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Maximising the Economic Benefits of Renewable Energy

A Northern Periphery Programme Perspective

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***Abstract* — The value of the global renewable energy market is growing at a rapid pace as the uptake of technologies continues to increase. As a direct consequence, regions are actively encouraging companies to invest in renewable energy in order to benefit from the prosperity that success brings to the area. Using knowledge gained from the NPP SMALLEST and NPP MicrE projects, this paper analyses the influencing factors on renewable energy companies and their relationships. By developing a closer understanding of these associations, this paper provides a basis for further economic research.**

Keywords - Renewable Energy Technologies; Northern Periphery Programme; Social Acceptance; Political Agenda; Economic Impact.

I. INTRODUCTION

"The world is facing twin energy-related threats: that of not having adequate and secure supplies of energy at affordable prices and that of environmental harm caused by consuming too much of it" [1]. Choppin [2] illustrates these facts by showing the worlds consumption of fossil fuels in 2008, with America burning the equivalent of 2299 million tons of oil and China following closely behind with 2002.5 million. The same source indicates that Singapore burned the equivalent of 58.2 million tons of oil, which whilst tiny in comparison (0.5% of the world's consumption) is still a significant drain on the earth's resources. Fossil fuels such as coal, oil, and gas are formed over millions of years from the "remains of prehistoric plants and animals" [3] and consist of a finite amount. Once fully consumed, there will be no way of generating new reserves of fossil fuels for an unfeasibly large time, meaning the world will have to adapt to having one less resource. According to The Paleontological Research Institution, [4] this will deprive mankind of many products that are derived from fossil fuels such as plastic, detergents, pesticides, medicines, and many others. In addition to the supply problems, the consumption of fossil fuel also contributes to climate change, due to the amount of Carbon Dioxide (C02) that is released into the earth's atmosphere when burnt. This process was first discovered by Joseph Fourier in 1824 who found that atmospheric gasses absorbed heat in the form of radiation omitted by the sun. $C0_2$ is one such gas, and as the amount of $C0_2$ in the atmosphere grows, so does the amount of solar radiation being absorbed, resulting in the earth's temperature gradually rising. There has been much debate within the scientific community over the consequences of this phenomenon, or indeed whether humans are having an effect on the climate. Some scientists claim that "unless we limit emissions, global temperature could rise as much as 7°C by the end of the century" [5]. Despite CO_2 emissions causing concern amongst the scientific community, it also presents an opportunity as the renewable energy (RE) market grows. Therefore the economic benefits of RE are potentially substantial for the countries / regions / communities that become market leaders.

The main aim of this paper is to present some of the anecdotal evidence relating to the issues that impact on the opportunities and threats associated with RET's. The paper is organised as follows: firstly, the paper presents the background of the research; secondly, each of the main influencing factors on the success of RE are discussed: namely the technology; the political factors and the social influences; thirdly, the economic effect of RE is discussed and the way in which the influences effect the market is illustrated; and finally the paper concludes by illustrating how each of the influences interact and overlap.

II. BACKGROUND

The Ulster Business School, University of Ulster Coleraine is presently involved in 2 renewable energy projects which are funded by the European Union Northern Periphery Programme (NPP) 2007-2013. The NPP aims to help peripheral and remote communities on the northern margins of Europe to develop their economic, social and environmental potential.

- MicrE (Micro energy to rural Enterprise) was developed with the objective of increasing the viability of Micro Renewable Energy Sources (MRES) for SMEs in order to introduce additional revenue streams. MicrE aims to prove that SMEs can reduce their wastage and greenhouse gas emissions whilst maintaining economic viability and creating wealth. To achieve this aim, MicrE offers advice, training, and mentoring to empower SMEs at all stages of decision making, from the initial planning stage through to the effective running of the successfully installed equipment.
- SMALLEST (Solutions for Micro-generation to ALLow Energy Saving Technology) is helping to raise the scale and quality of training, mentoring and support for rural communities that want to

develop MRES. The SMALLEST service is assisting rural communities in order to: increase awareness, planning and commercial capability; improve skills provision; and enhance their capacity for MRES development. The main aim of the project is to help rural communities achieve a commercially sustainable self dependence in energy. It is hoped that increased development of renewable energy projects will create enterprise and jobs in rural areas.

During the projects, a number of influencing factors have been encountered, which have affected the SMEs and communities in their conversion to RE technology. These influencers revolve around: 1) RE technologies; 2) the political agenda for RE technologies; and 3) social acceptance of RE technologies - all of which will affect how the economic value of conversion to RE technologies is perceived and evaluated in terms of the potential opportunities and challenges that it can present for our economies. These issues are discussed in more detail in the next sections of the paper.

III. Renewable Energy Technologies

Whereas necessity is considered to be the mother of invention, in the case of renewables it can also be considered to be the mother of reinvention, as pre-existing technologies are propelled back into the spotlight. The usage of RE predates fossil fuels; Archimedes was reported to have fought off Roman invaders in 214–212 BC with a weapon that harnessed the sun's rays in order to incinerate the attacker's boats. Upon the discovery of fossil fuels the usage of RE went into decline as coal and (later) oil proved to be a cheaper source of energy. In the 1970s, the interest in the technology was reignited due to the oil crisis and there was a "great deal of experimentation with renewable energy sources with a considerable amount of government money being spent on R&D" [6]. Despite this, once the crisis subsided, most countries reverted back to fossil fuels due to the cost and pre-existing infrastructure.

RE has proved to be an afterthought in the worlds energy mix with no one RE technology dominating the marketplace. Organisations have continued to develop existing technologies and pioneer new ones in an attempt to eat into fossil fuels share of the energy market; numerous technologies are jockeying for share as the market dynamics continue to change. Rao and Kishore [7] address this growth by expanding on Roger's Bell Curve, to consider the 5 stages in the innovation diffusion process for RE: innovators, early adopters, early majority, and the late majority. Almost all the countries in the EU-27 are innovators or early adopters, with Eurostat [8] reporting that only Latvia, Austria and Sweden are generating more than 40% of their energy from renewable sources. With ample opportunity for growth, RE firms are continuing to innovate in the hope of becoming the market leader in their technology or technologies.

As the competition for market share intensifies, the number of technologies has grown and, in an attempt to clarify the evolution of RE technology, Hara et al. [9] has categorised the technologies into three different generations:

- First Generation – are the well established power sources such as hydro, biomass and geothermal.
- Second Generation – are technologies that are rapidly gaining market share such as wind, solar hot water, solar photovoltaics and advanced bioenergy.
- Third generation – are technologies that are under development and have yet to make a significant impact in the market such as concentrated solar power, ocean energy, advanced biomass and advanced geothermal.

Each technology has advantages and disadvantages [10] [11] and careful consideration is required to ensure resources are used to their full potential. Size, cost, regional climate, energy output, available resources and the supply chain are only some of the factors that should be taken into the consideration when choosing a RE technology. It is for this reason, that having immediate knowledge of the availability and strengths of all the technologies is an impossible task for the average consumer and opens the door for consultancy and knowledge transfers opportunities that will further benefit the economy.

IV. Political

In light of the economic and technological impacts the political agenda for RE is compelling. According to REN 21 [12], each of the 27 members of the EU implemented policies to help promote the generation and usage of RE. Governments across the world are increasingly committing money and resources to the promotion of RE. A recent example is that "approximately $100 billion of the $787 billion stimulus package in the U.S. will go to clean-tech investments and activities." South Korea is another example, and their "'Green New Deal' is estimated to commit $84 billion to clean-tech investments by 2013" [13]. Although most governments agree that the market requires a capital stimulant, there is no clear consensus on the best method of distributing the cash to RE generators. As a result, each country has implemented a different mix of policies depending on their overall vision on how to reduce their usage of fossil fuels, resulting in each of the countries in the EU adopting one or more of the following policies:

- Feed in Tariff (FIT) – for each unit of RE that is exported back to the grid the government will pay an additional sum on top of the normal exporting rate. The rate varies from country to country and often is technology dependent and effectively lowers the payback period for the equipment used in the generation process. FITs have the negative side effect that they can encourage organisations to invest in RE technologies that would have otherwise been unsustainable.

- Grants/subsidies – often offered by government departments, quangos, charities etc. these lower the initial investment by covering some of the capital costs. Often the competition for grants is great and limits the number of beneficiaries; a large number of applicants can also increase the difficulty of the selection process.
- Tax Incentives – rebates can be offered on the tax attached to equipment or tax credits can be awarded in relation to thing such as the amount of energy generated, the overall reduction in carbon emissions, the amount VAT amassed etc. These incentives have the potential to lower the initial cost and the running cost (depending on the scheme or schemes implemented) however the money is taken directly from the public coffers and has to be recouped elsewhere.
- Tradable Certificates (Renewable Obligation Certificates aka ROCs) – organisations are set targets on the amount of RE they must generate over the course of a year. For each unit of RE generated, the company is awarded a certificate which can be used to prove they have produced the relevant amount of energy. The certificates are tradable, so companies that have an excess amount of energy can sell the certificates to companies that under produced. RE certificates act as a subsidy for production, however unlike FITs they are set at market price and can make financial planning difficult.
- Net metering – largely used to encourage small scale production at consumer level, net metering keeps track of the energy inflow versus the energy outflow. Excess energy that is generated and exported back to the grid is added to the customer's account in the form of credit. Net metering largely deals with small scale installations and as such is unlikely to have a large effect on the overall amount of RE generated.
- Loans – can be made available to investors in RE, allowing organisations easier access to start up capital. The interest rate can vary from the normal rate through to zero percent interest depending on the issuer. Having loans that are restricted to the RE industry ensures that the loan issuer is knowledgeable about the technology, and will better comprehend how the return on investment will occur, which may not be immediately obvious to a non specialist lender.
- Planning fast track – whereby planning applications are fast tracked through the planning application process in order to minimise the time delay between application and approval.

V. SOCIAL ACCEPTANCE

With the ever increasing political pressure to decrease reliance on fossil fuels, countries face a magnitude of problems in convincing people and organisations to utilise the technologies. Many of the core challenges are social and institutional rather than technological, as relevant existing technologies are not implemented or diffused due to 'lock-in' to carbon-intensive activities, driven by path dependent increasing returns to scale and reinforced by institutional and social adaptation to the status quo [14][15][16]. In this context, social and organisational innovations, such as community-based cooperation and enterprise, may facilitate a shift away from high carbon trajectories by allowing new norms, goals and practices to be developed and diffused [17]. In order to make this shift, organisations face a number of social challenges in order to obtain social acceptance of the technologies. Wüstenhagen et al. [18] attempts to amalgamate each of the social barriers to clarify the challenges facing organisations and communities (See figure 1).

Figure 1. The triangle of social acceptance of renewable energy innovation [18].

Overcoming these barriers requires careful consideration and stakeholder involvement throughout the stages of implementation. Bearing in mind that stakeholders in RE are not limited to the individuals directly related to the projects, and that indirect stakeholders can create support for, or/and create obstacles to the level of buy-in to RE projects. In terms of public perceptions, RE technologies (e.g. wind turbines; anaerobic digesters) are often viewed as a blot on the landscape; create unpleasant aromas, and other negative effects depending on the type of technology. Therefore it is vital that the both direct and indirect stakeholders are considered during the planning process to maximise the chances of achieving social acceptance.

VI. ECONOMIC IMPACT FACTORS

Despite CO_2 emissions causing concern amongst the scientific community, it also presents an opportunity as the

renewable energy (RE) market grows, with the economic benefits of RE being potentially substantial for the countries / regions / communities that become market leaders. Indeed in these times of economic instability, the worldwide investment in RE is becoming ever more important to the global economy. Companies interest in RE is growing as firms search for new market opportunities, with Makower et al. [13] predicting that the amount spent on clean energy will grow from $144.5 to $343.4 Billion in 2010. China for example once seemed to be an RE sceptic, is expected to announce a "clean energy stimulus plan that could direct as much as Rmb 5,000bn ($750bn) towards new energies" [19] China has taken the opportunity to invest in order to stimulate the development of the industry with the intention of becoming a world leader. Should this strategy be successful, China hopes to gain an inherent skill which will enable it to maintain its new-found leader status whilst providing a long term income in the form of exports. The consequences of having a successful domestic market are not limited to the manufacturers of the technology as the RE industry relies on a number of other manufacturers and service industries. For example the following table demonstrates how the consumer's money is rationed amongst the various manufacturers and service providers when installing solar PV and wind turbines.

Photovoltaics	**%**	**Wind Power**	**%**
PV Core Components	70	Wind Core Components	65
Materials	17	Tower	18
Wafers	18	Blades	18
Cell	10	Gear Box, power transfer	15
Module	25	Generator, power electric	14
Balance of System	15	Controller Units	7
Installation	15	Planning, Installation, O&M	28

Figure 2. Renewable expenditure breakdown [20]

With such a large number of companies benefiting from the investment in renewables, the consequential multiplier effect on the economy has the potential to be enormous. In principle the benefits of renewable technology are highly desirable, however convincing consumers to adopt will require careful consideration of the technologies, the correct political backing, and overcoming the social barriers.

The exportation of equipment and skills will bring a steady income stream into economic regions, whilst a supporting service and supply network will develop around the manufacturers creating jobs and additional wealth. Although the consequences of becoming a market leader are highly desirable, it requires careful consideration of the influencing factors to maximise uptake. The following diagram shows the influences and their effect on each other in relation to RE.

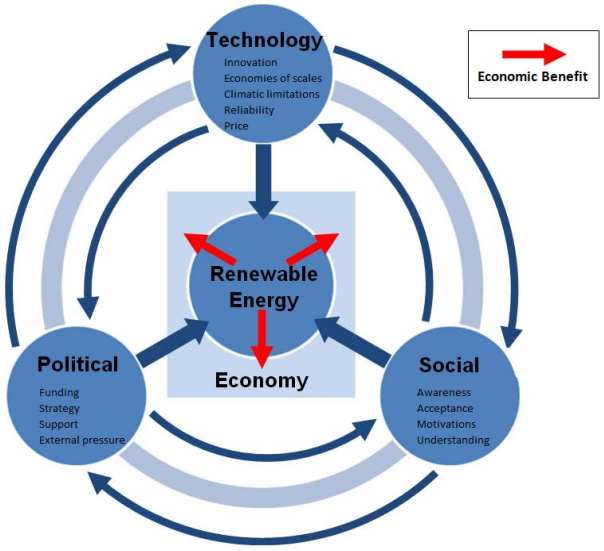

Figure 3. The economical effect of external factor on RE

In terms of social acceptance, Cowan et al. [21] make the point that: *"customers fail to implement energy efficiency projects when the cost savings are obscure or too far in the future"*. Most RE technologies are currently more expensive than their non sustainable counterparts, which can be partially attributed to the absence of economies of scale that other energy sources benefit from. As the production methods are refined and the amount of sales increase, the price of RE should be reduced, however policy makers can enable faster uptake by bridging the cost divide between clean energy and fossil fuels. Policy makers usually cannot subsidise all sources of RE due to funding constraints, and inevitably difficult choices must be made on the extent of support offered to each technology. To maximise the economic benefits of RE, it is important to take account of the technologies and the level of social acceptance when implementing policy, whilst continually monitoring and updating the policies to mitigate against factors that impede the adoption and diffusion of RE at micro and macro-level.

VII. CONCLUSIONS

RE is a developing market that holds enormous potential for countries, regions and organisations to derive environmental benefits and economic gains. Countries and regions are increasingly seeing the potential gains from having a thriving RE market and are investing increasing amounts on promoting the technologies in an attempt to maximise gains. Spending public money on a developing market requires prudence, justification under scrutiny, and careful contemplation in order to maximise the return on investment. Social acceptance, the technologies, and policy are interrelated and small changes in one can have a knock on effect on the others. A breakthrough in technology can quickly render policy obsolete i.e. policy may favour one technology despite more effective alternatives in the market.

Likewise a social revolt can hinder uptake of technology i.e. the increasing concern over the aesthetic impact of wind turbines on the landscape. In order to effectively monitor and manage changes such as these, the public sector, the private sector and consumers need to work closely together as the economic benefits of a successful strategy has high potential to bring long term financial benefits to all the stakeholders.

REFERENCES

[1] International Energy Agency, "World energy outlook 2006". Paris: OECD/IEA, UK distributor: Stationery Office, 2006.

[2] Choppin, S., "Global oil reserves and fossil fuel consumption". Guardian.co.uk, [internet] 2 September. Available at: http://www.guardian.co.uk/environment/datablog/2009/sep/02/oil-reserves [Accessed 25 November 2009].

[3] Darvill, A., "Energy resources: fossil fuels.[Online] (Updated 1 Nov 2008) Available at: http://home.clara.net/darvill/altenerg/fossil.htm [Accessed 17 October 2009].

[4] The Paleontological Research Institution, "Oil and Everyday Life". n.d . [Online] Available at:

http://www.priweb.org/ed/pgws/uses/uses_home.html [Accessed 3 December 2009].

[5] Act On CO 2, "Warming – climate change the facts". [internet] London: Met Office. 2009. Available at: http://actonco2.direct.gov.uk/actonco2/dms/Met-Office-climate-change-guide.pdf [Accessed 27 November 2009].

[6] Jacobsson, S. and Johnson, A., "The diffusion of renewable energy technology: an analytical framework and key issues for research". Energy Policy, 2000. 28 (9), 625-640.

[7] Rao, K.U. and Kishore, V.V.N., "A review of technology diffusion models with special reference to renewable energy technologies". Renewable and Sustainable Energy Reviews, 2010. 14 (3), 1070-1078.

[8] Eurostat., "Electricity generated from renewable sources". 2010 [Online] (Updated 17 June 2010) Available at:

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nrg_ind_333a&lang=en [Accessed 25 July 2010].

[9] Hara, N., Alisse, L., Barbière, J., Errington, B. and Kirchner, N., "Renewable energy: RD&D priorities - Insights From IEA technology programmes". Paris: International Energy Agency. 2006.

[10] Bergmann, A., Hanley, N. and Wright, R., "Valuing the attributes of renewable energy investments". Energy Policy. 2006. 34 (9), 1004-1014.

[11] Hepbasli, A., "A key review on exergetic analysis and assessment of renewable energy resources for a sustainable future". Renewable and Sustainable Energy Reviews. 2008, 12 (3), 593-661.

[12] REN21. "Renewables 2010 Global Status Report". 2010. [internet] REN21. Available at:

http://ren21.net/globalstatusreport/REN21_GSR_2010_full.pdf (accessed 29 July 2010).

[13] Makower J., Wilder C., Gauntlett, D., and White, W. "Clean energy trends 2010". 2010. [Online] Available at: http://www.cleanedge.com [Accessed 10 November 2010].

[14] Unruh, G., 2000. "Understanding carbon lock-in". Energy Policy Vol. 28. 2000. pp. 817–830.

[15] Arthur, W. "Increasing returns and path dependence in the economy", Ann Arbor: University of Michigan Press. 1994.

[16] North, D. "Institutions, Institutional Change and Economic Performance", Cambridge University Press. 1990.

[17] Willis, R., Webb, M. and Wilsdon, J. "The Disrupters:Lessons for low-carbon innovation from the new wave of environmental pioneers", London: NESTA.. 2007.

[18] Wüstenhagen, R., Wolsink, M. and Bürer, M.J., "Social acceptance of renewable energy innovation: An introduction to the concept". Energy Policy. 2007. 35 (5), 2683-2691.

[19] Hook, L., "US-China energy dispute heats up". FT.com, [online] 18 Oct. 2010. Available at: http://www.ft.com/cms/s/0/34ab3fbc-da86-11df-81b0-00144feabdc0.html#axzz15m0GeVft [Accessed on 11 Nov 2010].

[20] Lund, P.D., "Effects of energy policies on industry expansion in renewable energy". Renewable Energy. 2009. 34 (1), 53-64.Article in a conference proceding

[21] Cowan, K.R., Daim, T., Wakeland, W., Fallah, H., Sheble, G., Lutzenhiser, L., Ingle, A., Hammond, R. and Nguyen, M., "Forecasting the adoption of emerging energy technologies: Managing climate change and evolving social values. In: Anonymous Management of Engineering & Technology", 2009. PICMET 2009. Portland International Conference on. 3048-3058.