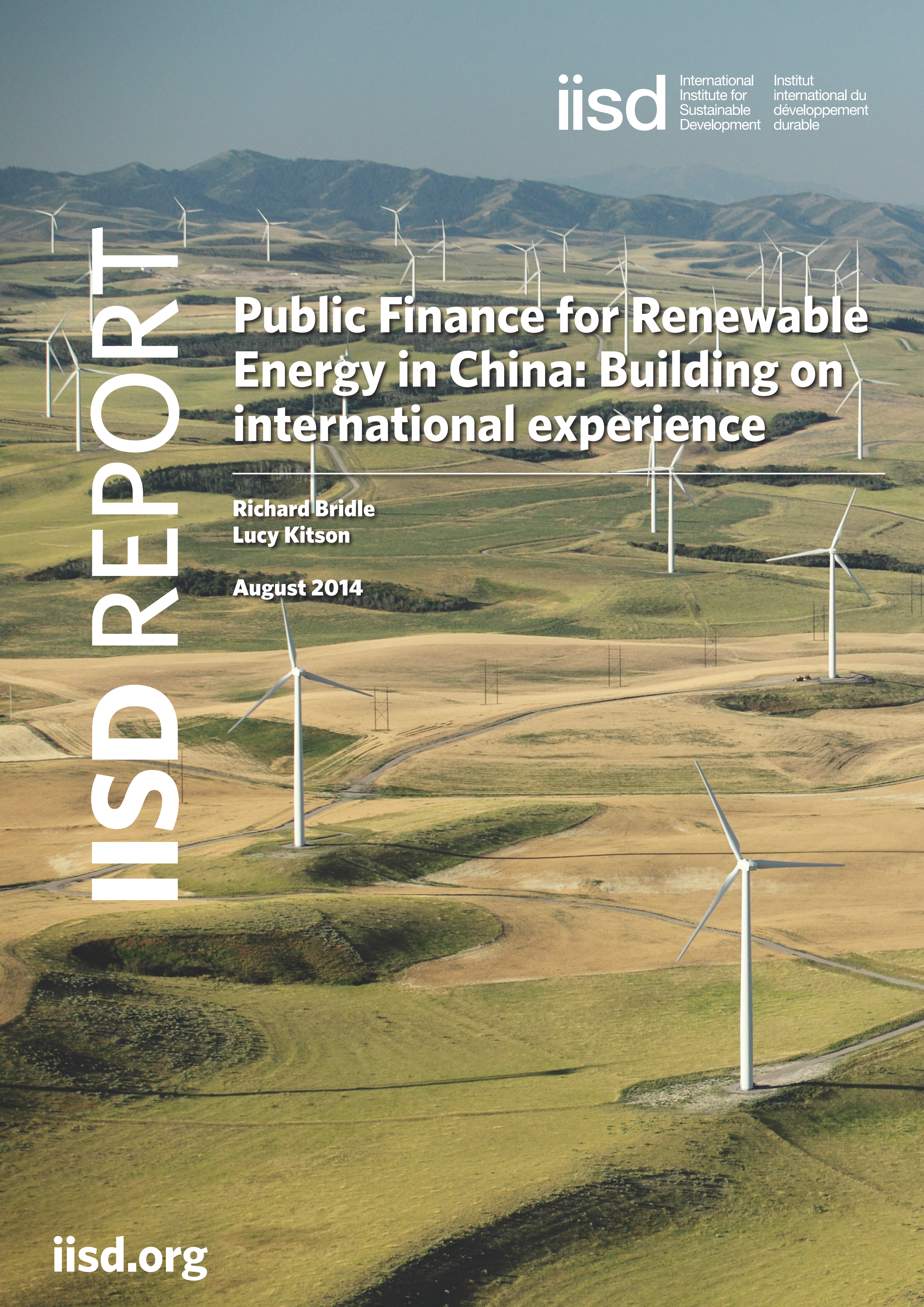

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Public Finance for Renewable Energy in China: Building on international experience

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Public Finance for Renewable Energy in China: Building on international experience

August 2014

Written by Richard Bridle and Lucy Kitson

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1.0 Introduction

The Chinese government has responded to the challenge of increasing energy consumption and environmental pollution with ambitious targets for renewable energy generation. In the 12th Five-Year Plan, running from 2011 to 2015, a target was introduced to generate 15 per cent of primary energy from renewable sources by 2015. To date, this expansion has been financed by an electricity surcharge, raising funds from electricity consumers to support renewable energy projects. To continue to fund the transition to renewable energy, attention has turned to using environmental fiscal measures to generate other possible sources of revenue. This report addresses the main issues facing the proposed introduction of a carbon pricing mechanism with some of the revenues hypothecated for renewable energy. This report will lay the groundwork for subsequent reports and research, which will focus on stakeholder views and research on the design of such a measure.

This report discusses the role of public finance in supporting renewable energy and highlights international examples and experiences that may be relevant to China as it continues plans to develop fiscal instruments that will provide public support to renewable technologies, including wind energy, hydro-electric generation and solar photovoltaic (PV) installations. In addition, China provides support to distributed generation of wind, solar, biomass, ocean and geothermal energies (National Development and Reform Commission, 2013). This report is chiefly concerned with on-grid renewable energy technologies.

This report is split into four parts. Following this introductory section, Section 2 discusses the international level of investment and subsidy for renewable energy. This section will observe the high level of investment and the high cost of public subsidy to renewables. The scale of the investment made to date and the further investment required to realize the deployment targets highlights the scale of finance required over the coming years and the need to consider how public finance can be raised and dispersed effectively.

In Section 3, the report discusses the role and structure of finance in renewable energy projects; explores the role of subsidies to reduce project risk; discusses the advantages and disadvantages of some common subsidy types; and finally reviews the tools available to evaluate the effectiveness and cost-effectiveness of renewable energy subsidies.

Finally, Section 4 outlines a set of five design criteria for carbon pricing mechanisms, including which sectors should be included, what a tax rate could be set at, how revenues should be used, what the impacts will be and how to ensure emissions savings. These criteria will be used to provide a framework for discussion of a number of the key debates and design aspects of a proposed mechanism.

2.0 Sources of Public Finance for Renewable Energy

2.1 The Global Investment in Renewable Energy

The decade up to 2011 saw a sustained rise in global investment, followed by reductions in 2012 and 2013. Bloomberg reports that investment in renewable energy was US$214 billion in 2013, down from a high in 2011 of US$279 billion. By far the largest component of this investment was in the form of investment in projects with smaller contributions from investments in manufacturing and technologies. Investment in small distributed capacity, defined as solar projects of less than 1 megawatt (MW) capacity, and asset-financed projects together accounted for more than 90 per cent of the total (Bloomberg New Energy Finance, 2014).

Estimates from the Pew Charitable Trust show the same pattern but slightly different figures. Pew reports that global public and private investment in solar, wind and other technologies fell to US$254 billion in 2013 from a 2011 high of US$318 billion (Pew Charitable Trust, 2014). The difference between these figures and Bloomberg's is due to Pew including a broader range of clean energy technologies, including "smart energy" and energy storage technologies that are not included in the Bloomberg report.

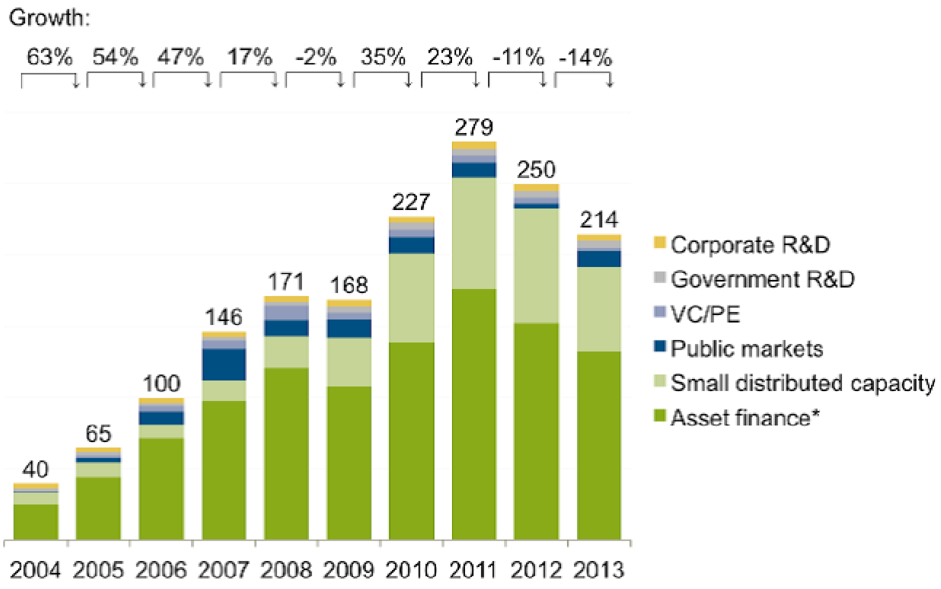

FIGURE 1: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY ASSET CLASS, 2004–2013, US$ BILLION

**Asset finance volume adjusts for re-invested equity. Total values include estimates for undisclosed deals.*

Source: Bloomberg New Energy Finance (2014)

However, while investment in Europe and the Americas has fallen, investment continues to rise in Asia (Pew Charitable Trust, 2014). In China, investment in renewable energy has been particularly rapid. Between 2004 and 2013 investment increased by an average of 42 per cent per year and, even as the global rate of investment dropped in 2012 in China, it rose by 22 per cent but fell by 6 per cent in 2013 (Bloomberg New Energy Finance, 2013, 2014). In

2013 China was the largest investor in renewable energy by a considerable margin (Bloomberg New Energy Finance, 2014). At the project level, asset finance of renewable energy projects was US$56.3 billion in 2013. These figures highlight the massive investments taking place.

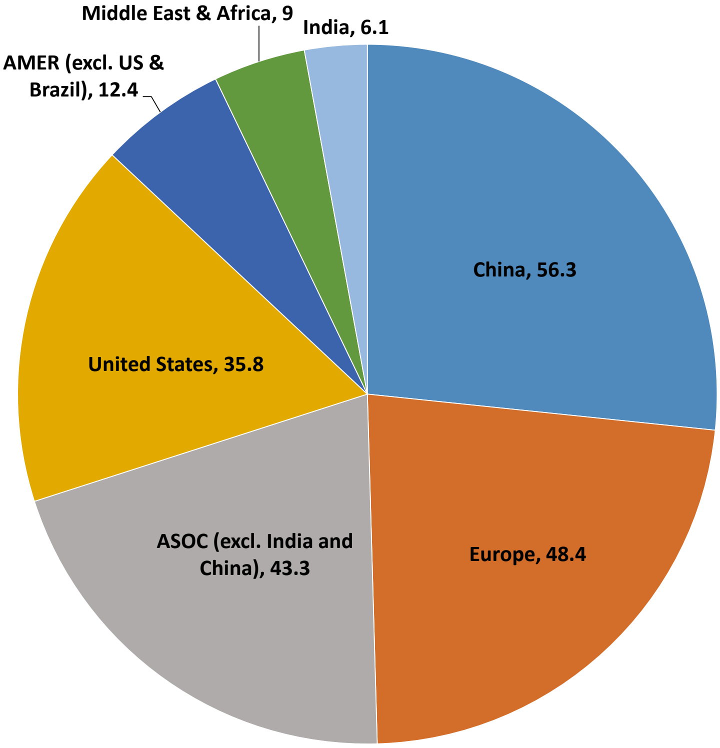

FIGURE 2: GLOBAL NEW INVESTMENT IN RENEWABLE ENERGY BY REGION, 2013, US$ BILLION

Source: Bloomberg New Energy Finance (2014)

These investment trends have resulted in a relative increase in the global level of renewable energy capacity. Table 1 shows the relative investments in renewable energy and fossil fuel generation over time. In 2013 the share of renewable energy in global electricity generation capacity, excluding large hydro, rose to 13.7 per cent up from 12.6 per cent in 2012. Renewable energy has steadily increased its share both of capacity and of generation. This trend shows the increasing importance of renewable energy in the electricity mix.

TABLE 1: RENEWABLE POWER DEPLOYMENT INVESTMENT COMPARED TO GROSS FOSSIL FUEL INVESTMENT IN US$ BILLION, 2008–2012

	2008	2009	2010	2011	2012	2013
Fossil fuel	254	293	307	303	309	270
Renewable energy	144	147	213	260	234	192

Note: Renewable energy total excludes large hydro. Fossil fuel is gross investment in coal, gas and oil capacity and assumes retired fossil capacity is replaced.

Source: Bloomberg New Energy Finance (2014)

As a result of the investment in renewable energy, costs have fallen over the last decade. The cost of generating electricity from wind turbines and crystalline PV systems has fallen by 15 and 53 per cent respectively since 2009 (Bloomberg New Energy Finance, 2014). Increasingly, renewable energy projects are becoming competitive without subsidies in areas with good renewable energy resources and relatively high costs of alternatives. The continued application of renewable energy subsidies continues to harness learning by doing to bring down prices through incremental improvements in technology, manufacturing, deployment and operation.

2.2 Global Level of Renewable Energy Subsidies

The high level of investment in renewable energy has not arrived by accident. In fact, concerted government action has led to the development of the modern renewable energy industry following the oil shocks of the 1970s. Policy-makers have a number of reasons to promote renewable energy including:

- The need to secure access to electricity, while minimizing environmental harm
- The need to secure energy supplies in the future and reduce the risk of energy supply disruption
- The rising costs of fossil fuels
- The opportunity presented to create new renewable energy industries and jobs

In order to discuss subsidies, it is first necessary to establish a definition that can then be used to determine whether a particular measure or policy may confer a subsidy. The Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD) uses a definition based on the World Trade Organisation's (WTO) Agreement on Subsidies and Countervailing Measures (ASCM). The agreement determines that subsidies exist where governments:

1. Provide a direct transfer of funds or potential direct transfer of funds or liabilities
2. Forgo or otherwise fail to collect revenue
3. Provide goods or services at below-market rates
4. Provide income or price support

In the *World Energy Outlook 2012* (International Energy Agency [IEA], 2012b), the IEA used the price-gap approach (see section 2.3) to estimate that the global level of renewable energy subsidies was US$88 billion in 2011. This support created an environment that was more favourable for the deployment of renewables, but still fell far short of the estimated US$523 billion subsidy to fossil fuels. The removal of subsidies to fossil fuels remains a priority to ensure a shift towards a more sustainable electricity sector.

2.3 Calculating Subsidies

A common methodology for calculating subsidies is the price-gap approach. Under this approach, the national prices are compared with international benchmarks. Other subsidy estimation methodologies, such as the bottom-up approach, aim to provide a more disaggregated picture of subsidies through identifying which policies confer. The downside of more detailed approaches is the level of resource required for accurate analysis. Further discussion of subsidy definition and measurement is available in the Global Subsidy Initiative's *Guidebook on Fossil-Fuel Subsidy Reform for Policy-Makers in Southeast Asia* (Beaton, Gerasimchuk, Laan, Lang, Vis-Dunbar, & Wooders, 2013).

For renewable energy, there are many types of subsidies. The IEA publication *Deploying Renewables* (2011) lists five of the most common measures, including feed-in tariffs, tradable certificates, tenders, tax incentives or credits and direct cash grants or rebates. Each of the measures has strengths and weaknesses. The characteristics of each type, including the subsidy type based on the WTO definition, are discussed in Table 2.

TABLE 2: COMMON TYPES OF RENEWABLE ENERGY SUBSIDIES

TYPE OF SUBSIDY	SUPPORT POLICY	CHARACTERISTICS
Direct transfer of potential direct transfer of funds and liabilities	Feed-in tariffs (FITs)	A per-unit payment that provides a predictable income per unit of generation
Income or price support	Tradable green certificates (TGCs)	Certificates are awarded for each unit of power generated. Certificates can be traded. This system also includes an obligation on utilities to surrender a number of TGCs according to their overall operations. A penalty for failing to surrender sufficient TGCs is often used to cap the cost of compliance in the event of market scarcity.
Direct transfer of potential direct transfer of funds and liabilities	Tenders	An authority procures generation capacity or allocates permits or development rights based on an open procurement process. A system of bidding can be used to allow market price discovery by allowing competition between project developers.
Government forgone revenue	Tax incentives or credits	Tax incentives and credits reduce the tax liabilities of project development, construction or operation, thereby increasing the profitability of renewable energy projects. Tax credits may be realized by the project owner or traded to other companies to reduce their tax liability.
Direct transfer of potential direct transfer of funds and liabilities	Direct cash transfers and grants	Grants and transfers are used to directly contribute towards the investment cost of projects.

Source: IEA (2011)

Each type of subsidy has associated strengths and weaknesses, and much has been written on the relative performance of each type. A recent report by Fraunhofer ISI and Ecofys provides a detailed overview of best-practice design features and examples from European member states (Held, Ragwitz, Gephart, de Visser, & Klessmann, 2014).

2.4 Renewable Energy Subsidies in China

With a rapidly growing economy and a corresponding increase in demand for energy, China has turned to subsidies to drive an increase in deployment of renewable energy and establish China as a leader in the manufacture and export of renewable energy technology. Subsidies to renewable generation play a major role in the sector. Bloomberg reported that subsides for wind, solar and biomass totalled US$1.4 billion in 2012 (Bloomberg News, 2012). This figure includes only the funds allocated to provincial and independent power companies from central government, so it is not directly comparable with the IEA figures mentioned in Section 2.2. A second estimate of the required subsidies to wind, solar and biomass from the China National Renewable Energy Center (CNREC) is presented in Table 3 below. This indicates a total subsidy cost of US$8.6 billion in 2012. This figure is significantly higher than the figure reported by Bloomberg and is derived from government data on the costs of various support programs. This approach to subsidy measurement is often known as a bottom-up approach (see Section 2.3). The most significant subsidy has been the benchmark prices paid to renewable energy generators, which provides stable above-market rates for electricity production.

TABLE 3: FUNDS NEEDED FOR SUPPORTING RENEWABLE ENERGY IN THE 12TH FIVE-YEAR PLAN PERIOD (IN US$ BILLION)

YEAR	2011	2012	2013	2014	2015	TOTAL
Subsidies for renewable energy power prices	4.6	6.2	7.7	9.1	10.3	37.8
The Golden Sun Project	1.2	1.2	1.1	1.1	0.9	5.4
New-energy cities	0.4	0.7	0.9	0.7	0.4	3.1
Green-energy demonstration counties	0.2	0.2	0.2	0.2	0.2	0.8
New-energy microgrid demonstration	0.1	0.1	0.1	0.1	0.1	0.5
Straw energy utilization	0.1	0.1	0.1	0.1	0.1	0.3
Research and development of renewable energy technology	0.1	0.1	0.1	0.1	0.1	0.7
Total	**6.6**	**8.6**	**10.1**	**11.3**	**12.0**	**48.5**

Note: Exchange rate: RMB6.15 = US$1

Source: CNREC (2013)

Regardless of the current level of subsidy, the Chinese government is likely to continue to expand renewable capacity over the coming years; this increase will lead to increases in the cost of subsidies in the future. The CNREC estimates that over the period of the 12th Five-Year Plan the funds for government programs to support renewable energy and related programs will rise to US$12 billion per year by 2015 (CNREC, 2013). Over the period of the 12th Five-Year Plan, the CNREC estimates that the cost of the renewable energy subsidies will exceed the amount raised from the electricity surcharge by approximately US$26 billion, with the remainder either raised from other sources or allocated from government spending

2.5 Raising Revenues for Renewable Energy Subsidies

There are a number of models available that can be used to raise the revenues needed to pay for renewable energy. Four measures are discussed here, though this is not an exhaustive list. These are:

1. Electricity surcharges and cost recovery from electricity consumers
2. Hypothecated revenues from taxes and auctions
3. Forgone tax revenues
4. General government spending

Funds for subsidies can be found by increasing **charges for electricity consumption** to cover additional payments to renewable generators. This can either be structured through a surcharge on electricity consumption, which is then allocated to renewable projects, or through an obligation on electricity distribution companies to purchase electricity from renewable generators. Under the both schemes, the additional costs of renewable generators are ultimately passed on to consumers.

China already operates a surcharge system that is the principal mechanism for funding renewables to date. Following the introduction of the Renewable Energy Law of 2006, the funds to pay for renewable energy subsidies have been primarily raised through the electricity surcharge, a levy on electricity consumption used to fund the deployment of renewable energy and related grid connection expenses. Due to the increasing demand for subsidies, this surcharge has been raised several times since 2006, starting at CNY0.002 per kilowatt hour (kWh) (US$0.03 per kWh), rising to CNY0.004 per kWh in 2009 (US$0.06 per kWh) and CNY0.008 in 2012 (US$0.13 per kWh) (CNREC, 2013).

The Erneuerbare-Energien-Gesetz (EEG) surcharge in Germany, one of the most far-reaching and longest-running funding mechanisms, is often seen as a model for funding renewable energy subsidies. In 2014 the surcharge was set at €0.06.24 per kWh (US$0.086 per kWh), of which €0.0254 per kWh (US$0.0349 per kWh) is directly attributable to renewable energy subsidies (Fraunhofer ISE, 2014). With typical domestic energy prices reaching €0.028–0.029 per kWh (US$0.039–0.040 per kWh) in Germany, the EEG surcharge increases electricity costs and has led to some recent criticism of the high cost of funding renewable energy subsidies in this manner. To reduce the impact on energy-intensive industries, the German government has introduced surcharge exemptions for certain organizations. These exemptions are expected to be worth around €5.1 billion in 2014. Exemptions can help to relieve pressure on competitiveness for industry, but leads to a corresponding increase in the burden on those who do not qualify for the exemption or potentially impairs the effectiveness of the scheme.

There are a number of examples of **hypothecating revenues** from environmental taxes to support renewable energy. Hypothecation itself remains a controversial issue, as it may inhibit government's ability to respond to changing priorities by restricting freedom to allocate resources. A summary of the debate around hypothecation or earmarking of funds is discussed in more detail in Box 2 in section 4.6. The Energy and Climate Fund (ECF) in Germany is one such mechanism that uses hypothecated revenues from the European Union Emission Trading Scheme (EU ETS) to fund energy-related programs. The ECF is discussed in more detail in Box 1. The Public Service Obligation Tariff (PSO) in Denmark gives a further example of hypothecation for renewable energy in the form of a hypothecated electricity surcharge. The PSO is similar to the surcharge system in operation in China with the exception that the tariff rate is adjusted quarterly to meet the funding needs of the various renewable energy programs included in the scheme. More detail on the operation of the PSO is given in Box 3.

BOX 1: THE ENERGY CLIMATE FUND, GERMANY

The ECF was established in 2011 to provide additional resources to fund energy efficiency, renewable energies and the development of e-mobility in the context of the phase-out of nuclear energy. The ECF was established in the context of a shift away from an agreed nuclear phase-out. Nuclear plants were allowed to extend their operations if they paid into the ECF. Subsequently, the ECF law was amended so that the scheme was funded exclusively from revenues of the emission allowance auctions within the framework of the EU ETS.

Due to the low carbon price in the EU, the receipts from auctions failed to meet expectations and ECF was left with less funding than expected. The ECF was not able to meet its intended objectives within the funds available, and rather than compromise the objectives of the fund, loans were secured from the German Bank for Reconstruction (KfW) to make up some of the shortfall.

The ECF shows one of the pitfalls of hypothecating variable revenue sources. The government is not able to control the underlying carbon price and therefore the revenues can vary significantly, making it difficult to maintain consistent support to the planned suite of programs (Cottrell et al., 2013; Bridle, Collings, Cottrell, & Leopold, 2013).

However, the fund does show that even with trading schemes it is possible to generate revenues to support energy-related programs. In this case, the problems associated with the ECF are due to wider problems in the EU carbon market. If reform of the EU ETS eventually yields a higher and more stable carbon price, the revenues for the fund will become more predictable.

The tax system can be used to provide a reduction in costs to renewable energy developers and operators, thereby improving project economics. For example, tax exemptions and reductions on import tariffs for renewable energy equipment are common in many countries. In the United States, the Production Tax Credit (PTC) provides a transferable tax credit per unit of generation from renewable sources. This provides a level of support comparable to a feed-in tariff (FIT) but without the need to collect and distribute revenues. The PTC has been responsible for a large increase in renewable generation in the United States despite periods of uncertainty and suspension due to the contentious nature of U.S. energy policy (Bridle, Collings, Cottrell, & Leopold, 2013).

Finally, the provision of subsidies from general government spending is often used for smaller-scale spending to reduce the administrative and financial burden on the sector. The United Kingdom's Renewable Heat Incentive (RHI), essentially an FIT-type mechanism to promote heating from renewable sources, is funded directly from government spending. Funding the mechanism in this way means that the cost of the subsidy is monitored under the United Kingdom's spending review process and that the spending must be subject to the same level of impact assessment and scrutiny as other government expenditures (Department of Energy and Climate Change, 2013).

3.0 Renewable Energy Project Development

3.1 The Typical Project Development Process

A full understanding of the role of subsidies in the promotion of renewable energy requires knowledge of the project-development process. The process described here represents a typical development process for utility-scale renewable energy projects such as wind farms, ground-mounted solar PV parks and hydropower projects larger than a few hundred kilowatts. The process is similar to the process of developing fossil fuel generators. For smaller distributed generation, a similar process may be also followed, albeit with a number of the steps simplified or omitted completely. The process operates in a similar manner if the developer is a private or public organization, though some steps, in particular at the planning and permitting stages, may be slightly different if government agencies are acting as both a regulator and developer. Figure 3 shows a graphical representation of this process.

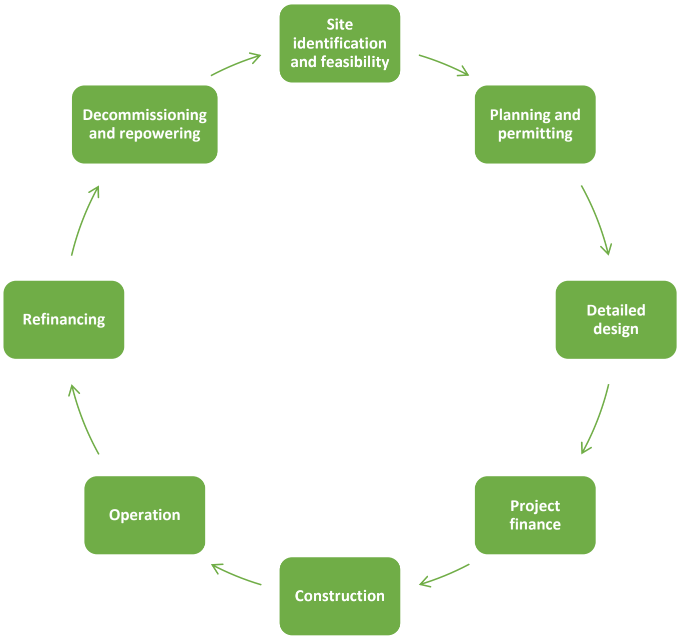

FIGURE 3: THE RENEWABLE ENERGY PROJECT CYCLE (AUTHOR'S DIAGRAM)

Financial assessment runs through each stage of the development process and aims to balance risk and reward. An assessment process will include a series of hurdles to avoid excessive expenditure before there is a reasonable chance of success. In the early stages, the financial assessment may contain many assumptions and benchmarks that are gradually refined and replaced with project-specific estimates and data as they become available.

In the first step of the process, suitable sites are identified, the many constraints are evaluated and the feasibility of the project is assessed. This stage typically involves signing agreements for land and making technical assessments of resources, site access and grid connection options. The size and scale of the proposed project will dictate the cost and complexity of the permitting process, which will affect the decision-making process. Projects that are expensive to develop may be required to undergo a more rigorous initial feasibility process to determine that there is a good chance of success before a commitment is made. The feasibility process is designed to enable the developer to identify insurmountable project barriers quickly and cheaply and thereby avoid spending resources on projects that will not proceed.

Once the developer has decided that there are no significant barriers to the development of the project, resources are committed to obtain the relevant permits and planning permissions. During this stage, the developer will also conduct as much detailed design work as necessary to be sure that it will be possible to build the permitted design. For example, to ensure that the turbine locations selected for a wind farm planning application are viable, it may be necessary to carry out some preliminary geotechnical assessments. Once the necessary permits have been issued, detailed design can begin. The specification for the project is developed in line with the constraints of the permits. This process addresses any technical challenges, outlines how the project will be built and establishes the cost to construct the scheme. At this stage, the project must demonstrate that it functions commercially to attract the finance needed for the project to go ahead. Finance may be obtained from state-owned or private banks or from investors. More information on project finance is presented in section 3.2.

At the pre-construction project finance stage, there is still an element of construction risk for investors. If finance is secured, the project will move into construction. The construction will generally follow the established design, although there may be some small alterations in response to site conditions. After the project is constructed and commissioned, it enters operation. During the early stages of operation, plant availability rises as problems are ironed out of the system. After several months, the operational performance of the generator will have been established and the construction risk of the project will be significantly reduced. At this stage, some investors will decide to sell their stakes to investors with lower tolerance for risk. Once constructed, renewable energy projects make very reliable assets, as they typically have no fuel costs and long-term power purchase agreements. Finally, as permits expire and equipment reaches the end of its life, the renewable energy project is either decommissioned or repowered. Repowering is the process of installing new generators at an existing site and typically has lower costs due to lower planning and permitting risk, the possibility of reusing existing infrastructure and the availability of excellent resource data.

3.2 Renewable Energy Project Financing

Financing for renewable energy projects is made up of debt, equity or a combination of the two, giving rise to four broad classes of investment strategy. A brief description of these four investor types is given below (Pierpont, Varadarajan, Nelson, & Schopp, 2011).

Debt investors bear the least risk because debt repayments are always met before returns are made to equity investors. Reflecting this low risk, they also receive the lowest returns, usually earning a specified interest rate above a benchmark interest rate. The main risk for debt investors is that the project will default on their debt if they cannot generate sufficient revenue to service debt. To assess the risk of default investors, consider scenarios that would lead to default and consider their likelihood: the debt-service ratio that identifies the revenues that are available to meet returns is a key piece if information in this analysis. Debt may be provided at preferential rates to particular projects to support investment goals. In China, the state-owned banks have historically provided relatively low-cost debt to renewable energy projects.

Mezzanine investors have more tolerance for risk than debt investors, but expect higher returns. Mezzanine investors receive a return that is linked to the overall financial performance of the project. However, the return on investment (ROI) for mezzanine investments may have both a cap and floor, so that they can share in some of the upside from successful projects while not facing all the downside risk. Downside risk is reduced by providing investors the ability to convert debt to equity if the loan is not paid back in full and on time.

Balance sheet equity investors are large organizations that finance projects entirely from their own capital. Balance sheet equity investors are able to manage risk by having a portfolio of generation assets. The portfolio approach reduces risk as a change to the business environment, which negatively affects one type of generator, but is likely to be offset by increasing demand for other generators within the portfolio. Furthermore, the risk of failure of a single project is diluted. Balance sheet equity investors take on most of the project risk and the project returns. The important metrics for balance sheet equity investors are the internal rate of return (IRR) and ROI. Balance sheet equity investors may take on debt to fund their investments, but that debt is held against the entire business, not just a single project.

Non-recourse project finance equity investors are shareholders of the special purpose vehicle set up to own the project. Equity investors can recoup their investment through the profits of the project or by selling their stake to other investors. Equity investors bear the most risk and will only make a profit if the project is able to cover the costs of operation, service the project's debt and generate profits. The equity investors take on most of the risk, but also stand to benefit most from successful projects.

At the global level, in 2013, Bloomberg estimates that on-balance sheet investment was the main type of asset finance for renewable energy, accounting for US$90.4 billion. Non-recourse project finance accounted for a further $39.4 billion. Other types of finance accounted for $3.6 billion (Bloomberg New Energy Finance, 2014).

3.3 Financing for Renewable Energy Projects in China

A key enabler of renewable energy projects in China has been the availability of relatively low-cost financing from a number of state-owned banks, including the China Development Bank. The largest developers in China (Longyuan, Datang Renewable Power, Huaneng and Guangdong Nuclear) and the major wind and solar companies have received billions of dollars of credit. Under the definition of subsidies in Section 2.2, if this debt is provided at lower interest rates than would be available from the market, then this would constitute a subsidy to the sector. However, estimates of renewable energy subsidies, such as those discussed in Section 2.3, do not include the value of low-cost credit. To calculate an estimate for the value of this support would require detailed knowledge of the credit lines available to Chinese developers. This data is not readily available.

To date, projects have generally been financed on the balance sheet of one of the big five-generation companies and the amount of non-recourse project finance is limited (Norton Rose Fulbright, 2010). This is in contrast to other geographical markets where independent ownership and non-recourse project finance is de rigueur. A number of government schemes have helped to provide credit to enable companies to invest on their balance sheets as well as to fund investment in manufacturing capacity. Most notably, in 2010 the Government of China extended US$36 billion in loan guarantees to renewable energy companies (Tan, Zhao, Polycarp, & Bai, 2013).

Recently, the situation has started to change. The rising cost of finance has led Chinese developers to begin to use other measures, such as structured loans and bond issues. Bloomberg reports that in 2013 China Longyuan Power Group raised US$279 million from a loan from three banks at an interest rate of 3.75 per cent. The lowest rate available for a loan of more than one year from a Chinese state-owned bank was 5.9 per cent in 2012 (Bloomberg New Energy Finance, 2014).

Access to low-cost finance from state-owned banks has supported extraordinary levels of expansion of renewable energy deployment. There are now signs that the other financial institutions are starting to increase their involvement in the sector. For historical reasons, projects in China tend to be developed on-balance sheet. This approach has a number of disadvantages, as only firms with sufficiently large balance sheets are able to finance projects that may act as a barrier to new entrants and small companies that would typically favour a project finance approach. In addition, lending decisions of state-owned banks may be influenced by political considerations, so that finance is not necessarily allocated to the most economically feasible projects.

3.4 Key Risks for Renewable Energy Projects

Renewable energy projects face a number of key risks. The level and nature of risk will vary depending on the national context and the specific risks associated with the technology and application. The specific risks that are present in the Chinese renewable energy industry will be further evaluated in subsequent stages of this project. However, many of the risks are common. Some of the key risks that may be encountered are (Economist Intelligence Unit, 2011; Pierpont et al., 2011):

- **Financial risk** – the risk of failing to obtain finance
- **Revenue risk** – the risk of project revenues falling below expectations
- **Political and regulatory risk** – the risk of policy and regulatory changes undermining the viability of projects
- **Technological risk** – the risk of technological problems preventing the project from working as envisaged
- **Resource risk** – the risk that extended periods of inclement weather or changes in climactic conditions will adversely influence the project performance
- **Sovereign risk** – the risk that a foreign central bank will change foreign exchange regulations to the detriment of a project's financial performance
- **Enforceability of contracts and property rights** – the risk of an inability to hold counterparties to contractual obligations

At the global level, the relative importance of each of these risks and the main available risk-mitigation strategies were explored by a report by the Economic Intelligence Unit (2011). The report examined the key risks facing renewable energy projects. The report was based on a survey of 280 senior executives in the renewable energy industries based in Europe, North America and Australia. The report found that the main risk-management tool employed is spreading projects across geographies to mitigate the risk of detrimental political or regulatory changes. The track record of technologies and the use of a diverse range of technologies were cited as ways to reduce technological risk. In part, investors' reluctance to use new technologies due to technological risks presents a barrier to technological progress, which policy often addresses. A number of these risks can be mitigated through insurance products. Specifically, insurance products to mitigate the risk of under production during extended periods of inclement weather were reported to be in use and respondents predicted a greater role for standardized risk-mitigating financial products in the future (Economist Intelligence Unit, 2011).

A number of risks are more strongly associated with emerging markets, including sovereign risk, enforceability of contracts and property rights and political instability (Pierpont et al., 2011). Analysis of national legal frameworks and the track record of national governments are key factors in assessing and mitigating risks.

Subsidies have a specific role to play in improving the overall financial performance of renewable energy projects and providing secure revenues. In addition, where other risks are present, such as technological risk, increased reward through subsidies can offset the greater risks associated with less mature technologies. However, the presence of subsidies may also increase risks due to the potential for policy changes to affect policy feasibility. Some of these risks are discussed in Section 3.5.

3.5 Key Risks Arising from the Use of Renewable Energy Subsidies

Some subsidy types have inherently desirable characteristics, but the type of subsidy employed is normally of secondary importance to the detailed design. All types of subsidy policies have the potential to develop unintended consequences, and detailed terms and conditions based on scenario-based "stress testing" are essential to prevent negative outcomes. There are a number of key risks with subsidy policies for renewable energy. These include:

1. **Boom and bust** – the cost of the subsidy will prove too expensive leading to a deployment "boom" and ultimately a "bust" when subsidies are removed
2. **Pricing** – under or overpayment leading to low deployment, excessive profits or spiraling costs
3. **Creating dependence** – that the subsidies will create dependence and prove difficult to remove in the future

Renewable energy subsidy policies resulting in boom and bust have been seen in a number of markets. In Spain between 2007 and 2008, falling costs for PV led to extremely favourable investment returns leading to an investment boom. The high costs of the subsidies, caused by the extraordinary rate of deployment, led to the slashing of subsidies and the collapse of the industry. A detailed account of this example is provided in a recent report published by IISD (del Río & Mir-Artigues, 2014).

Pricing is clearly a challenging problem. FIT schemes rely on the ability of the government to determine a price that will provide a fair return on investment for developers. If realized technology costs are less than predicted, deployment will exceed expectations leading to an overspend against budgets. If technology costs are higher than anticipated, deployment targets may be missed. Even when technology cost estimates are initially reasonably accurate, subsequent changes, such as the cost reductions seen in the solar PV industry, can render the levels of support inappropriately high. In both cases a "safety valve" mechanism, where the level of support is linked to the rate of deployment, can be used to reduce support rates automatically in the event of a rapid rise in deployment.

Market-based pricing mechanisms have an advantage in determining a price for renewable energy and linking this to an overall level of deployment. However, a single price for renewable energy provides adequate support to those technologies that are closest to parity with conventional generation, often on-shore wind, but will not enable a wider strategic shift towards the promotion of a broad range of technologies. In the United Kingdom, the Renewable Obligation was originally conceived as a market-based support scheme, but the desire to include support for other renewable technologies led the scheme to be "banded," whereby the number of certificates received varied by technology and application. This change diluted the ability of the scheme to discover the market price for a unit of renewable generation and opened the process up to lobbying, as each technology attempted to plead their case for a favourable level of support.

Where the level of support is determined by tenders or auctions, the government does not need to understand the technology in detail or the project development costs, as developers will factor these costs into their bids. However, the uncertainty over whether a project will be selected may create barriers for developers to carry out the necessary development works. There have been examples of speculative bidding in energy auctions and failure for winning bidders to take forward projects. A robust system of prequalification, technical bid evaluation and possibly penalties for failure to develop winning projects is needed to ensure the smooth functioning of the system.

Globally, FITs remain the most widely adopted support measure. In the Global Status Report, REN21 (2013) reported that, as of early 2013, 71 countries and 28 states or provinces had adopted some form of FIT; 22 countries and 54 states and provinces had enacted TGC or renewable portfolio standards; and 43 countries are using auctions and tendering. The number of renewable energy support schemes available shows that there is considerable international experience and examples that should be drawn on to develop policy designs.

Once in place, all recipients of subsidies have a special interest in continuing the support. This is one of the reasons that subsidies can prove very difficult to remove and why governments should be cautious about their use. To mitigate the problem, subsidies can be designed to reduce over time, known as “digression,” or phase out automatically through a “sunset clause” in the legislation.

Good design and consideration of the risks of renewable energy subsidies and the development of mitigation strategies and design features are very important to ensure that subsidies achieve the intended impacts and that unintended consequences are minimized.

3.6 Measuring the Efficiency and Effectiveness of Renewable Energy Subsidies

To consider whether renewable energy subsidies can be said to be cost effective, one available tool is an impact analysis approach. An impact analysis approach (Wooders, Beaton, Bridle, Moerenhout, & Liebert, 2012) separates policies, outputs (such as the increased deployment of renewable energy technologies) and outcomes (the effects that the policy is intended to deliver) to determine the cost of the policy and the impacts. This process is shown in Figure 4.

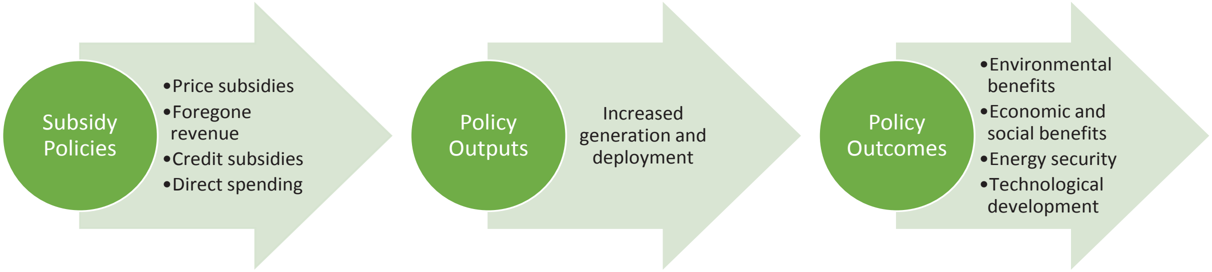

FIGURE 4: IMPACT ANALYSIS

Source: Wooders, Beaton, Bridle, Moerenhout, & Liebert (2012)

Impact analysis is a holistic approach to the analysis of cost-effectiveness by avoiding a focus on a single objective. An approach that only considers one objective, for example a reduction in carbon emissions, may unfairly conclude that a renewable subsidy program has been unduly expensive. Presenting the overall impact of a policy as the sum of a wide range impacts provides a fairer assessment of policies that are designed to achieve multiple objectives.

In general terms, the goals that are often mentioned for renewable energy subsidies can be characterized under four categories. First are environmental goals, including the mitigation of climate change and local pollution through the displacement of more polluting forms of electricity generation. Second are economic and social goals, such as the creation of jobs, globally competitive industries and economic development in relatively underdeveloped areas. Third are energy security goals, through displacing energy imports with domestically reduced renewables and benefiting from portfolio effects to reduce the dependence on a small number of technologies. Finally, the deployment of renewable technology today will reduce the cost of technology tomorrow through the impact of learning by doing (Kitson, Wooders, & Moerenhaut, 2011; Moerenhout, Liebert, & Beaton, 2012).

Some of these benefits can be assessed quantitatively, and some are only possible to assess through more qualitative methods. In an ideal world it would be possible to create accurate economic estimates for all of these impacts and compare these to the costs of the schemes, but in many cases, the complexity of the system and the assumptions built in to any assessment methodology prevent this kind of analysis. For example, placing an economic benefit on the environmental benefits of carbon emission reductions can be challenging. In theory, the price of carbon in an emissions trading scheme such as the EU ETS could provide economic value for offset carbon, but in practise the carbon prices have been volatile and have been influenced by political and non-technical factors. Nevertheless, impact analysis is a useful tool for structuring the assessment of the costs and benefits of policies to promote a reasonable comparison.

3.7 Carbon Pricing and Finance

Externalities associated with electricity generation, including local pollution and greenhouse gas emissions, can be damaging to the environment. Back in 1920 it was argued by Pigou that these externalities should be addressed through taxation and that the appropriate level of taxation was equal to the level of harm caused. Placing a cost on externalities allows environmental considerations to be internalized and built in to the decision-making process.

There is a clear trend in favour of emissions pricing mechanisms, whether they are taxes or trading systems. A recent study by the Organisation for Economic Co-operation and Development (OECD, 2013) showed that emissions pricing mechanisms, such as carbon taxes and trading systems, reduced emissions consistently and at a lower cost than alternatives. There has been much debate on whether taxes are preferable to trading systems though the two approaches share more characteristics than it might be supposed. For example, both place a cost on carbon and create an incentive to reduce emissions, both can be used to generate revenue, both require exemptions and mitigation measures to reduce impacts on vulnerable groups, both can use offsets to drive least-cost reductions and, finally, both require clear monitoring, reporting and verification (Goulder & Schein, 2013).

Since the Kyoto Protocol came into force in 2005, Clean Development Mechanism (CDM) credits have effectively provided a carbon price for many low-carbon projects. The World Bank estimates that in the period from 2014 to 2020 the supply of credits from the existing project portfolio will be around three times greater than demand, leading to a reduction in the ability of low-carbon projects to realize financial benefits from the carbon markets (World Bank, 2014). In the absence of a realistic prospect of a global initiative that would re-energize carbon markets, national-level schemes in which funds are raised and spent domestically potentially provide an alternative source of revenues for these projects. However, 10 years of experience with the CDM has generated a wealth of expertise in the measurement and monitoring of carbon reductions that can guide the next generation of instruments.

China already has six operational pilot emissions trading schemes in the cities of Shenzhen, Shanghai, Beijing, and Tianjin and the provinces of Guangdong and Hubei. The seventh pilot, in Chongqing, launched in June of 2014 (Reuters Africa, 2014). All emissions trading schemes allow some proportion of offset credits, typically 5–10 per cent of the total. All offsets must be Chinese Certified Emission Reductions (CCERs).

FIGURE 5: MAP OF CHINA WITH ITS SEVEN ETS PILOTS HIGHLIGHTED

Source: International Emissions Trading Association (2014)

Carbon finance and pricing is relevant to renewable energy projects for two reasons. First, revenues raised through sale of emissions allowances in a trading scheme, or tax receipts, under a carbon tax may be allocated to renewable energy projects in the form of subsidies. Second, since renewable energy projects offset carbon emissions by reducing the demand for other forms of fossil fuel generation, renewable energy projects may be used to offset carbon emissions produced elsewhere. This report is primarily concerned with the potential for tax receipts to be used to fund renewable energy deployment, and considers how funds may be raised and dispensed to support renewable energy.

4.0 International Experience of Hypothecated Carbon Pricing Mechanisms for Renewable Energy

4.1 Introduction

As identified in Section 2, there is a significant shift toward renewable energy across the globe, and in China in particular. Significant public funds have been spent to support this transition and more funds will need to be allocated to meet China's ambitious deployment targets over the coming decades.

The introduction of a carbon tax for which some of the revenues would be used to support this energy transition is one option. Other options, such as the expansion of carbon trading or the use of general taxation to fund renewable energy, are beyond the scope of this project. This section considers the international experience, design considerations and debates around the use of carbon taxes to support renewable energy.

China's Ministry of Finance has been considering the idea of introducing a carbon tax since 2007, albeit without ever setting a clear timeline for a possible implementation. There are suggestions that the tax should start at CNY5–10 per tonne of carbon dioxide equivalent, and escalate over time (Shuang, 2013).

4.2 International Examples of Carbon Taxes, Pricing Mechanisms and Charges

Emissions pricing instruments started to be implemented over two decades ago. Prominent examples included the New South Wales system in Australia or the Danish and the British systems implemented in the early 2000s, before the EU ETS was set up in 2005 (Philibert & Reinaud, 2004). They are now increasingly viewed as working hand-in-hand with development and growth policies and are therefore envisaged and implemented in more and more developing countries, while continuing to be an instrument of choice in developed countries (World Bank, 2013). Table 4 provides an overview of carbon pricing mechanisms around the world from the World Bank's *State and Trends of Carbon Pricing 2014* and other sources.

In developing countries, the World Bank has been promoting carbon trading schemes under the Partnership for Market Readiness initiative, which aims to provide capacity building and support the piloting of market-based tools for greenhouse gas emission reductions. In a few years, assuming current programs are implemented on schedule, carbon pricing will be in place in jurisdictions that together account for almost 25 per cent of carbon dioxide emissions from energy and industry (Whitmore, 2013). It is estimated that if carbon pricing extends nationally in China, the coverage will increase to 40 per cent (Whitmore, 2013).

TABLE 4. OVERVIEW OF CARBON PRICING MECHANISMS

PRICING POLICY	TYPE OF REVENUE GENERATION	DATE OF IMPLEMENTATION	EARMARKING TO CLIMATE MITIGATION PROGRAMS
Alberta's Specified Gas Emitters Regulation (Canada)	Auction	2003	Yes
Australian CPM	Tax	2012	Yes
Bay Area Air Quality Management District GHG Fee	Tax	2008	Yes
Boulder Climate Action Plan Tax	Tax	2007	Yes
British Columbia carbon tax (Canada)	Tax	2008	
California Air Resources Board cap-and-trade program	Auction	2012	Yes
Costa Rica carbon tax	Tax	1996	Yes
Denmark's CO_2-afgiftsloven	Tax	1992	
European Union Emissions Trading System (EU ETS)	Auction	2005	Yes[1, 2]
Finland's Hiilidioksidivero	Tax	1990	
France's Taxe intérieure de consommation sur les produits énergétiques	Tax	2014	
Iceland's Kolefnisgjald á kolefni af jarðefnauppruna	Tax	2010	
Ireland's Natural Gas Carbon Tax and Mineral Oil Tax	Tax	2010	
Japan's Tax for Climate Change Mitigation	Tax	2012	Yes
Mexico's Ley del impuesto especial sobre producción y servicios	Tax	2014	
Netherlands carbon tax	Tax	1990	Yes
Norway's CO_2 avgift	Tax	1991	
Regional Greenhouse Gas Initiative (RGGI) (USA)	Auction	1990	
Sweden's Koldioxidskatt	Tax	1991	
Switzerland CO_2 tax	Tax	2007/2008	Yes
UK Climate Change Levy and Carbon Price Floor	Tax	2001 and 2013	Yes
Quebec cap-and-trade programme (Canada)	Auction	2012	Yes
Quebec carbon tax (Canada)[3]	Tax	2006	Yes

Source: Adapted from Sumner, Bird, & Dobos (2011) for carbon taxes; International Council on Mining and Metals (2013); Haita (2013) and World Bank (2014)

[1] Under the EU ETS, the use of the revenues from auctioning is left with the member states. For Phase 3, the European Commission recommends the earmarking by member states of 50 per cent of the auctioning revenues to climate change programs, without however making it a legally binding requirement (CDC Climat 2013).

[2] During Phases 1 and 2 of the EU ETS, the following countries have earmarked all or a portion of the auction revenues to climate mitigation programs: Czech Republic, Germany, Lithuania (Haita, 2013).

[3] The Quebec carbon tax will be phased out by the end of 2014.

4.3 Considerations for Designing Carbon Taxes

Carbon pricing mechanisms can take many forms. This section reviews the main design characteristics of carbon taxes, though several of the characteristics apply equally to other mechanisms. A full discussion of the design of other mechanisms is beyond the scope of this report.

There are many possible questions in the design of carbon taxes. A report from the American National Renewable Energy Laboratory (Sumner, Bird, & Smith, 2009) raised five key considerations that apply to the development of a carbon tax. To structure the discussion in this section, these five factors will be discussed in turn below. This list of factors is not exhaustive and other issues, such as interactions between policies and the political economy of carbon tax design, are beyond the scope of this research. The considerations are (Sumner, Bird, & Smith, 2009):

- Which sectors to tax
- Tax rate (and associated mechanisms)
- How to use revenues
- Impacts on consumers
- How to ensure emission reductions

4.3.1 Which Sectors to Tax

Taxes may be placed on upstream activities (such as the coal mine mouth, gas wellhead, refineries, port of entry), large point sources (such as factories and power stations) or downstream users of energy. Taxing upstream and point sources tends to be administratively simpler, due to the small number of large, often technically sophisticated, actors. By contrast, downstream markets are characterized by a larger number of relatively less sophisticated market actors. The design of the system should reflect the sophistication and composition of the market actors.

The decision to impose additional taxation on a particular sector is a compromise between the environmental benefits of reduced emissions, the revenues generated for government programs and the economic impacts on the affected sector. The decision is often political in the sense that it must take account of the perceived ability of different groups to bear increased energy costs without overly adverse consequences. Carbon taxes are most commonly placed on gasoline, coal, natural gas and electricity (Sumner, Bird, & Smith, 2009). There is often pressure to provide exemptions to low-income consumers, who are at risk of energy poverty, or certain sectors of industry, who are considered to be strategically important or vulnerable to increases in energy prices.

The elasticity of demand (the ability to which consumers are able to adapt consumption patterns to follow price signals) dictates whether taxes will continue to generate consistent revenues over time or decline as behaviours change. If the tax is primarily a revenue-generation tool, then sectors with low elasticity (indicating that consumers do not have obvious alternatives that would reduce the tax burden) may be chosen. If behaviour change is the goal, then taxes may be focussed on areas where a competing technology is available, but is currently more expensive.

4.3.2 The Tax Rate

From a theoretical standpoint, the existence of environmental externalities is a justification for environmental taxation. In *The Economics of Welfare* (1920), Arthur Pigou argued that the level of environmental tax should be equivalent to the external cost it addresses. This is often considered the true economically efficient level for environmental taxes, yet these theoretical concerns are often secondary to political concerns.

In practice, setting the tax rate requires that a number of concerns are balanced. In the first instance, taxes can be introduced with the goal of changing behaviour in line with environmental imperatives, or with the aim of raising revenue. Often environmental taxes are introduced with objectives that combine the two (OECD, 2011). Economic models are used to assess the impact of environmental taxes to aid design. Taxes that are successful in changing behaviours will generate diminishing levels of revenue over time, so are not well suited to provide funds for long-term programs (Sumner, Bird, & Smith, 2009).

4.3.3 How Revenues Can Be Used

The use of revenues from environmental taxes depends on policy-makers' objectives and the political context in which the tax is being introduced. In this section, three possible allocation approaches will be discussed. These are (Sumner, Bird, & Smith, 2009):

1. Revenues earmarked for environmental objectives such as the deployment of renewable energy, increased energy efficiency and other carbon reduction measures
2. Revenues recycled to those who are subject to the tax
3. Revenues allocated to general government spending

In many cases, revenues are allocated to all of these areas, each weighted to reflect a balance between the relative influence of various stakeholder groups and the priorities of the government.

Revenues from environmental taxes have been allocated to renewable energy and other environmental programs. In a recent study by IISD, Cottrell et al. (2013) examined nine case studies of fiscal measures that allocated some revenues to support renewable energy. The case studies showed that, despite the debate about whether earmarking of revenues (Box 2) is good economic policy, many countries have decided to design fiscal measures in this way. Common types of renewable energy subsidies are discussed in Section 2.3. As discussed above, subsidies are commonly allocated in the form of FITs, TGCs, tenders, tax credits or grants.

BOX 2: THE EARMARKING DEBATE

A key issue for governments is that of earmarking, or hypothecation. The non-affectation principle states that government revenues should not be earmarked or ring-fenced. The reasons for this include the tendency for tax rates to be set to match revenue needs, which may not be the most economically efficient level to correct for externalities. A further problem with earmarking is that it reduces government flexibility to allocate resources according to changing requirements.

The benefits of hypothecation, on the other hand, are primarily related to the political economy. Governments have found that linking a tax increase to a particular spending priority can increase acceptance. Furthermore for investors evaluating the policy risk of relying on government subsidies, a secure source of revenue from a hypothecated tax can provide confidence. A more detailed discussion of hypothecation is available in Cottrell et al. (2013).

Hypothecation can be formal, whereby the revenues from a particular tax are transferred to a separate fund, or informal, where tax rises are announced at the same time as increased spending to connect the two together in the public imagination without actually guaranteeing that funds will continue to be allocated in the same way.

The case studies presented in Cottrell et al. (2013) show that revenues that are allocated to renewable energy tend to be spent in two main ways. First, the spending can be channelled through government departments. The advantage of this is that it makes use of government processes and structures and allows the spending to be accountable to the political system of the country. The alternative is to use a dedicated fund, publicly owned company or other organization to manage spending. This type of arrangement was observed in a number of the case studies, including Australia, Alberta, Denmark, Germany, India and the United Kingdom (Cottrell et al., 2013). One advantage of the second type of spending is that some organizational structures are better suited to certain activities; for example, if a publicly owned company fund was to make investments in projects, then returns could be retained within the fund, creating a clear commercial relationship with the projects. If a government department invested directly, it would raise conflict-of-interest issues if that department had to implement policy that might harm their investments.

Where there is an element of project-level judgement, such as the allocation of grants following a tender procedure, the separation of these decisions from political interference reduces the potential for funding to be allocated based on political expediency. The separation of project-level decisions and scheme design also allows the government to monitor the performance of the fund without being in the position of regulating itself.

A key issue for the design of funds is whether the system is to be led by spending or revenue. Spending-led schemes are designed to raise the required funds from taxation to meet pre-defined spending objectives, such as the need to provide a particular level of subsidy to a targeted capacity of renewable energy projects. Revenue-led schemes are designed around the need to set an efficient tax rate and to allocate whatever money is raised according to defined goals. In general, spending-led systems are better suited to providing consistent long-term funding, but may result in a burdensome tax on those who must pay, especially if behaviour change reduces the tax base over time.

For revenue-led systems, such as the Clean Energy Cess in India or the Specified Gas Emitters Regulation in Alberta, Canada, funds have been channelled to organizations that allocate one-off grants in response to proposals. Liabilities are controlled because there is no obligation to provide support to all qualifying projects, only those that are successful in a tender process.

An alternative model is provided by the Public Service Observation tariff (PSO) in Denmark, where the rate of the tax is set in response to spending requirements. This example is discussed in Box 3.

BOX 3: THE PUBLIC SERVICE OBLIGATION TARIFF (PSO), DENMARK

The principal mechanism for supporting renewable energy in Denmark, the PSO, is a levy on electricity consumption. According to the current Electricity Supply Act, revenues from the PSO are to be used to support renewable energy, decentralized combined heat and power production, research and development of environmental energy production and energy efficiency, and certain expenses related to security of energy supply.

Unlike conventional taxation, the revenues are not collected by the government but by Energinet.dk, an independent, non-profit enterprise that is 100 per cent owned by the Danish Ministry of Climate, Energy and Building. The revenues from the PSO are not listed in the state budget, although the level of the tariff and the total quantity of the revenues are established by political processes in accordance with overall energy policy.

The PSO is responsible for much of the increase in renewable energy use since it was established in 1998. The PSO is used to provide FITs, pay a variable premium on the power price to wind generators and guarantee an annual income to independent power producers. The tariff levels are set four times a year on the basis of expected power prices and compensation requirements to match the demand for funds provide a system where renewable energy subsidies can be funded without having an impact on the government budget. This mechanism, whereby energy policy is supported without the risk of funding shortfalls, could provide a model for a carbon tax in China (Bridle, Collings, Cottrell, & Leopold, 2013).

The PSO shows how hypothecated taxes or tariffs can be used to generate predictable revenues to support renewable energy.

As an example of a potential problem of relying on uncertain revenue sources to meet spending commitments, the Energy and Climate Fund in Germany was established on the basis that it would receive revenues from the auctioning of emissions allowances under the EU ETS. Due to the low carbon price in the EU, the receipts from auctions failed to meet expectations. More information about the ECF is presented in Box 1 (Cottrell, et al., 2013).

Revenue recycling is a tool that can be used to reduce the economic impacts of taxes by reallocating tax revenues to those subject to the tax through spending programs or cuts in other taxes. If all revenues are recycled within a sector, the overall impact will be to make transfers from relatively inefficient firms to efficient firms. Revenue recycling is also used to reduce the impact on particular sectors or groups to reduce political opposition to the imposition of the tax.

In some cases, such as in Australia, British Columbia and the United Kingdom, the total package of measures has been designed to be "revenue neutral" to indicate that the government is not increasing the overall tax burden.

Where revenues are channelled into general government funds, there is still a positive impact on environmental performance, as those technologies or fuels that have lower impacts are better able to compete against more polluting alternatives. In addition, the tax receipts effectively offset taxes that would otherwise be needed to maintain the same level of revenue. For example, in much of Europe, taxes on liquid transport fuels are a major source of government revenue. If these taxes were not in place, it would be necessary to raise revenues from other sources. Some of these, such as payroll taxes, would have adverse economic and social consequences.

4.3.4 The Impacts of Carbon Taxes

Carbon taxes—and any other carbon pricing policy—result in an additional financial cost for liable entities. In some cases, consumers are directly subject to the tax (e.g., the tax on fuels in British Columbia, Canada), while in other cases, industries are responsible for making payments (e.g., the proposed carbon tax in South Africa). In this latter case, if industry is able to pass through the costs of carbon pricing, then consumers may also indirectly experience higher prices.

For consumers, higher prices will lead to lower disposable income. As lower income groups tend to spend more of their income on energy than higher income groups, there is a significant danger of carbon taxes being regressive. Recycling revenues to schemes that compensate for these higher costs and that smooth the transition to carbon pricing can help reduce the adverse effects experienced by consumers. For example, British Columbia makes a payment to low-income households as compensation for higher costs experienced. Other mechanisms could include grants for installing energy-saving equipment or tax rebates.

For industry, the concern is often that higher costs in the form of carbon pricing will result in a competitive disadvantage vis-à-vis producers operating in jurisdictions where carbon pricing is not applied. In the short term, this could lead to a decrease in production, and over the longer term, a relocation of investment, both with associated impacts on economic activity and social well-being. There may also be environmental impacts due to differences in the emission intensities of industry in different countries. For these reasons, countries that introduce carbon pricing for industry frequently also look to introduce revenue recycling measures, such as tax rebates, or cost reduction measures, such as allowing international credits as a means of meeting an obligation.

A study from 2011 examining the impact of a carbon tax in China found that the impacts would vary significantly by region. In provinces where the production of primary products was the main form of industry, the impacts would be more significant whereas in the eastern regions, where much of the hi-tech industry is located, the impacts were likely to be lower. This study highlights the importance of designing measures that take into account the regional and sectoral impacts (Zhang & Li, 2011).

Exemptions and rate reductions can be used to mitigate the impact of carbon pricing on subsets of the population or on specific industry groups. Further, a government may choose to vary the tax rate or, for upstream schemes, the emissions threshold at which tax is paid across liable entities. Applying such modifications for a limited time can facilitate a smooth transition to a carbon tax regime, allowing liable entities time to adjust to the new environment and helping to diffuse political objections.

Ultimately, elimination of competitiveness concerns would require an international carbon tax, something that remains an unlikely prospect. In the absence of such a tax, harmonization of domestic tax schemes would help to mitigate competitiveness concerns, but even this is dependent on overcoming significant political and technical concerns, including incorporating those jurisdictions with ETS schemes. Allowing the use offsets, whereby certified emissions savings in other countries can be counted towards national schemes, can help to reduce the cost of reductions and limit the cost of the tax. However, the certification of emissions savings must be sufficiently robust to ensure that savings are really additional and not awarded for projects that would have happened regardless of the presence of a carbon tax or trading scheme.

Understanding the effects of carbon pricing and developing appropriate responses can be usefully informed by modelling techniques. These models should account for the impacts of the tax on particular social groups, as well as industry and other sectors of the economy. A detailed impact assessment is a key part of the development of an effective carbon pricing regime.

4.3.5 How to Ensure Emission Reductions

Both ETS and carbon tax policies are predicated on the assumption that putting a price on emissions creates an incentive to reduce emissions. However, under a carbon tax, the price is fixed and the level of carbon reduction is unknown, while with trading systems, the carbon emissions are fixed and the market mechanism adjusts the price to deliver this reduction. Where carbon taxes have a goal to save a certain amount of carbon, prices can be linked to emission reductions to automatically adjust levels to meet targets. Determining this price level will, however, require substantial analysis and the application of modelling techniques.

To ensure environmental effectiveness, a number of issues need to be considered. First, in both the case of an ETS and a carbon tax, expected emission reductions can be compromised by granting concessions such as lower tax rates or exemptions, as described in previous sections. In particular, where these mechanisms are inappropriately applied (e.g., to consumers or industries that are not in need of assistance) or are applied over the long term, environmental effectiveness will be impaired.

Finally, policy design needs to be accompanied by rigorous and effective processes and systems for monitoring, reporting and verifying emissions. Where this is not the case, the integrity of the system may be compromised and environmental benefits not realized.

5.0 Conclusions

Across the world, renewable energy is increasingly assuming a key role in the energy mix. The level of investment and the public subsidy expended on promoting renewables indicate both the priority given to renewable energy and the costs of overcoming the incumbent carbon-intensive technologies. Having committed to a scaling-up of renewable energy, China faces a challenge to realize a corresponding increase in the level of funding available to renewable energy subsidies.

This report has highlighted the role of renewable energy subsidies in reducing risks for private and public sector investors and provided some discussion of how the effectiveness and cost effectiveness of these subsidies can be assessed.

To bridge the gap between the necessary revenues and the current funding available from the electricity surcharge, the introduction of a carbon pricing mechanism has been proposed, from which a portion of the revenues would be allocated to support renewable energy. This report has outlined some of the main considerations in the design of such a mechanism.

In many cases highlighted in this report, the actual design of carbon taxes and charges is driven by a combination of economics and political economy concerns, that is, the opinions of stakeholders. To understand these stakeholder concerns and to better define the political economy of the introduction carbon pricing in China, it is proposed that a consultation exercise around the following three themes is needed:

1. Support and opposition to the concept of a carbon pricing mechanism
2. How revenues should be used – striking a balance between the need to fund renewable energy and impacts on affected groups and sectors
3. Governance and institutional structures – how could a carbon tax be implemented within the current trading systems and how should revenues be managed to ensure the efficient use of resources?

Environmental fiscal reform mechanisms offer an opportunity to create an incentive to reduce environmentally harmful pollution and to fund the planned expansion of renewable energy technologies. However, some major challenges remain to define how such a measure could be implemented and how some of the design challenges could be overcome. Further work is recommended to gather stakeholder views to inform the debates around the various design aspects of a proposed carbon pricing mechanism.

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