Renewable energy support mechanisms: an overview

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1. Introduction

1.1 What is renewable energy?

The definition of renewable energy varies according to the context in which it is discussed, but for the purposes of this paper it is assumed that the term covers energy that occurs naturally in the environment, and as such is essentially inexhaustible. Renewable energy therefore encompasses energy harnessed from solar, wind, hydro,[1] biomass,[2] marine[3] and geothermal sources.

1.2 Why support renewable energy?

Harnessing natural energy resources in order to produce electricity and heat is considered to be more environmentally friendly than burning fossil fuels, largely because there is no direct increase in the levels of carbon dioxide in the earth's atmosphere as a result. Because of this, it is widely believed that increasing the use of such energy resources and reducing the reliance on carboniferous fossil fuels will ultimately reduce the carbon levels in the atmosphere and therefore any detrimental effects on the climate. In addition, the use of a region's natural resources increases the security of energy supply in that area by ensuring a constant (or at least a known and friendly) supply of energy, rather than relying on fuel imports from other territories.

In recognition of these issues, governments across the globe have set targets for carbon reduction and renewable energy generation, although the recent Copenhagen summit failed to deliver a global agreement on climate change to succeed and build upon the Kyoto agreement. In parallel, they have also accepted and acted upon the need to incentivise the market to invest in such technologies, and as a result have set up a multitude of financial support schemes for renewable energy.

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1 Hydro refers to energy derived from flowing water. This can be from rivers or from man-made installations, where water flows from a high-level reservoir down through a tunnel and away from a dam.

2 Biomass covers a broad range of natural materials including wood, energy crops and energy from waste. It is defined as organic material, derived from recent plant or animal matter. The carbon savings from using biomass to generate power or heat can vary widely because the savings need to be considered in the light of the fossil fuel energy that is used for cultivation, harvesting, processing and transportation. In addition, major land use change can totally negate the carbon saving. It is for these reasons that any biomass sources used need to be grown and sourced sustainably in order to be considered 'renewable'.

3 'Marine energy' covers both wave and tidal energy (which can be tidal stream or tidal barrage)

1.3 Why is financial support necessary?

Investment in renewable energy projects requires financial incentivisation because such projects are not only typically more expensive on a cost per unit of energy generated basis[4] than the traditional methods of energy generation, but that they are in some cases, also considered to be riskier investments due to technology or resource uncertainties.

The degree to which cost and risk factors apply varies according to technology and geography, but as a general rule these factors mean that not only do investors in renewable energy projects need to invest greater sums on a £/MW basis, than if they invested in more traditional forms of generation, they also need to get a higher return on their investment to compensate them for taking on additional risk, or the risk needs to be reduced through providing more revenue certainty.

(a) Cost

Renewable energy has historically been more expensive for a number of reasons; renewable resources are often located in remote areas that require costly power lines to be built in order to access the market (e.g. offshore wind), renewable sources are not always available due to weather effects, and generation relies (for the most part) on relatively novel and less efficient technology to harness the natural energy sources. This additional cost varies significantly across technologies and geography, and means that the level of support required to incentivise investment varies also.

In addition, the detrimental climate impact of the carbon dioxide gases emitted from fossil fuel combustion was until recently an unrecognised 'negative externality'; a societal cost resulting from energy generators' commercial operations and end-users' consumption that was not quantified or factored in to energy market economics. This cost omission contributed, and still contributes, to the lower cost of fossil fuel generation, and is the reason why regulators are attempting to put a cost on carbon through such schemes as the European Union Emissions Trading Scheme (EU ETS).

On the flip side, as renewable technologies become more widespread and engineers 'learn by doing' it is expected that technology costs will fall. In addition, a long-term contributor to lower renewable energy costs is the fact that the cost of renewable fuel can in most cases be zero, biomass being the most obvious exception. Going forward, therefore, it is not unreasonable to expect that at some point the cost of most renewable energies may be on a level with fossil fuel energy and will no longer require financial support, reaching "grid parity".

(b) Risk

Although the concept of harnessing natural resources for power and heat has been around for centuries, modern-day applications suitable for the large scale capacities required are generally still commercially uncompetitive with traditional sources of power. Where a technology has no proven or limited track record of performance, investors view the investment as more risky, and their required returns are therefore

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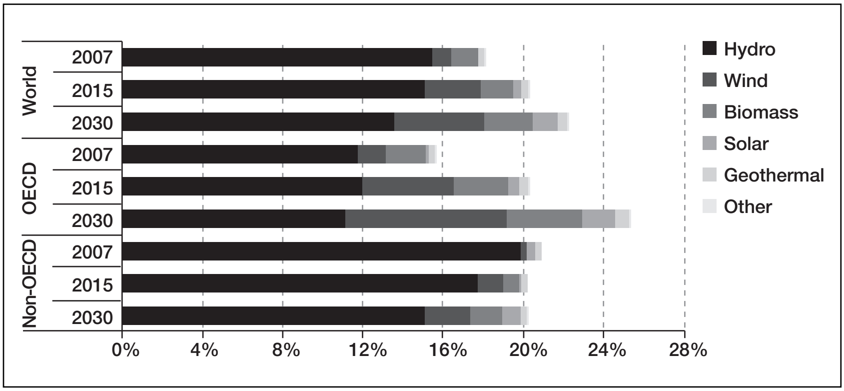
4 Typically referred to in the UK as the £/kilowatt hour (£/kWh) or £/megawatt hour (£/MWh) measure

higher. The performance question for wind is one of understanding the probability of wind speeds, and the availability of the turbines, for solar how much energy the sun gives out and how much can be converted into energy, and for biomass, ensuring compatibility between the boiler and the feedstock.

To date, renewable support mechanisms around the world have favoured technologies such as landfill gas, solar PV or large scale wind. As a result, the installed capacities of both technologies are significantly greater than other technologies and costs have fallen significantly. For technologies such as wave and tidal, however, the technology question is trickier and at an earlier stage, the risks higher, and the level of support to date has been minimal.

The chart below illustrates the current and forecast installed capacities of the key renewable technologies.

Share of renewables in electricity generation by region in the Reference Scenario



Source: International Energy Agency: World Energy Outlook 2009, Reference Scenario

Scope of this paper

This paper provides an overview of the most common financial support mechanisms that have been or are available for renewable energy technologies around the world and examples (primarily from Europe) are used in order to highlight how such schemes work in practice.

The key stakeholder groups that are directly affected by the form and application of renewable energy support mechanisms include the investors in renewable energy projects, taxpayers that pay for the government's support through taxes or consumers through additional costs on their energy bills, and the regulators that design and manage the schemes. The benefits and drawbacks of each mechanism are therefore considered from the point of view of these three key stakeholder groups; Investors, Consumers and Regulators.

This paper does not attempt to be comprehensive, but is intended to give readers an understanding of the most prevalent support mechanisms used and their impact on the key stakeholder groups.

It is important to note that a key route to reducing carbon emissions associated with energy consumption is demand side management; reducing energy usage and introducing energy efficient technologies and practices. This paper does not cover the incentive mechanisms that drive growth in this area.

2. Stakeholder interests

2.1 Investors

The term 'Investor' refers to all organisations or individuals who contribute capital and/or resources to the development of renewable energy projects, small or large scale, and who anticipate a financial benefit.

This definition of Investor covers private equity and venture capital organisations, banks, wealthy individuals, ordinary consumers and communities, corporations, utilities and public sector bodies. Each of these separate investor groups would typically have different risk and return appetites and evaluation criteria.

However, for the purposes of this paper there are some general investment characteristics that will be preferred by most, to a greater or lesser degree depending on context, such as:

- Low as possible risk around technology performance and revenues
- High as possible cost savings and/or carbon savings and/or overall investment returns

This translates into a preference for renewable energy support mechanisms that deliver satisfactory returns over the long-term; regulatory certainty and transparency is therefore a very important factor in an Investor's decision-making process.

2.2 Consumers

The broader consumer body includes individuals and organisations that consume energy and/or pay taxes. It is from this stakeholder group that the additional cost of supporting renewable energy is recovered; either through additions to energy bills or through taxes and levies on earnings and energy consumption. It is also this group that would ultimately bear the cost of climate change, although that is not so easily quantified.

From the perspective of being the 'bank roller' for renewable energy support schemes, the following issues are of key concern to Consumers:

- Total additional cost to consumer bills;
- Efficiency and effectiveness of the expenditure (total cost per tonne of carbon abated or per unit of installed capacity);
- Wider benefits of supporting renewable energy (positive climate effects, increased security of supply).

2.3 Regulators

Renewable support schemes can require significant upfront and ongoing administrative support and oversight. This includes the initial design process, public consultation, scheme administration and any additional treasury burden. The term 'Regulator' is used here to cover all governmental or independent bodies that have an administrative or regulatory role in relation to renewable energy support schemes.

The success or failure of high profile and costly support schemes can also have political repercussions similarly to any other public expenditure programme. In recent years, as the sector has grown, governments have set up separate teams to build expertise and drive forward policy initiatives in this area. For example the UK government made a number of reshuffles to bring together what is now the Department for Energy and Climate Change and the associated Office for Renewable Energy Deployment.

Regulators are largely concerned with the following:

- Effectiveness of the scheme against carbon and renewables targets;
- Cost of oversight and administration of the scheme;
- Overall efficiency of the scheme in terms of expenditure and impact on end consumer tariffs; and
- Public perception.

3. Typical support mechanisms

3.1 Summary

Renewable energy support mechanisms range from grants for early-stage technologies, to tax incentives for capital invested in renewable energy plant, through to payments for each unit of energy generated. The objectives, scope, application and level of support of these schemes is based on, amongst other things, geography, technology and project scale.

Theoretically, all support schemes could be funded through tax revenues. In practice, however, the burden of the costs is typically placed on market participants such as electricity suppliers or transmission operators, who then pass on the additional costs to electricity consumers.

A summary of some of the most prevalent support mechanisms is set out below.

3.2 Research, development and demonstration

(a) Research and development (R&D)

New technologies such as those used to harness wave and tidal energy typically require considerable early-stage investment to get them through R&D to prototype stage and for some through to commercial operation. As they progress through each stage the required levels of funding often increase. Given the levels of funding required and the technology risk, there are a limited number of Investors who have this risk appetite.

In cases where private sector investment does not flow, the government must provide some level of support if it wishes to see a technology-driven industry develop.

R&D support programmes are typically in the form of grants or loans and in most cases will not be designed with the expectation of financial returns. However, some R&D schemes have a built-in mechanism that enables the Regulator (and the Consumer) to share in any financial returns from technology successes. The UK's

Launch Aid scheme for civil aerospace is a globally recognised method for supporting R&D efforts on such terms. It enables the Government to contribute to the development of technologies, and in return gives it the right to a levy on each unit of the technology that is sold once certain thresholds are reached.

The typical recipients of Launch Aid funding are technology developers who use the funds to further their R&D experimentation, thereby (ideally) producing patentable, valuable technologies that can be sold on for commercial gain.

It is therefore crucial that the programme receiving such funds can really be said to be one of R&D, and one that is working to develop identifiable, patentable technologies. This concept could well be applied to renewable energy technologies such as wave and tidal, although the potential value of each device developed has to be weighed against the potential cost to get it to the next stage of development.

(b) Demonstration scale grants

Innovative technologies that make it through the R&D phase also typically struggle to make the leap from prototype to commercial status due to Investors' continued reluctance to spend money on demonstration scale projects that have not yet been proven and where no commercial returns are therefore considered likely in the near future, or at all. As a result, governments and non-profit-making organisations are frequently called upon to assist the market in developing the technology to a commercial stage by providing funding for 'demonstration' projects; proving that technologies work at a commercial scale. The levels of funding required can increase significantly between the R&D and demonstration stage.

The primary method employed to support demonstration projects is the grant scheme; funds are set aside from government funds (which could be tax receipts and/or government debt) to develop a certain type or group of technologies, grant award criteria are set, bids are received and evaluated, and grant funding awarded on certain conditions. The granting body does not typically expect to see a return on its funding, although it does expect its money to be spent wisely and according to the grant scheme rules.

As a recent example, the Australian Ministry for Resources and Energy set up a competitive grant scheme called the Renewable Energy Demonstration Program (REDP) in 2009, with aims that included demonstrating the viability of renewable energy technologies at a large scale, enhancing Australia's international leadership in renewable energy and attracting private sector investment in renewable energy power generation.

The REDP has since awarded AUS $235 million to support the development of four commercial-scale renewable energy projects, comprising geothermal energy, wave energy, and an integrated mini-grid project involving wind, solar, biodiesel and storage technologies.

REDP grant funding was awarded on the basis that the applicants contributed funding in excess of AUS $500m. This is a typical requirement of modern-day grant schemes; private sector match funding/majority funding is a requirement in order for grant funding to be awarded.

There have been a number of grant schemes that have proved too stringent or unrealistic in their award criteria for the market to actually gain access to the funds. For example some grant schemes have required the technology developer to agree to make their IP available to the public as a condition precedent to receiving funding. This can cause problems at a later stage in accessing private sector funding, where retention of IP is a key part of investor diligence.

(i) *Investor perspective*

By participating in partially-grant-funded projects Investors are benefiting from a financial partner who shares in the financial risk of the project but who won't typically share in any future value that the applicants gain by virtue of having successfully delivered the projects and grown their respective businesses as a result. A downside of using publicly funded grants is that typically it places a restriction or additional burden on an Investors commercial operations, and typically the grant project itself will not of itself be likely/able to make significant returns.

(ii(*Regulator perspective*

The Regulator will typically either be the grant funding body or be associated with the funding body though providing an administrative role. Grant schemes for renewables are generally used by governments to not only deliver against targets for renewable energy, but also to support the broader market for renewable technologies and expertise; thereby promoting trade in their region and raising their international profile. In awarding grants it is important for the Regulator to ensure that clear award criteria are set, that value for money is considered, and that the risks of supporting developing technologies are understood and mitigated appropriately.

(iii) *Consumer perspective*

Grant funding for early stage technologies is not typically as high profile as that for demonstration projects given the sums involved and the largely invisible nature of R&D programmes. Consumer perspectives and pressure can come to bear more significantly on schemes that quite clearly lay out significant sums of money for risky and expensive projects. In such cases the Consumer fear of overspend and desire for accountability for any mistaken investment can lead to high profile press coverage and it can be difficult for governments to justify an expenditure where other more economically viable investment projects are available.

3.3 Tax incentives

Tax incentives can be preferable to subsidies in the eyes of many governmental authorities as it is politically easier to defend tax incentives because there is no direct link to the consumer through higher energy tariffs. However, tax-related incentive schemes do have a cost to society that follows the reduction in tax revenues flowing through to the government and therefore public services.

Tax incentives used to promote the use of or investment in renewable energy technologies and projects include the following:

- reduced corporation tax rates;