability and resource conservation took place.

Transferability Aspects
Public financial support has been a deciding factor in making refurbishment programmes for relatively voluminous apartment houses possible.

Key Learning
Seed money in the form of grants from government and structural funds is a factor, which could trigger massive programmes of refurbishment of multi-store apartment houses.

4.6 Institutions

The below cases show that institutional settings can support or hinder economic dynamics, often depicted as merely dependent on accumulation of capital or technological progress. This is particularly the case in the context of emerging markets like China and economic activities like starts-up.

Case Study 16: Municipal depart. for building construction - SWITZERLAND

Market: Urban mining

Industrial Sector: Waste management

Low Carbon Innovative business solution: Urban Mining of building construction

Because construction and demolition waste comprise around 33% of waste generated annually in the EU (EEA, 2010), recycling is a large opportunity for increasing resource efficiency. With regard to this Urban Mining, it is not only relevant for decoupling ithe construction sector, but also for reducing primary resource inputs at the overall level of economies. The resource strategy is part of the political vision "Sustainable City Zürich – on the Pathway to a 2,000 Watt Society". This vision integrates the targets of a lower resource use with a low carbon perspective. The Urban Mining Strategy has been developed in three steps:

- Analyzing the state of the art of construction and demolition recycling.
- Modeling scenarios with different pathways.
- Creating a vision and measures of sustainable material management.

Environmental, Economic and Social Impacts	
Economic:	The output/input relations of secondary material fluxes have a considerable influence on urban mining practice. If there are more materials than can be integrated in new buildings, prices may decrease and high grade-recycling sites could experience problems achieving an adequate turnover.
Environmental:	The idea is to reduce energy consumption to 2,000 watts per inhabitant, reduce its annual CO_2 emissions to one ton per capita by 2050, promote renewable energies and energy efficiency, and not renewing its investments in nuclear power plants.
Social:	It is important to promote recycling businesses, as they have also been long known to be a substantial job provider to various sections of society.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
Urban mining in the construction sector and the business of building houses and infrastructures has been almost completely separate regimes characterized by quite different logics. This has hindered systemic innovation and delayed progress toward a circular economy.	Energy efficient technologies in the building sector represent a competitive market for innovative companies implementing sustainable business models and support the mainstreaming of energy and resource efficient technologies, products and services.

Transferability Aspects

- A sustainable urban mining strategy needs an integrated monitoring based on indicators and methods to quantify and qualify the material inputs in new construction.
- Access to basic data such as a systematic data base on stocks in the existing built-environment and the state of back loops to the construction sector from refurbishment and deconstruction.
- Knowledge of specific market conditions and operating processes, consumer behaviour, government policies and environmental legislations.

Key Learning

- By promoting urban mining to displace virgin inputs for the construction sector and its products, city leaders can ensure resource savings.
- It is relevant for policy makers to consider to what extent building stocks are close to exhaustion and where necessary, develop appropriate recycling strategies using the wasted materials as a new source for new construction activities.

Case Study 17: Beijing Deqingyuan Agriculture Technology Co. Ltd - CHINA

Market: Eco-Design Services & Models

Industrial Sector: Agribusiness

Low Carbon Business Solution: Ecological Breeding

Beijing Deqingyuan Agriculture Technology Co. Ltd. (DQY Agriculture) is a pioneer in agricultural industrialization and ecological agribusiness. It was founded in 2000 and aims to provide high-quality green foods to customers. Its investors include the International Finance Corporation (IFC) and Global Environment Facility (GEF). DQY Agriculture's ecological breeding farm produces a tremendous amount of chicken manure annually, which would become a huge source of pollution if not treated effectively. At the same time, the manure is an untapped biomass resource with enormous energy and fertilizer potential. DQY Agriculture started the feasibility study and the design for a Biogas Power Generation Project in 2006. The initiative has obtained great support from the IFC and local government. The Biogas Power Generation Project has reduced the waste of the agriculture's breeding farm, supplying farm's internal needs and selling extra electricity to State Grid.

Environmental, Economic and Social Impacts	
Economic:	The development of the project brings an annual revenue of 0.94 million Euros through its sales of extra electricity to State Grid. It is estimated that the electricity cost alone of DQY will save more than 0.88 million Euros per year
Environmental:	The project enables the hazard-free treatment of chicken manure, and reduces 83,000 tons of CO_2 emissions per year. Moreover, the 150,000 tons of liquid methane and 6,600 tons of methane residues produced in biogas process systems will be transformed in low-cost organic fertilizers
Social:	The DQY Agriculture's breeding farm consumes 60,000 tons of corns planted in this area every year, guaranteeing as much as 8.29 million Euros stable annual income to the neighbouring farmers. The project activity can reduce the emission of SO_2, NO_x and dust, enhance the quality of the water, control the odour, and improve the working environment of the workers and the production and living conditions of the farmers.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
Producers view the Animal Waste Management System (AWMS) as a stage that is outside of the production process and have difficulty to finance changes that should be undertaken. Even banks are unwilling to finance such activities without government guarantees or other incentives. Specialist management skills are required to meet such high environmental standards.	Demand for higher agricultural standards, waste management and low carbon energy. Once established the high price of entry and skill requirements may deter competitors from capturing market share for the foreseeable future.

Transferability Aspects

- Setting up an operation like Deqingyuan's is expensive. The birds' cages have come from Italy, the fertiliser-making equipment from Germany, and the biogas plant from America's General Electric.
- Heavy weight foreign investors are necessary in order to start up such a business model.

Key Learning

Expenditure on household consumption is rising, much of it going towards better quality food. So highest environmental and animal-husbandry standards are becoming more and more relevant with respect to market competitiveness.

Case Study 18: Samsoe Renewable Energy Island - DENMARK

Market: Energy services and analysis

Industrial Sector: Housing & Living

Low Carbon Business Solution: Renewable Energy

The project aimed at 100% renewable energy on the Samsø Island within 10 years (1998 - 2008, achieved 2 years before target). In order to facilitate the transition, it built upon counselling services for citizens who wanted to establish their own energy efficiency projects as well as education campaigns on renewable energy technologies and energy savings for reluctant citizens. The project used the following means to develop the project: cutting consump-

tion and increasing efficiency of heat and electricity consumption as well as transport; expansion of the district heating supply systems, combined with utilization of local biomass resources; expansion of individual heating systems using heat pumps, solar heating, biomass-plants and other means; construction of land-based and offshore wind power plants to cover electricity production. The island is energy independent since 2003.

Environmental, Economic and Social Impacts	
Economic:	It is 100% owned by the Municipality of Samsø. Most of the money from the energy produced by the windmills is used to pay off the loans the municipality had to take in order to finance the cost of 16.76 million euros. However, there is a potential total profit of 33.5 million Euros. There is an annual saving of 3.22 million Euros.
Environmental:	• The 10-year plan has reduced Samsø's CO_2 emissions by 140%. • All in all, Samsø produces approximately 10% more energy than the amount consumed on the island • Annually, the offshore wind turbines send more energy to the mainland than the island consumes in the transport sector - incl. oil for the three ferries.
Social:	The project resulted in increased investment on the island as well as increased tourism. Both these factors have subsequently led to job creation.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
Initial reluctance from the citizens who had reservations regarding the conversion to 100 percent renewable energy technology.	In 2001, the consumption of fossil fuels on Samsø was reduced by half. In 2003, the island exported electricity to the mainland.
Transferability Aspects	
Broad participatory approach of several stakeholders is a fundamental component to the success of a public funding project aiming at improving the living conditions of citizens through energy and resource efficiency measures	

Key Learning
• The direct involvement of citizens is necessary to successful plan and implement cost saving measures in localised municipalities and it enables a small community to transform to renewable energy within a foreseeable timespan. • The participation of citizens in investment on energy infrastructure gives them a sense of ownership.

Case Study 19: Sino-Singapore Tianjin Eco-City - CHINA

Market: Smart Buildings

Industrial Sector: Housing & Living

Low Carbon Business Solution: Eco-city Development

The city of Tianjin is one of four municipalities in China directly administered by the central government. Sino-Singapore Tianjin Eco-City (SSTEC) is located in the northern part of Tianjin's Binhai new area, a newly established development zone 45 km (28 miles) from the city center and 150 km (93 miles) from Beijing. SSTEC covers a total land area of 30 square kilometers (11.58 square miles), and targets a total population of 350,000 people. Construction of SSTEC started in September 2009 and is planned to be completed by 2019. The SSTEC project has received significant attention because of its aim to become a "model eco- and low-carbon city replicable by other cities in China." The project receives consistent support from the highest levels of leadership in China and Singapore. In 2007, Chinese Premier Wen Jiabao and Singapore's Prime Minister Lee Hsien Loong signed a Framework agreement to jointly develop the SSTEC. SSTEC uses a set of Key Performance Indicators (KPIs) based on existing Eco-City standards in China to monitor and track progress. This innovative system will measure the sustainability of the natural environment and the built environment and allow officials in others cities to replicate SSTEC's tracking methods. SSTEC's performance on the indicators will be instrumental for the development of future low-carbon projects in China.

Environmental, Economic and Social Impacts	
Economic:	Economic development and community development will be closely intertwined in SSTEC. Economic activities in the area are expected to generate 175,000 jobs, at least half of them filled by area residents. As most residents in SSTEC will live and work within the development's boundaries, both the need for long distance commuting and the residents' carbon footprint will also be reduced.
Environmental:	For a large-scale project like SSTEC, low-carbon planning necessarily covers a broad range, though not every aspect receives equal emphasis. According to project developers, while energy supply and behavioural energy savings are considered beyond the control of a low-carbon city, industrial and commercial energy consumption is directly under the city's control. As buildings will account for 80% of energy consumed in SSTEC, the project is determined that all buildings should meet its green standards. Indeed, one of SSTEC's KPIs is the percentage of green buildings, targeted at 100%
Social:	Community development is a top priority for SSTEC. The project aims for an ideal mix of work and life for its residents by following the planning standards of the U.S. green Building Council leadership in Energy and Environmental design for neighbourhood development (lEED-ND). The lEED-ND standard helps evaluating environmental sustainability in urban design and community development and builds on the idea that urban design, land use and the environment are inextricably linked. Buildings in the SSTEC neighbourhood have to meet the gold standard of the Tanjin Eco-City's GBES. Several high-end residential buildings will demonstrate net zero energy technologies, meeting their energy needs with power generated on site.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
• Information on construction costs is limited, if the cost of constructing green buildings is higher than that of standard buildings, and if the achievable sales or rental levels remain unchanged, developers will have less incentive to engage in green development. • Furthermore, SSTEC is not entitled to offer any special tax incentives, and the project relies on government mandates in its pursuit of green building development.	China's strong need for sustainable urbanization is evident in the high level of government support for the SSTEC project and its mandate for low-carbon city development projects.
Transferability Aspects	
Government support is the first and foremost guarantee of success.	

Key Learning
The on-going project has shown how the use of multiple sets of indicators to monitor planning and implementation at both the micro and macro levels is a key factor for a successful implementation of low carbon city planning strategies.

Case Study 20: Sumitomo Trust and Banking – JAPAN/CHINA

Market: International Business Consulting

Industrial Sector: Finance

Low Carbon Business Solution: Sustainable Investment Funds

Sumitomo's objective was to create a sustainable investment fund composed of Chinese equities. Thus, Sumitomo asked Business for Social Responsibility (BSR) to support with research and advice on Environmental, Social and Corporate Governance (ESG) integration in China. In response, BSR created a customized monthly ESG news screener that analysed publicly traded companies across more than 90 ESG issues. The news screener incorporated both international norms and standards for financial analysis and China-specific context. The system covers developments related to China's main sustainability concerns, tracks local regulations and laws. In March 2010, Sumitomo successfully launched the "China Good Company" stock fund, the first sustainable investment fund offered in the country by a non-Chinese financial institution.

Environmental, Economic and Social Impacts	
Economic:	Within 12 months of operation, the portion of A-shares in the fund outperformed the market benchmark by 4.5%. This new investment model and good performance has attracted significant attention and serves as a role model for domestic and international investors in China.
Environmental:	This new investment model will foster the growth of sustainable business models in China, significantly supping the reduction of negative environmental impacts.
Social:	The model's ESG issues incorporate social criteria into investment decisions.

Market Barriers and Drivers	
Market Barriers	**Market Drivers**
Lack of credible and comprehensive ESG data could constitute one of the major barriers to running a successful ESG fund.	Sustainable investing, the integration of ESG factors into investment analysis, helps mitigate risks, drive long-term financial returns for investors, and create an effective lever to shift companies toward greater environmental and social responsibility.
Transferability Aspects	
The formation of this fund required in-depth understanding of the Chinese market and the identification of high- and low-performing companies based on ESG factors.	

Key Learning
Screening services alone are not sufficient for analysing and measuring companies' ESG awareness, management quality, and performance. There is the need of in-depth research on specific portfolio companies, events, and ESG issues in order to be successful in the long-term.

5 Comparative Analysis of Good Practice Cases

The case studies presented in the report highlight a range of innovative low carbon business measures, the barriers and drivers that affected their feasibility and the framework conditions for transfer elsewhere. Low carbon technologies, products and services constitute an opportunity for Chinese companies to consolidate their market position and to expand at the national and international level. In addition, low carbon measures bring along significant environmental and social benefits for the company and the society at whole in which they operate. Last but not least, city governments can utilise low carbon entrepreneurship systematically to drive the transition to a low carbon society and economy in their city.

The analysis of the identified good practice cases has resulted in several key observations in each of three fields: economics and policy, technology innovations, and consumer and market trends. These observations do not allow for quantitative generalisation, but they offer valuable insights on interactions between different contexts and entrepreneurial approaches to climate change. Comparative evaluation of these interactions informs and inspires the recommendations to practitioners provided in the conclusion of this study.

5.1 Economics & Policy

The cases indicate that coordinated state-market interaction carries great potential for utilising low carbon entrepreneurship. Economics and policy, going hand in hand, can help to integrate segregated markets, overcome actor lock-ins and unleash innovation potential.

- Analysing local conditions for low carbon measures is fundamental to developing and implementing successful policies and market-based instruments (see Case Study 18)
- Effective implementation of low carbon entrepreneurial activities can require governmental support (see Case Study 3, Case Study 9 & Case Study 17)
- Market opportunities in the form of access to new national and international market segments and financial streams can function as key drivers for low carbon business strategies (see Case Study 15)
- Compliance with national and international environmental legislations represents a key driver for Chinese companies. Factors such as reducing environmental liabilities and taxation start influencing aspects in businesses decision-making processes (Case Study 1 & Case Study 4). The general trend towards the rule of law in China (Heuser, 2004; Peerenboom, 2002) and the identification of local corruption as one of the key challenges to one-party rule on the central level (Shambaugh, 2008) are likely to drive this trend.
- Close interaction among the different actors in the supply chain of a product brings significant competitive advantages (see Case Study 10, Case Study 19, Case Study 20 & Case Study 21). China's value-chain based innovation model (Breznitz & Murphree, 2011) increases the importance of this observation for China.
- Access to finance is substantial to easing the transition and adoption of low carbon business solutions specifically for SMEs in China (see Case Study 11). This observations also holds when looking into quantitative studies, for instance, on China's SME finance in comparison to SME's access to finance in the UK (Hussain, Millman, & Matlay, 2006)

5.2 Technological Innovation

Low carbon technologies, beyond their carbon emission effects, positively affect the economic performance of enterprises and can deliver value to society. Taking these interrelations into account opens up new potentials for low carbon technology innovation.

- Economic benefits through resource efficiency in the form of reduced use of raw material, energy and water savings can strongly drive the implementation of low carbon technologies and products (Case Study 8 & Case Study 14). These benefits become even stronger levers in settings characterised by relative resource-scarcity – such as China, and Wuxi in particular (Liang, Wang, & Song, 2013).

- Technological low carbon improvements do not only produce substantial cost savings but also deliver environmental (i.e. CO_2 emissions, less waste to landfill, reduced use of natural resources) and social benefits (i.e. improved local living conditions and access to basic services, enhanced job creation and social inclusion) (see Case Studies 2 & 16).
- Enhanced cooperation at the international level can improve access to innovative research results and tools (see Case Study 13).

5.3 Consumer and Market Trends

Consumer power and resulting market trends can strongly support low carbon business models, in particular when they make transparent their value added to consumers and society. However, there is still a widespread lack of consumers` trust in companies, labels and brands.

- The presented good practice cases demonstrate that market trends and consumer demand increasingly shape and influence value chain approaches and business models in different industrial sectors (see Case Study 12). In China, this trend just kicks in on a mainstream level. After decades of production dominance and export orientation, the country transforms to a consumer-led society (Li & Woetzel, 2012).
- Consumers' pressure on companies is progressively resulting in enhanced accountability and transparency with respect to production processes. Companies are increasingly investing in branding campaigns due to the economic profitability and reward that informed and loyal consumers bring about (see Case Study 12, Case Study 20 & Case Study 21). Severe food scandals and local-level corruption continue to shake consumer trust (Wang, Mao, & Gale, 2008) in local brands and Chinese companies, including service providers. Low carbon business models can contribute to changing this, provided they are applied with stakeholder involvement and transparent procedures.

5.4 Summary

The case set presented in this study comprises of such cases that address specific leverage points identified by Philipps, Grossi and Coles (2012). The following table reflects a comparative assessment of the entire set. It graphically identifies the key low carbon dimensions and markets related to each good practice case, as well as the relevant actors to drive implementation. In this context:

- **The darker blue dots** identify the key constituent for the case study under analysis,
- **The lighter orange dots** denote the pinpointed component has a secondary role.

Table 3: Comparative Overview of Good Practice Cases

Case Study no.	Low Carbon Markets						Impact fields			Who should take action		
	Service for energy system integration	Energy Analyst and Energy Services	Urban Mining	Smart Buildings	Eco-design services	International Business Consulting	Mitigation	Adaptation	Resource Effiency	Policy-makers & Public Administration	Business Community	Academia & Civil Society
1. Tsingtao Beer Stock Company CHINA	●						●				●	○
2. Gold HongYe paper CHINA	●						○		●	●	○	○
3. Daikin Air-Conditioning CHINA		○		●						○	●	
4. ENN Group Co. Ltd. CHINA		○				●	●		○		○	●
5. LowExNet CHINA		○			○	●	●		○	●	○	○
6. Ningxia Yinxing Energy Co.	●						●		○		●	○
7. GEA Heat Exchangers GERMANY	○			●			●		○		●	○
8. China Glass Holding				●	○		●		○	●	○	○
9. Verbraucherzentrale NRW – GERMANY		●					●		○	○		●
10. Shenzen Institute of Building Research (IBR) CHINA				●			○		○	○		●
11. Wuxi Reatgreen Energy Efeiciency Co. Ltd. CHINA		●		○			○		●	○	●	○
12. Shenzen Vanke Real Estate Co. CHINA				●			●	○			●	○
13. Material ConneXion CHINA					●				●		●	○
14. China Merchants Bank CHINA							○		●	○	●	
15. KredEx – Estonian Credit and Guarantee Fund ESTONIA		○		●			●		○	●	○	
16. Municipal department for building construction SWITZERLAND							○	○	●	●	○	
17. Beijing Deqingyuan Agriculture technology Co. Ltd CHINA			●					○	●	●	○	○
18. Samsoe Renewable Energy Island DENMARK	●					○	○		●		●	○
19. Sino-Singapore Tianjin Eco-City CHINA			○	●			○		●	●	●	
20. Sumitono Trust and Banking JAPAN / CHINA						●	○			●	●	

6 Conclusions and Recommendations for Enablers

The Chinese government has already undertaken many initiatives to foster low carbon development, as described in chapter 2. Nonetheless, systemic gaps still hinder the mainstreaming on low carbon business strategies and solutions. Although, these challenges are common to many countries, given China's rapid growth, extent of international engagement, and decentralised development and governance model, they become more complex to address. In particular Chinese cities carry potentials for optimisation of state-market interaction (Hurst, 2006) in favour of low carbon development.

6.1 Summary and General Outlook

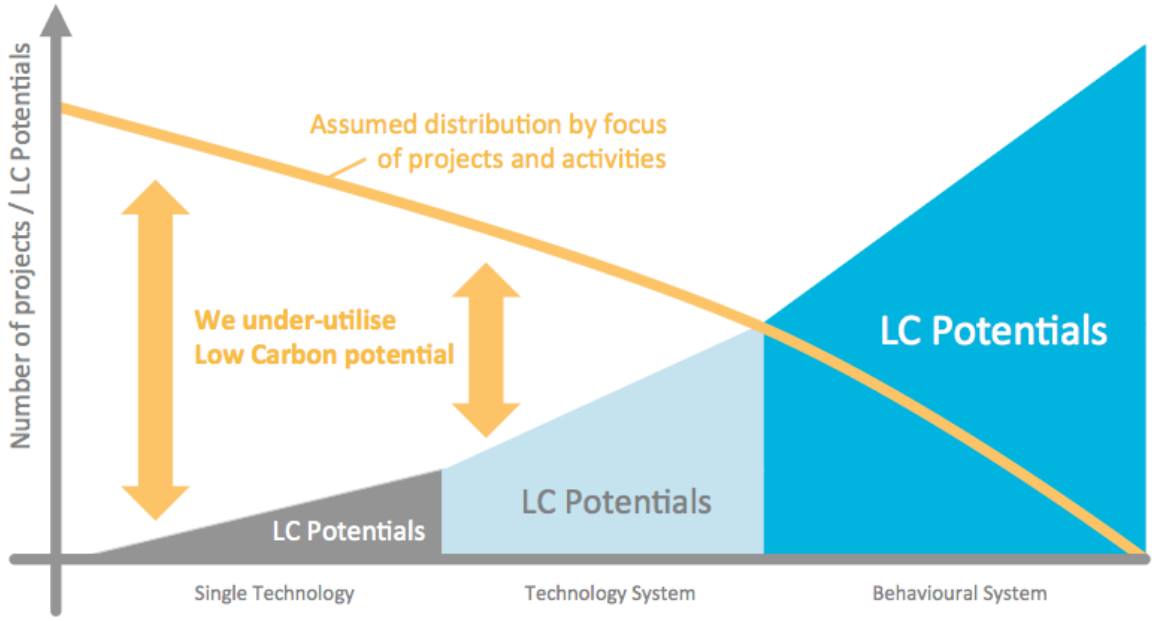
The presented analysis addressed concrete leverage points for optimisation, previously identified for the city of Wuxi, China. Chapter 3 compiled a set of 20 good practice cases that provide examples for where, how and why low carbon business successfully drives low carbon development and brings value to society. These good practice examples do neither allow for quantitative generalisation nor do they follow a one-size-fits-all logic by sketching the ideal system. However, they yield a row of observations to inspire concrete actions by enablers of low carbon entrepreneurship and business models (chapter 4). The approach and selected good practice case were already tested through a purpose-designed workshop of relevant actors from policy, business and academia during the 2nd LCFC Stakeholder Forum in Wuxi, in October 2012, with positive feedback and generation of several ideas for collaborative action. The transferability of these to Wuxi and other cities in China may face limits, but two main features prevail: the dynamics of multi-stakeholder cooperation on the local level and the need for systemic thinking beyond company boundaries and isolated impacts stand out as learning from the cases, and also with regard to the general discourse on China's development.

This concluding chapter addresses enablers of low carbon entrepreneurship in Chinese cities, including policy makers and administrators, academia and civil society, and business actors. It provides these groups with concrete recommendations and supports them with suggestions regarding the transferability of good practice cases. Recommendations clearly go beyond scientific inference. They represent options for initiatives and experiments. With this, they adapt to predominant Chinese policy-making styles (Heilmann, 2011) and acknowledge the complexity and variety of urban systems. In line with this, this study – instead of prescribing ideal outputs –closes with the proposition of process innovations.

6.2 Transferability of Good Practice

The fundamental capabilities of East China and Wuxi to transfer international good practice have immensely improved throughout the last two decades. Nowadays, western business representatives praise China's swift implementation of single technologies and measures as an exemplar, when lamenting bureaucratic hurdles in Europe. Nevertheless, transferability challenges prevail in the form of path dependencies and inconsistencies within regulatory, economic and technological systems on national and local level in China. Tackling these transferability issues may demand even more circumspection and knowledge than needed in the past. Figure 6 illustrates the potential that isolated technology approaches lose.

Figure 6: Isolated technology options carry limited potentials for low carbon development



Source: Philipps / Schröder (2012)[8]

The presented set of good practice cases support this view with regard to both drivers and barriers of transferability. China's propensity to base big political changes on local experiments (transferability driver for Case Study 12), early technology decision such as the one in favour of district heating (a plus for transferring Case Study 20), the strategy to establish industry clusters (may ease transferring Case Studies 4 and 10) and China's network-oriented approach to business (fits transfer of Case Study 18) all stem from path dependencies and systemic configurations and not from isolated capabilities and decisions.

On the other hand, path dependencies and systemic inconsistencies may hinder the transfer

[8] This illustrative figure is built on an estimate based upon generalised research findings.

of good practice. The structure of the Chinese real estate sector[9] could impede the implementation of good practice as described by Case Study 13, 20 and 4. The Chinese national innovation strategy[10] (potentially impeding transfer of several practices, such as Case Study 5, 13 and 19) and partial weaknesses in the statistical system (Moser & Solymosi, 2009) (could negatively affect Case Study 13 an 17) add further barriers to good practice transfer.

This mixed assessment of transferability outlines why a prescriptive recipe-based cooperation might easily fail and often does in other contexts. It calls for a conscious evaluation of applicability in the replication of good practice solutions by local actors and emphasises the importance of process-oriented approaches (5.3).

6.3 Concrete Recommendation for Enablers

Politicians and public administrators, the business community, civil society and academia largely benefit from enabling low carbon entrepreneurship in their sphere of influence. They can increase the economy's capacity to comply with existing regulation, enable smarter regulation and free administrative capacity. For the business community, low carbon innovation can shape new markets with positive side effects on existing industries and increase competitive market advantages of local enterprises on the national and international level. To society, low carbon entrepreneurs can bring added value and help end production and consumption patterns that run counter to civil society efforts by outperforming such practices economically. The academic community benefits from innovative business approaches and entrepreneurial activities when they open up spaces for new thinking, make new data available and create dynamics that foster exchange between business and academia, also carrying additional opportunities to create self-funding university spin-offs and start-ups based on recent research results.

While most actors would obviously benefit from more low carbon entrepreneurship, its realisation also depends on their support due to the nature of public good management in general and Chinese specifics (as described in chapter 2 and in the run of the transferability discussion). Good practice cases support the general notion that low carbon entrepreneurs face a row of relevant barriers:

[9] The Chinese real estate market differs starkly from other real estate markets with regard to features such as ownership structure, process organisation of real estate development, short building lifecycles, the raging use of the real estate market as speculative market and the material mix in the building stock.

[10] At the beginning of reform and opening the Chinese government focused on diffusion of inventions, with intellectual property hindering diffusion. Only with increasing their own innovation capacity the protection of inventions gained importance. This brought about structural changes in the administration of innovation. However, selective implementation of policies in place continues. In particular for technology transfer this still implies relevant threats (Erd & Rebstock, 2010; Mertha, 2005; Nie, 2006; Yang, 2003).

- Business as usual high-carbon technologies remain strong thanks to their maturity, well-rehearsed financial management procedures behind them, and existing tacit knowledge and capacity with regard to their application. Many practitioners, investors and regulators regard emerging low carbon technologies as still expensive and risky. Vested interests capitalise this perception (for instance, relevant for Case Study 10).
- The performance of low carbon solutions remains undervalued, because the absence of reliable market demand and stable prices for carbon hamper the proper valuation of mitigation. As an effect, neither banks, nor stock markets and individual investors can sensibly include low carbon solutions in investment appraisal of companies. Investment portfolios display a bias against low carbon solutions (Case Studies 3, 14, 15 and 21 examples for the use of energy efficiency as a valuation proxy).
- Low carbon innovations other than technologies, such as for instance collaborative consumption, depend on changes of lifestyles that happen gradually and tacitly. Low-carbon entrepreneurs might identify these opportunities but regulators, investors, suppliers and B2B partners often lag behind. Without them entrepreneurs can barely succeed (addressed e.g. by Case Study 18).

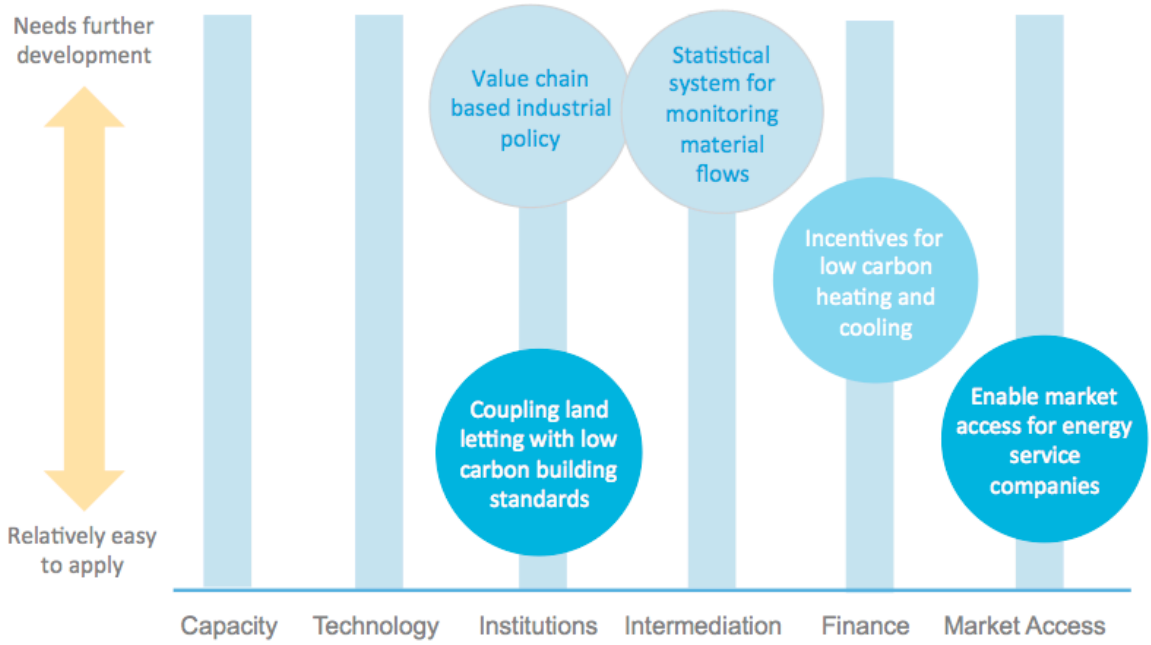
The following sets of recommendation concretely address policy makers and public administrators, business, academia and civil society. They do not represent comprehensive strategies but rather provide specific options for taking action. They aim to inspire and mobilise actors to re-shape their local economy and society in a way that allows the generation of value added by low carbon entrepreneurs.

How Policy Makers and Public Administrators Can Set the Stage

Policy makers and administrators in Chinese cities not only hold immense political but also social and economic capital (Nee & Opper, 2010; D. L Wank, 1996; David L. Wank, 2001). Beyond their function as urban planners, they represent the state that– representing its people – owns and lets the land; they have great influence on local banking and investments rules (Tsai, 2004); they control collectively-owned and local state-owned enterprises; and they play official an inofficial intermediary roles in most relevant associations and societal organisations, in line with the concept of local state corporatism (Oi, 1997). With these levers at hand, this group of enablers carries significant potential to shape the entrepreneurial landscape and intervene directly on a meso or micro level.

Figure 7 shows five concrete examples how government actors can shape the entrepreneurial landscape of Wuxi, to enable a low carbon future for their city and become a role model. The following overview shows a broader set of opportunities and links them back to case studies:

Figure 7: Five concrete examples for government action towards low carbon development



Source: Collaborating Centre on Sustainable Consumption and Production (CSCP)

- **Link urban planning with long-term resource, energy and climate protection strategies**: demand re-usable materials in real estate design; consider modular infrastructure solutions; link public land letting to resource and energy-efficiency performance of envisaged projects; build up databases on energy and resources flows (could be relevant practices like those in Case Studies 2, 4 and 9).
- **Design industrial policy around mega-trends on low carbon consumption and production:** provide office space, money and political support for energy service companies, educate consumers on energy efficiency; collaborate with banks on enhancing their lending criteria towards industry; support collaborative consumption solutions such as car sharing, community gardens when planning infrastructure systems; plan alongside the envisaged value chains of the future (linked to Case Studies 12, 13, 14, 16, 20 and 21).
- **Offer public services to industry, academia and citizens:** establish reliable databases on building stocks (solar potentials, material flows, energy consumption etc.), material flows (biomass, metals, paper etc.) and hazardous substances and practices (applies especially to Case Studies 2, 5, 8, 13, 17 and 21).
- **Take an intermediary role towards other enablers and entrepreneurs:** support networking among enablers; give bureaucrats the chance to get involved in networks for low carbon solutions officially; act as warrantor to support new actors; ensure transparency of initiatives and availability of knowledge; play the role of low carbon advocate towards the business community (relevant, for instance, for Case Studies 9, 11, 12, 14, 19 and 21.).

- **Practise collaborative compliance strategies:** bundle enforcement of low carbon policies with initiatives in the field of low carbon innovation and market development; bundle water, energy and low carbon development regulation on the implementation level; assign roles to business initiatives; include civil society actors in policy making.

How the Business Community Can Shape Low Carbon Markets

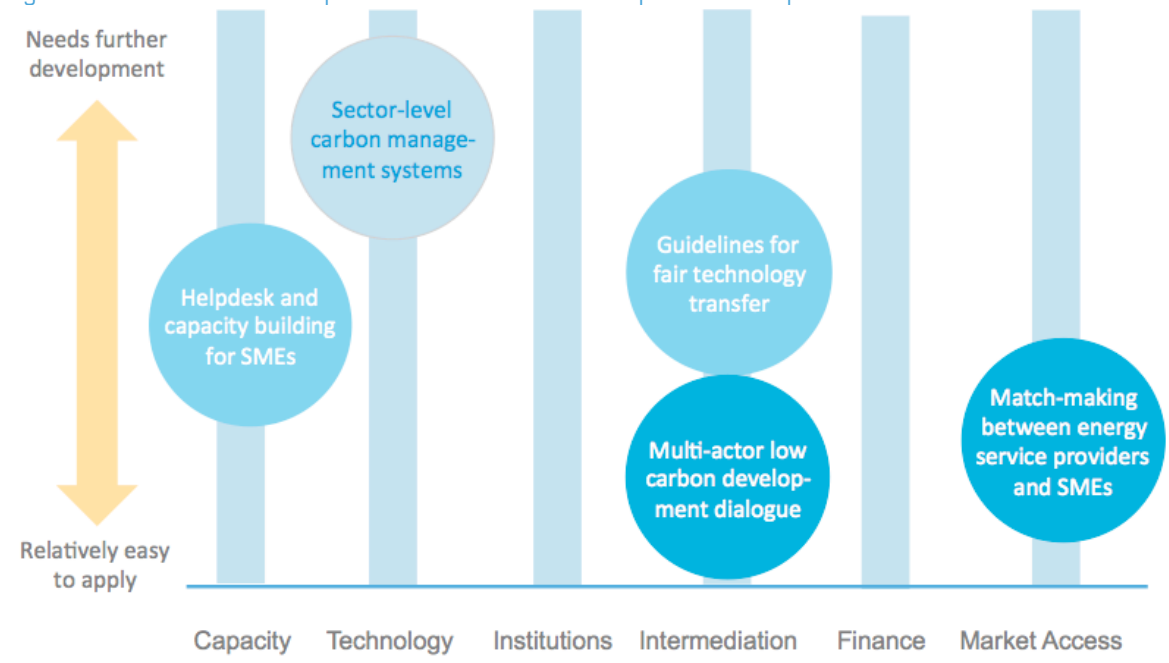
Without relevant players from the business community on board, local low carbon economies will not easily come into being. Strong overlaps of state, party and market and corporatist local approaches to governing the commons may hinder pure top-down regulative solutions. On the other hand, this is outweighed by the benefits of an opportunity-oriented business sector, which can accelerate regulatory approaches and drive low carbon development. In order to release this potential, business can integrate activities stronger along value chains and on the sector level. Such collaborative approaches enable more than merely monetary synergistic effects. They rather help overcoming real path dependencies with regard to value chain based innovation, carbon management systems, financial risk and investment, and labour pool development. All in all, low carbon business strategies can make business sustainable also in the economic sense.

Figure 8 shows five concrete examples of how business actors can address leverage points in different dimensions of the entrepreneurial landscape of Wuxi, in order to tap low carbon potentials. The following overview shows a broader set of opportunities and links them back to the case study set.

- **Take a sector-level approach to climate protection:** develop sector-wide carbon and energy management schemes; institutionalise a sector-wide help desk or support scheme; jointly invest in material flow optimisation (circular economy) and forge alliances with other industries for this; organise match-making between service providers, investors and industry members to realise shared-benefit project that help modernise their industry (related Case Studies 2, 3, 5, 16 and 20).
- **Foster strategic alliances and initiatives along the value chain:** optimise your activities together with your suppliers and customers, in the construction sector, for instance, developers, design institutes, construction, decoration and energy service companies together could significantly reduce energy demand, carbon emissions and resource consumption; heavy and chemical industry can develop product-services together with their suppliers and customers; photovoltaic producers can team up with installers and project developers and recycling companies in national and oversees markets (also see Case Studies 1, 11 and 13).

- **Enhance capacity in the industry and the labour pool:** create industry-wide support services on energy efficiency, resource and carbon management; offer training and capacity building programmes on industry level, with recognised transferrable standards; collaborate with educational institutions; cultivate networks for technical staff on energy efficiency, and resource and carbon management (among others, relevant for Case Studies 3, 13, 17 and 20).
- **Invest in cooperation on international market access:** incorporate global value chains and carbon markets in business and sector strategies; cooperate with up- and downstream value chain actors on carbon and resource efficiency; create capacity building and intelligence services towards industry members on international market access (applies to cases of the kind provided in Case Studies 1, 18 an 19).
- **Share and smoothen funding risks:** team up for open innovation approaches to synergy potentials in resource efficiency, carbon management, international market access and improving of local capacity; work towards sector standards for valuating resource efficiency and climate protection from a banking point of view; establish industry-based funds for lending to resource efficient and low carbon projects and investment within member companies.

Figure 8: Five concrete examples for how business can tap low carbon potentials



Source: Collaborating Centre on Sustainable Consumption and Production (CSCP)

How Academia and Civil Society Can Inspire and Support Low Carbon Business

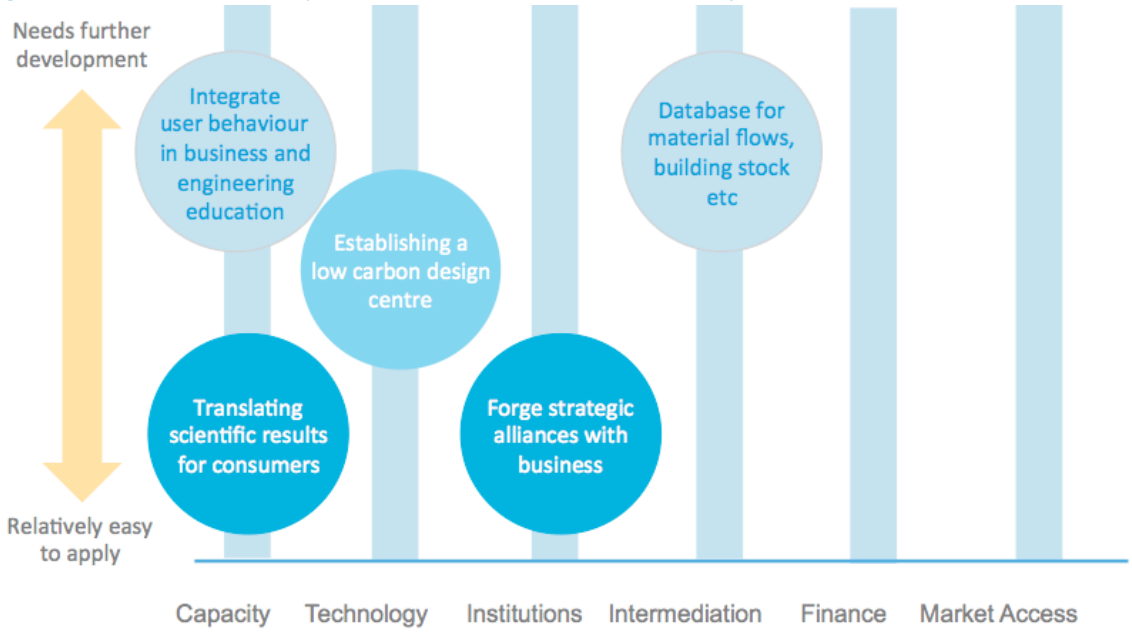
Until today, many actors call for 'scientists' to invent the technological solution to everything, while not less actors still view 'civil society' as opponents of pragmatism. Both views have proven obsolete in many cases with clear limits to solely technological solutions and highly pragmatic civil society actors bringing value even to those that usually criticise them. For a low carbon city development, both groups play crucial roles for providing perspectives and facts, upon which good political and business-driven solutions usually build. Both can act as facilitators of transition processes and provide institutional hubs to serve as nexuses of cooperation and change.

Figure 9 provides five examples for academia or civil society driven action that can contribute in a crucial way to reshaping the entrepreneurial landscape of Wuxi, and presumable other cities in China. The broader list of potential approaches by academia and civil society following after the figure further underlines that these actors do not only play a support role but can become protagonists of change towards a low carbon economy and society.

- **Provide intelligence for low carbon solutions:** develop knowledge on value chains; create databases on material flows, building stock, and user behaviour; establish advisory programmes for industry; join advisory boards of industry associations and corporations; co-create labelling schemes; calculate carbon footprints of business practices, products and lifestyles (relevant for Case Studies 1, 2, 3, 5, 13, 20 and 21).
- **Connect actors**: foster stakeholder communication along value chains, for instance between industry associations in China and consumer associations in Europe; make the link to consumer interests (4, 10, 11, 13 and 20).
- **Create new forms of education:** integrate behavioural sciences and sustainability criteria further in engineering and business administration courses; add modules on sustainable entrepreneurship to management school programmes; come up with courses on low carbon lifestyles for product developers; provide capacity building on energy efficiency and low carbon approaches for executives and working-level employees in local companies and corporations; underline systemic thinking and interlinks between systems in education (relevant, for instance, for Case Studies 5 and 21).
- **Provide institutional hubs for cooperation:** create low carbon technology and business centres; develop regular events that focus on the cooperation of different actor groups; provide experts and knowledge for helpdesk functions on sector level; cooperate with the local government and, for instance, act as a network facility to coordinate transition processes in sectors (for instance Case Studies 17 and 18).

- **Support technology development:** simplify low carbon technologies for upscaling; develop and promote technology systems that take into account interlinks between different technologies; develop technologies that specifically address the needs of Chinese low carbon consumers (e.g.Case Studies 11, 14 and 16).

Figure 9: Five concrete examples for what academia and civil society can contribute



Source: Collaborating Centre on Sustainable Consumption and Production (CSCP)

6.4 Teaming Up For Change – A Call for Process Innovation

Strong path-dependencies, prevailing processes of policymaking and implementation, and the mix of powerful actors such as bureaupreneurs and state-owned energy enterprises constrain both regulatory and market-driven pathways to a low carbon future in China. Until today, approaches to public good management in China remain opaque and network-based compromises (Guthrie, 2012; Kostka & Hobbs, 2011) depending heavily on the cooperation of systemic actors and the development of mutually beneficial solutions. Good practice cases from China presented in chapter 3 underline this, and international good practice illustrates the importance also in other contexts: cooperation within sectors, along value chains, and between stakeholders from politics, business, civil society and academia ranks as the key driver to low carbon development in most of the presented cases.

However, replicating the presented good practice cases for low carbon entrepreneurship demands more than local compromises and one-to-one transfers of concepts. Indeed, it calls for stakeholders from the city region to assess the local landscape for low carbon entrepreneurship and jointly re-shape it, under consideration of interdependent political, economic, environmental, social and technological realities and trends. The Low Carbon Future City

project will continue to support its large-scale implementation in the twin cities Düsseldorf (Germany) and Wuxi (China) and the promotion and dissemination of the collaborative solutions created with their key leaders and actors.

Figure 10: The triangle of change – isolated action leaves major potentials untapped

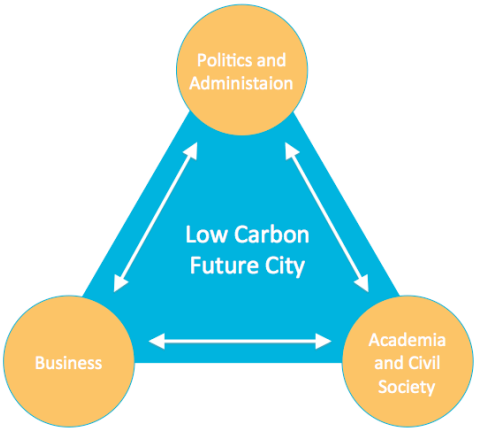


Figure 10 with the triangle of change visualises the need for multi-actor collaboration in the face of the climate protection challenge. Most recommendations, may they refer to a single actor group, but automatically involve at least a second one and regularly depend on others to be successful.

Source: Collaborating Centre on Sustainable Consumption and Production (CSCP)

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