The Birth of a Born Global Industry:

– The Case of the Offshore Renewable Energy Industry

Abstract

Born Global companies have been a much studied over the past couple of decades, but now we also see evidence of Born Global industries. This study is a descriptive case study of such an industry – the offshore renewable energy industry. This industry faces very favorable global market conditions as there is a very strong global demand for new renewable energy technologies and the offshore environment represents an exciting opportunity for energy production. This study show how the emergence of this industry is driven by the establishment of highly mobile and ambitious international new ventures. The study concludes that these organizations are very good carriers of innovation and that individual, organizational and industry level factors all contribute the formation of these types of organizations. We also conclude that the understanding of these processes is vital if we are to create new industries that can provide us with more sustainable energy solutions.

Introduction

The world's dependency on hydrocarbons as a dominating source of energy is increasingly becoming a major global problem. Not only does it cause regional political instability, as the battle of control over new and increasingly scarce oil and gas reservoirs intensify, but the emissions from the use of fossil fuels are also the dominating contributor to increased global green house effects.

Due to these political and environmental problems related to fossil fuels, intergovernmental institutions and national governments in most countries have developed plans to increase the share of renewable energy. Tangible examples are e.g. the Kyoto agreement and EU's Renewable Energy Directive. Many countries have implemented support schemes to facilitate the development of renewable energy in general and some have introduced tailor made schemes towards chosen natural resources, like e.g. offshore renewable energy.

Common for all these agreements and support schemes is that they require successful development and dissemination of new technology in order to meet their objectives. To ensure the former, many governments invest heavily in research and development on new energy technologies. To promote the latter, we must rely on motivated market actors that can carry new innovations rapidly and broadly into international markets. This can be done effectively by motivating existing multinational organizations, such as energy companies or technology providers that already have experience in industrialization of new technologies worldwide. Alternatively it can be achieved by internationalization of newly established firms that have developed new solutions to our energy problem.

Intuitively, the solution including the multinational corporations might seem the most effective; however, both previous experience and the data we will provide in this study show that new firms might be even more effective carriers of new energy solutions than established actors. The reason for this is that new firms have fewer incentives for preserving current energy regimes and they also show a remarkable innovativeness in terms of coming up with radical new solutions.

According to International Energy Agency the theoretical potential of wave and tidal energy sums up to more than 80 000 TWh/year. This amounts to an exploitable potential of 15-30% of the worlds projected electricity need in 2050 (IEA 2004). The potential for offshore wind is also tremendous. In European Wind Energy Associations scenarios their reference case

suggests 35 000MW cumulative installed offshore wind capacity in Europe within 2020 (EWEA 2008). Hence, the business potential for exploiting offshore renewable energy sources is vast and global.

This study contributes by providing a descriptive study of a born global industry – the offshore renewable energy industry. Today, this industry constitutes primarily of newly established firms (see figure 1 below). Hence, we found it appropriate to analyze the globalization of the industry from the literature on International New Ventures (INVs). We employ a triangulation method based on quantitative and qualitative data from the offshore renewable energy sector in order to provide managerial and policy lessons on how new energy solutions can rapidly and extensively be deployed globally.

Theoretical background – International Start-ups

Traditionally, international business has been viewed as the arena of the large players, but in the past couple of decades small international firms have received more attention and recognition as viable international players (OECD 2000). The newest trend is that even newly established firms play a significant part of international trade (Rialp, Rialp et al. 2005; Aspelund, Madsen et al. 2007).

These newly established international firms have been given different names in the literature, but the most frequently used, International New Ventures (INV), was coined by Oviatt and McDougall in a seminal article in the Journal of International Business Studies in 1994. They defined an INV as *"a business organization that, from inception, seeks to derive significant competitive advantages from the use of resources and the sales of outputs in multiple countries"* (pp. 49). This definition has been broadly accepted and widely used in the literature thereafter.

One of the most interesting features of INV, in addition to their rapid and extensive internationalization strategies, is that they are extremely good carriers of innovations. INVs are often formed in order to exploit business opportunities that arises from new technologies (Keeble, Lawson et al. 1998; Crick and Jones 2000; Aspelund and Moen 2001; Stray, Bridgewater et al. 2001) when industries goes through major shifts (Jolly, Alahutha et al. 1992). This treat makes INV excellent carriers of new innovations on a global level as they effectively disseminate new technologies when the existing technological regimes become obsolete (Aspelund and Cabrol 2009).

In the following we will use the literature on INVs to understand how such firms could facilitate rapid and extensive global dissemination of clean energy innovations by unveiling some of their characteristics and describe under which conditions they tend to emerge.

Characteristics of Founders of International New Ventures

There has been quite a lot of research focusing on the role of the entrepreneurs in the internationalization process of new firms. One of the most frequently reported findings is that the entrepreneurs instill a strong international orientation in their organizations right from inception. International orientation is defined as *"…proactive and risk-seeking behavior that crosses borders and is intended to create value in organizations" (McDougall and Oviatt 2000, pp. 903)* and a key question to ask is where this international orientation stems from. One of the likely explanations was put forward in one of the earliest studies of INVs by McDougall, Shane and Oviatt (1994). They found that entrepreneurs with extensive international business experience developed *alertness* to international business opportunities by their unique insight into business opportunities that arises with heterogeneity in factor costs and market demand across national borders. Hence, entrepreneurs with extensive international experience have a stronger tendency to establish international start-ups. This finding has found support in both qualitative (Jolly, Alahutha et al. 1992; Kuemmerle 2002) and quantitative studies (Bloodgood, Sapienza et al. 1996).

However, as former business and educational experience is likely to affect the choice there is also equally likely that current activities are influential. Especially, it is likely that INV entrepreneurs obtain a lot of business related information through different communities of practice which they participate in. Research communities are good examples of such communities of practice. Research communities are normally highly international and participants often share large amounts of detailed information, not only on particularities of technological advances, but also on market development for potential applications, international research funding opportunities and governmental support schemes. It is likely that both the direction of internationalization and the extent of it might be based on information obtained through communities of practice. Hence, we propose:

P1a: *International entrepreneurs adopt an international orientation on their new ventures due to their extensive international experience and interaction with their international community of practice.*

The focus on international orientation deserves merit, because instilling an international orientation from the outset is maybe the most defining feature of INV and a precondition for rapid expansion. One example of a study that found the lack of international orientation to inhibit the internationalization process is found in Crick and Jones' (2000) study UK high tech firms. They found that technology entrepreneurs often had a tendency to develop *'technological myopia'* and neglected the natural, and indeed necessary, internationalization of marketing activities. Moreover, in McDougall et al. (1994) found that early international orientation is very favorable for the organization because they would then avoid the often far more painful change process associated with internationalization in later stages. This finding is consistent with a broad range of studies throughout the internationalization literature history showing that early strategic decisions regarding internationalization have long-term effect on international performance (Simmonds and Smith 1968; Bilkey and Tesar 1978; Lee and Brasch 1978; Cavusgil and Nevin 1981; Moen and Servais 2002). Hence,

P1b: *The new venture's early international orientation is a necessary and facilitating factor for rapid and extensive internationalization.*

Characteristics of International New Ventures

Even though some INVs might tell impressing stories of extreme growth and profitability, the general case is that newly established firms have severe resource constraints (Vesper 1990; McDougall, Shane et al. 1994). International start-ups might be even more exposed to resource constraints than the average new firms as they need to establish international sales and marketing capabilities at the same time as they deal with all the other entrepreneurial challenges such as product development, finding investors and building an organization. A natural consequence of the resource limitations is that new firms find that 'textbook solutions' to strategic problems that they face might not be viable options for them as they simply

cannot afford them. This means that the strategic freedom of new firms is limited in comparison to established actors with a credit record, higher credibility in the market and more organizational resources at their disposal. We propose:

P2a: *International New Ventures' strategic freedom is constrained by limited firm resources.*

In order to solve the problem of resource constraints INVs often turn to hybrid structures to govern their international activities (McDougall, Shane et al. 1994; Gabrielsson and Kirpalani 2004; Aspelund, Sørheim et al. 2009). They frequently involve in partnership arrangements so that they can rely on the resources of a larger partner to perform necessary tasks that they cannot afford to do in-house. Most of the studies that have been done on the partnership arrangements of INVs focus on how they use partners to establish international sales and marketing capabilities, but there is no reason why the same thing should not apply to activities in the other end of the value chain. Hence, there is a strong tendency that INVs actively search for larger complementary business partner to perform resource demanding tasks that the organization hardly can afford to do in-house.

P2b: *New Ventures often rely on hybrid structures and partner resources in their internationalization.*

When one reads the literature on INVs one is quite often left with the impression that one is exposed to stories of extremely successful, growth-oriented and profitable businesses that only seldom arises in the population. However, the few quantitative studies with random sampling procedures that have been performed often show a very different picture. Studies from the Scandinavian countries and France show that early and rapid internationalization rather constitutes the rule rather than the exception among international firms (Madsen, Rasmussen et al. 2000; Moen and Servais 2002; Aspelund and Moen 2005). Hence, they are very common. Moreover, the studies that have looked into motivation for international expansion specifically conclude that INVs primarily internationalize as a survival strategy

rather than a strategy to increase profitability (Oesterle 1997; Kuemmerle 2002; Aspelund and Moen 2005). However, the survival motivation appears to be a strong one as INVs reportedly operated on average in three times as many countries as firms with a slower and more restricted internationalization strategy (Aspelund and Moen 2005).

P2c: *Internationalization of New Ventures is primarily motivated by need.*

The factors mentioned above might lead to the conclusion that due to limited strategic freedom, reliance on partners, weak governance structures and growth strategies based on need INVs are unreliable carriers of new innovations into new markets. These shortcomings, however, might just be the factors that spur these firms into internationalization as they are strongly motivated by their need for expansion and actively search for appropriate complementary business partner that can help them launch their products and services on a global scale.

Characteristics of the context that nurture International New Ventures

Policy and institutions are well known to affect innovation and are regarded as central within the tradition of research on innovation systems (Bergek, Jacobsson et al. 2008). The concept can e.g. be used to evaluate the conditions to develop new energy innovations in certain a nation (Foxon, Gross et al. 2005). Research on how contextual factors, like policy and institutions, lead to internationalization is not very well studied in relation to INVs (Zahra and George 2002; Etemad 2004; Autio 2005; Rialp, Rialp et al. 2005; Zahra 2005). McDougall (1989) compared INVs with domestic firms and found that INVs perceived governmental policies more restrictive. However, the study did not address whether this was because INVs seek more attractive policy context, or if it indicates that INVs is confronted with increased regulatory requirements when competing abroad. When the conditions to develop or commercialize an invention are radical better in a foreign country than in the home country of the start-up this will presumable motivate for internationalization. Different industries have different needs Malerba (2002) and research has shown that certain industry factors tend to favor the establishment of INVs (Aspelund, Madsen et al. 2007). In cases where social added

value constitutes a significant part of the value proposition, as with renewable energy, policy and institutions play a more important role. Hence we propose:

P3a: *Differences in national innovation systems facilitate internationalization of New Ventures.*

As small companies with time and resource constraints INVs have benefit from markets with high levels of standardization. For example in the ICT and microelectronic industries we have seen examples that new firms have entered into OEM contract with global manufacturers that have given them high sales volumes in a very short time period (Jolly, Alahutha et al. 1992; Gabrielsson and Kirpalani 2004). The reason why this is possible in these industries is that all equipment operates on common technological platforms and the interfaces between components are standardized. IN the general case this means that the entry barriers in the industry is lowered as new entrants does not have to overcome the cost related to adopting to specialized interfaces or risk being held out of the industry by incumbents with proprietary technological systems.

P3b: *Common technology platforms and international standards facilitate internationalization of New Ventures.*

INVs are dependent on access to capital in the first crucial years of their existence. Obviously, they need financial capital in order to overcome the period of negative cash flow that most entrepreneurial firms experience. They also need access to a great deal of human capital in order to develop an efficient organization that can deliver world-class products and services. And most importantly, the creation of INVs requires motivated international entrepreneurs that are willing to forego other safer career options to dedicate themselves to the life of an international entrepreneur. In other words, the establishment rate of INVs is dependent on the availability of relevant financial, human and entrepreneurial capital to an industry. If the environment is interested in supporting the emergence of a new industry there are several ways that they can stimulate the supply of capital. First of all, national and supranational

governmental institutions can signal long term commitment and industry-specific investments to initiate and develop an industry. Such signals and commitments can to a large extent reduce the perceived risk of investors and potential entrepreneurs to invest time, money and efforts in a new industry. Moreover, the media and political attention given to specific industries can increase access to capital in an industry because business opportunities become in the industry become well known to the public and because the general level of social status associated with the industry is increased. Hence, our last proposition:

P3c: *Supranational agreements and media attention facilitate internationalization of New Ventures.*

Method

From a methodology perspective, our research may be described as case study with multiple case data and multiple unit of analysis (Yin 2003). The case is the offshore renewable energy industry and unit of analysis are the three levels *entrepreneurs*, their *new ventures* and the *context* these are embedded in.

Combinations of case studies and surveys has been recommended to investigate complex and context-specific internationalization processes (Rialp, Rialp et al. 2005). To enhance construct validity we have triangulated case data with the results from a web based survey of all the companies in the world that hold a technical concept to harness large scale wave or tidal energy, which they aimed to commercialize through a dedicated organization. The companies was identified by an assessment of International Energy Agency (IEA 2006) list, through internet search and extensive use of personal networking. Embryonic projects and pure university research projects were excluded, and some newcomers were added. In 2007 the survey was sent to 90 companies worldwide. To ensure commitment and avoid getting answers from persons outside the target group telephone contact was taken on manager level before sending the web survey on personal e-mail addresses. 50 companies answered the survey with sufficient quality, which gives a respond rate of 56 % of the whole population. With this respond rate we have a very good picture of the worldwide population of companies within the offshore renewable energy sector.

The evolutionary stage of the offshore renewable energy industry could be defined as "emerging" (Stephanie A. Fernhaber 2007) and this gives an excellent opportunity to study internationalization processes in early phases of an industry. By focusing on one sector we reduce the risk of getting confound results (Michael J. Rouse 1999).

Case data was gathered from public available information (web pages, conference papers, newspapers, magazines, annual reports etc) and personal contact with managers from the different companies. The corresponding author of this chapter has in-depth industry knowledge through an extensive industry network based on internships at research institutions dedicated to offshore renewable energy, consultancy work for several energy companies, as founder of International Network on Offshore Renewable Energy and as invited speaker on industry conferences, research seminars and courses. This enabled us to give more nuanced picture of how the companies in the industry act.

Findings from the offshore renewable energy industry

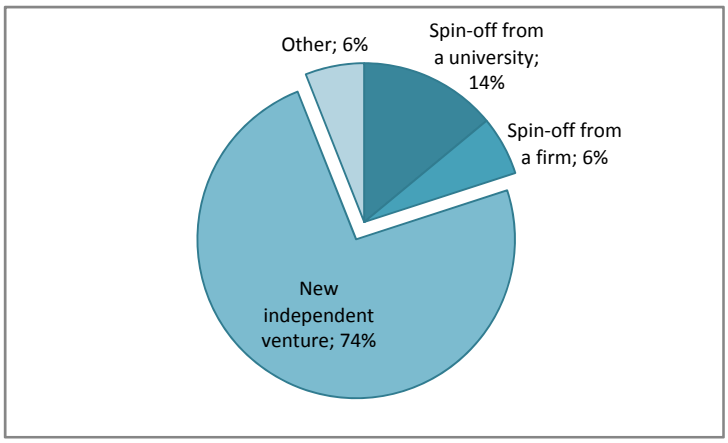


Figure 1 Type of company

To set the scene we already now conclude that the majority of the companies who are developing new concepts are start-ups. As Figure 1 shows 74 % of the respondents classify themselves as "*new independent ventures*", 14 % are spin-offs from universities and only 6% are reported to be spin-offs from existing firms. This strongly indicates that most of the new innovations within renewable energy originate from new venture rather than incumbents. The average age of the firms was six years (measured from

the company was registered). Geographical distribution of the companies is as follows: 49% Europe, 35% N-America, 12% Oceania, 4% Asia.

Obviously we do not expect all new ventures within offshore renewable energy to be INVs. However, when we regard the historical or expected future location for testing a prototype, doing a demo project and sale to the first full scale power park, we can conclude that internationalization will be an important issue. As Figure 2 shows, 38 % of the firms will do their demo projects in a foreign country and more than half of them expect the first sale to be abroad.

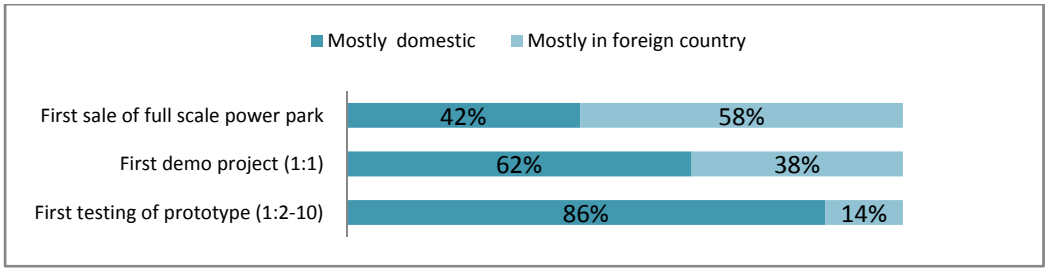


Figure 2 Historical or expected location of activities

In the following sections we will present our findings on the three different levels through quantitative analysis of survey data and short qualitative case examples from offshore wind, wave and tidal.

The entrepreneur level

Survey data shows that an increasing number of nationalities represented in the founder team correlate with the urge for *rapid internationalization*. Those with very strong international experience (32 %) are more agreed on statements like "*It is important for our company to internationalize rapidly" and "10 years from now I believe my company is one of the dominating companies worldwide"*. They are also less concerned about theft of technology and cultural problems. Further, they are less reluctant to internationalize before the technology is proven. On the other side, the survey reveals that respondents who agree to the statement *"The domestic market still offers sufficient growth potential"* are significant more agreed on the statement "10 years from now our company is a dominating national firm

without international activities". Hence, a domestic orientation correlates with a higher probability for becoming a non-internationalized company in the future.

The historical development of the wave energy industry provides good examples on how research driven communities have given new players an international view of the industry. What today looks like an international vibrant and emerging industry, with a good mixture of new ventures, established large companies and public initiatives, all started in the 70ies[1] as national research projects. For many years the whole "industry" was dominated by players from public research institutions. During the 70ies and 80ies the projects could be characterized as "national projects", but already in 1979 the first international *Symposium on Wave Energy Utilization* was held in Sweden. Two international conferences were held during the 80ies despite a more difficult time to find funding to do research on wave energy, and in 1993 the first *European Wave Energy Symposium* was held with support from the EC to invite the international community to discuss results from various national research projects. This conference has today turned in to *European Wave and Tidal Energy Conference* and has since been held eight times in different countries. EU funding has carried the phenomenon further by supporting international networks; The WaveNet (2000-2003) was set up as a European Commission Thematic Network to share understanding and information on the development of ocean energy systems. 18 organizations from 9 countries took part in the network. The network members worked e.g. to describe generic technology challenges and made drafts to the development of standards. The work from WaveNet was continued in Coordinated Action on Ocean Energy (2004 - 2007), established through EU's 6th framework program with the main objectives to *"develop a common knowledge base necessary for coherent development of R&D Policies in Europe, the dissemination of this knowledge base and promotion of ocean energy technologies"*. The network had 77 partners from 23 countries.

84 % of the respondents report to have participated in an international conferences or similar. With basis in the international culture and network developed between the researchers a community evolved were new industrial players could interact trough international conferences, research projects and public funded networks. In this sense the international

[1] Trigged by the oil crisis in 1973 when the members of Organization of Arab Petroleum Exporting Countries proclaimed an oil embargo in response to the U.S. decision to re-supply the Israeli military during the Yom Kippur war.

industrial network was, and still is, shaped through the relations and culture that already existed in the research communities.

Table 1 Industrial organizations

Organization	Founded	Origin	Members	Countries represented
IEA-OES[2]	2001	International	15	15
OREG[3]	2004	Canada	120	8
AWATEA[4]	2006	New Zealand	57	5
OREC[5]	2005	US	41	3
EU-OEA6	2007	Europe	55	18 (incl.3 outside EU)

In recent years several industry driven organizations have been established to better serve the industrial needs (Table 1) and these have all multiple nations represented among their members. Survey data shows that 52 % of the respondents are members of an international industry organization. Companies with membership are more oriented towards *rapid internationalization* and even show more *willingness to move the main office to a foreign country (if needed).*

The venture level

The development of offshore renewable energy concepts are capital intensive, especially when it is deployed into real sea conditions. Figure 3 gives a picture of how much each company has spent so far on R&D.

Marine Institute of Ireland has made a Development & Evaluation Protocol (Holmes, Nielsen et al. 2007) for wave energy concepts which include a rough budget. The estimate cost on tests from concept verification to full scale demonstration project is €9m-€21m. Clearly it is a

[2] www.iea-oceans.org
[3] www.oreg.ca
[4] www.awatea.org.nz
[5] www.oceanrenewable.com
[6] www.eu-oea.com

challenge for new ventures to raise these levels of funds and sometimes internationalization is an outcome.

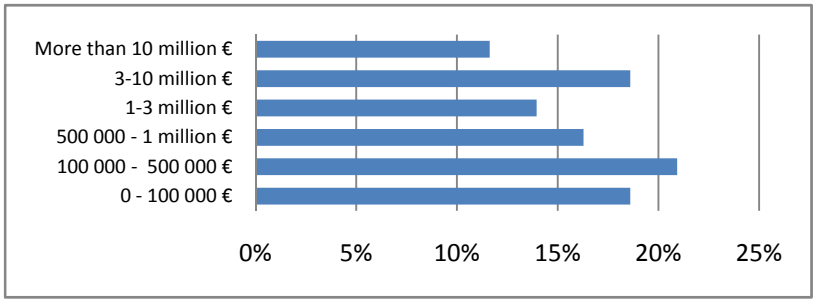


Figure 3 R&D investment distribution

The Dutch company Teamwork Technology is a very good case to illustrate how INV use international resources to reach their goal to commercialize their innovative idea, and how they manage to reuse the network and knowledge they get from this process. The company was established in 1995 in the Netherlands. Portugal was selected as the place to deploy their prototype, caused by Portugal's attractive feed-in tariff and apparent hassle free procedure of getting a permit to deploy the device. A scaled test of the device was done in Ireland, where they had suitable test facilities along with the needed experience. The hull was produced in Romania because of their international competitive shipyards. Generator parts came from France and China and the converter from Germany. After a fairly successful deployment of the prototype the company needed substantial new funding to further develop the business. A subsidiary in Scotland was set up because they knew the investment climate in Scotland was better than in the Netherlands. They found local investors and with a new management team the company got substantial governmental funding from Scotland to develop a 2nd generation device to be tested in Scotland. This shows how a start-up has navigated internationally to develop the idea they believed in. As a consequence of the new knowledge and network Teamwork Technology got from this process they are now in the process of preparing a full scale demonstration park of a new tidal energy innovation – in Scotland.

An example from offshore wind is illustrative to see the difference between incumbents and new ventures;

OWEC Tower is a Norwegian start-up who designed a jacket foundation for offshore wind turbines that allows wind turbines to be installed on deeper water than any traditional foundation allow. The company was established in 2004 by two engineers with experience from the oil and gas sector. The market for offshore wind in Norway is very limited compared to e.g. UK and Germany. Hence, the entrepreneurs decided already from the beginning to aim

for the international market to get their product developed and commercialized. The first years they earned money on consultancy work for foreign companies while they developed their own patented design. In 2005 they won a contract on two towers to the 41m€ EU supported Beatrice demonstrator wind park in Scotland led by two big energy companies. The jacket foundations delivered by OWEC Tower were built by a Scottish shipyard. In 2009 OWEC Towers have customers in USA, Germany, UK and South-Korea.

HyWind is an internal innovation project in the Norwegian state owned energy company StatoilHydro. The concept is a floating wind turbine for use in deep water. According to the company itself the technology is especially well fitted for energy poor countries with good offshore wind conditions, like USA and Japan. In contrast to OWEC Tower StatoilHydro installed the first full size demonstration project in Norway. This was done in 2009 with a project budget on approx 47m€ (NOK400m).

As we can observe, the start-up ventured abroad to find the opportunity to build their first demo, while the incumbent company did it in their home country. We would like to stress the point that this example does not indicate the success rate of these innovations. It is purely to illustrate the classical rapid internationalization process of a start-up compared to large established companies.

So, does international activities only stem from need and limited resources? The answer to this is no. INVs regard internationalization both as a need and as an opportunity. Figure 4 demonstrates this statement as it shows the share of respondents who considered factors that best explain their international activities. *Foreign opportunities attract us* turns out to be the most important factor, but survival in a competitive market is right behind, indicating internationalization to be an act of necessity.

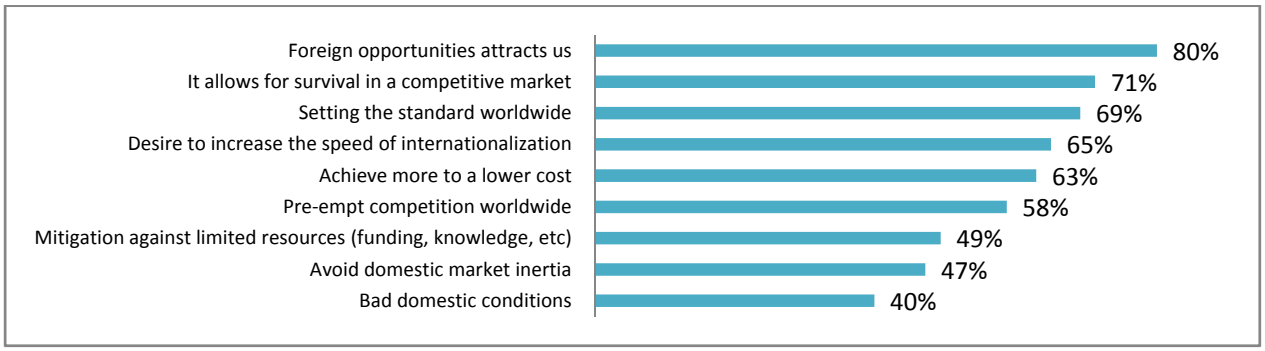


Figure 4 Factors explaining the international activities

We have proposed that INVs make use of hybrid structures to organize their rapid internationalization, and the industry is full of examples of internationalization through partnership. Below we have given some examples of agreements with different characteristics.

Table 2 Examples of internationalization through partnership

Company name	Country	Technology	Type of agreements
Renewable Energy Holdings	Australia	wave energy	Agreed to give a European utility company exclusive rights to use their technology in the northern hemisphere
Ocean Power Technology	US	wave energy	Agreements with national energy company in France, a national utility company in Spain and construction/energy companies in Australia to establish wave energy projects in the respective countries
AW-Energy	Finland	wave energy	Building a pilot power park in Portugal with a local construction company
Wave Dragon	Denmark	Wave energy	JV with German and Portuguese investors to set up projects in Portugal and a JV with a Welsh company to do tests in West Wales (heavily subsidized by the Welsh European Funding Office)
SWAY	Norway	Offshore wind	Deal to use a UK based consultancy company as knowledge provider in their technical development

To get a deeper understanding of which business activities that trigger partnership we asked the companies about which business activities they planned to do themselves (in-house) and which they plan to do through external firms. As Figure 5 clearly shows the companies are

planning for hybrid structures and close cooperation with external partners in nearly all activities. It is only the activities *research*, *development* and *sale* that contain less than 10 % external content.

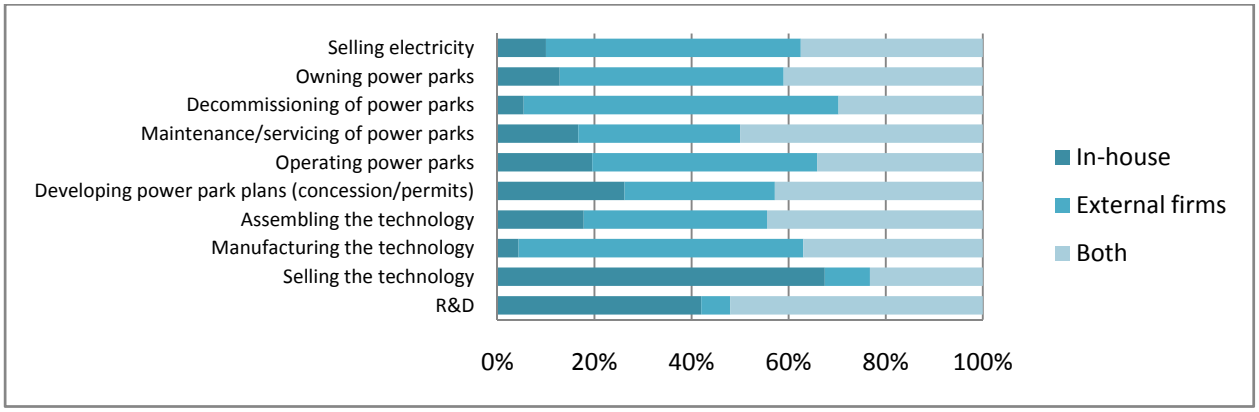
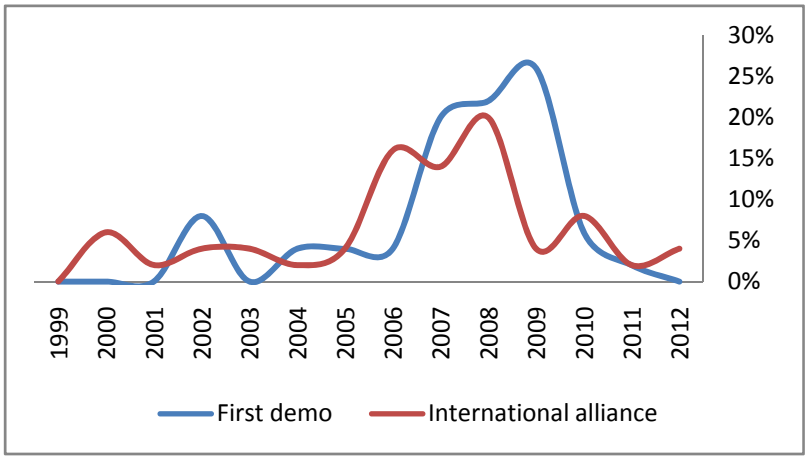


Figure 5 Planned business model

The use of hybrid structure related to all phases of a typical power park should make new ventures a good fit with incumbents carrying strategic interest in this sector. Observations of utility companies in Europe reveal this to be the case. According to the major utility company Statkraft (2008)more than 50 % of the top 20 European utility have taken positions in new wave and tidal technology through investments in start-ups. The same goes with the more traditional energy companies, even if they are fewer in numbers.

Very few of the companies will manufacture their technology in-house. This indicates use partners related to downstream marketing activities. In fact, more than 50 % of the companies reported to have three or more foreign nationalities among their consultancies, suppliers and the research institutions they cooperated with.



As previously shown a large share of the companies are doing their first full scale demo in foreign country and if this is done trough hybrid structures it should lead to a need for foreign alliances in connection to the demo project. A good indication of this being correct is the correlation between “experience or planned first international alliance” and

Figure 6 Time between first alliance and full scale demo

"time for first full scale demo" as shown in Figure 6.

The context level

The most important barriers to development of the industry perceived by the companies are *lack of long term governmental support*, *license challenges* and *lack of public awareness*. All these factors are affected by policy and institutions. Therefore it is not surprising that *a proactive government* is rated as the most important factor for the companies when they consider doing a demo or full size park project abroad. Some countries have made far more effort to facilitate the development of offshore renewable energy than others[7]. This could be e.g. in form of direct financial mechanisms to technology development or market formation, more institutional efforts like a transparent concession procedure or simply the existence of needed infrastructure like e.g. subsea cables.

UK and Portugal are the countries that by far have introduced most tangible initiatives to support the development of offshore renewable energy. As an example UK is the only country in the world who have officially announced a public international concession round for wave and tidal energy sites (700MW), and related to offshore wind they are in the 3rd round of offshore wind concessions including as much as 25GW in total capacity. In the UK electricity from renewable energy sources is subsidized through Renewable Obligation Certificates (ROC). Electricity from all the offshore renewable energy sources is given 1.5 – 5 times as many ROCs than e.g. onshore wind. In Scotland they have even put up a prize on 10 £m to the first team who achieves a minimum electrical output of 100GWh from marine energy[8]. In Portugal, a "pilot zone" on 320 km^2 with simplified concession procedures dedicated for wave energy projects have been defined by the government. At the same time Portugal offers has introduced Europe's highest feed-in tariff (fixed price) on electricity (up to 0.26 €/kWh) from wave energy demonstration projects (MEI 2007).In the survey Portugal and the UK are perceived as the two most attractive countries to build demonstration projects in and they are rated as the countries who will earn the highest value creation in the long term.

To illustrate the effect of differences between innovation systems we will use the case of Fobox, a Norwegian wave energy developer.

[7] For a full overview of all countries see: http://www.iea.org/textbase/pm/?mode=re
[8] http://www.scotland.gov.uk/Topics/Business-Industry/Energy/saltire-prize

Fobox is about to plan a full scale demonstration project. They have been granted license to do so in Norway. At the same time they have been granted, after application, access to a public financed subsea cable in England. In Norway the government has recently rejected a proposition to fund subsea cables to this purpose. Both Norway and England have a feed-in tariff applicable for these kinds of projects that comes in addition to the general market price on electricity. The basic price of electricity is lower in Norway than in England. The feed-in in Norway is 0.1NOK per kWh (approx 0.01€). In England, where they have introduced a tailor made feed-in for wave energy demonstration projects[9], this tariff is potentially 0.1£ per kWh (approx 0.11€), ten times as much as in Norway. Fobox is still to take the decision, but as this small example shows it is difficult not to go for the internationalization option.

A quote from the CEO of the US based wave energy developer OPT, who went public on the London AIM stock exchange in UK, underline how context might affect the access to resources (Taylor 2006): "…*OPT "test marketed" its story in both New York and London, and found that the London capital markets were more knowledgeable about both the general renewable energy sector and about the wave energy arena. This was due in part to the UK having had several wave power companies gaining press coverage, and because the UK government had identified wave energy as an important, strategic source of electrical power. At that time the level of interest in renewables in the US, in particular wave power, was somewhat limited. Traditionally when companies listed they tended to do so in the countries where they were headquartered. But for an increasing number of renewable energy companies it makes perfect sense to look further afield where the political and investor audiences are potentially more receptive, while maintaining a broad international scope."*

As the point above is to show how differences might lead to internationalization, equality might lead to the same – through standardization. The electricity sector is highly standardized regarding what is allowed to be fed into the grid and delivered to the end customers. As described by Wüstenhagen and Teppo (2004, pp. 11) *"…[the customer] cannot tell the difference in the final product that comes out of the wall socket*". This fact might make it more difficult for offshore renewable energy to differentiate from other sources of energy, but it sure makes it easier to sell the technology in several markets. The goes with all kinds of standardization as certification makes technology compatible and make it possible to e.g.

[9] http://www.berr.gov.uk/whatwedo/energy/environment/etf/marine/page19419.html

compare the different concepts. 77 % of the companies report that they are aiming for some kind of certification of their technology.

The EU funded program EquiMar (2008 - 2011) is a good example of how barriers might be lowered through the development of international standards. The aim of EqiMar is to "*deliver a suite of protocols for the equitable evaluation of marine energy converters*". This program involves a consortium from 11 countries representing universities, technology developers and certification agencies.

International programs like EqiMar facilitate internationalization through common standards. Other intergovernmental facilitate internationalization through a *common understanding of a global challenge*. Agreements like Kyoto (1997) clearly stated global warming and the need for new renewable energy technology as a common challenge for every country in the world. This challenge demand cooperation between nations and several supranational activities have found place already. Through the renewable directive (CEC 2008) EU have decided to implement at least 20 % share of renewable energy in their energy mix within 2020.

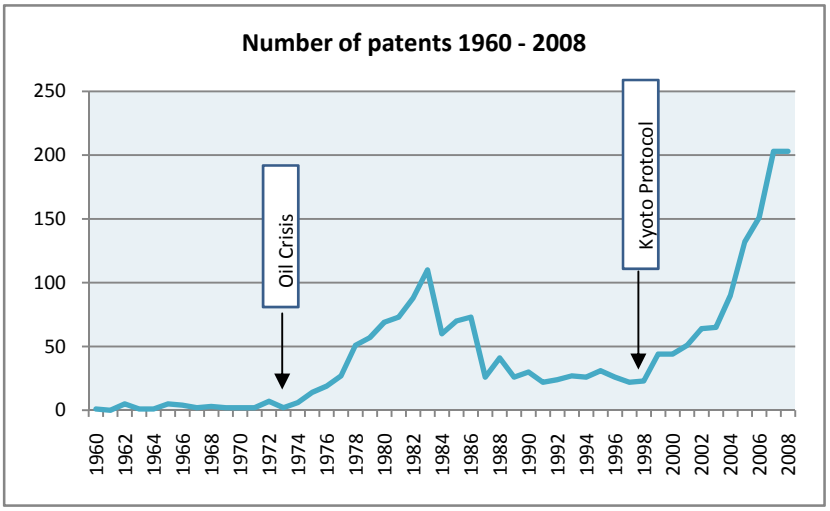


Figure 7 Wave and tidal patents 1960 - 2008

The acceptance of global warming and scarcity of hydrocarbon resources combined with supranational agreements and plans lead to extensive media coverage of different technical solutions. This again affects the direction of search when entrepreneurs are searching for new business opportunities. The patent statistics[10] in Figure 7 gives good indication for this being true. The number of issued patent per year increased after major events focusing this issue. An assessment of the development in media coverage of offshore renewable energy revealed the same, with a 36 % growth since year 2000[11]. One company that have

[10] # of patents in class F03B13 (Machines or engines for liquid) with keywords "wave" or "tidal" in title or abstract

[11] Based on a search on the keywords marine energy, ocean power, wave power and tidal power in Factiva

experienced especially much media attention is the Scottish company Pelamis Wave who installed the world's first wave energy project under commercial terms in Portugal (caused by the high feed-in tariff). This turned to many requests from all over the world from people who considered their technology as an option in their home country. As a consequence of this Pelamis Wave designed a brochure tailor made to educate potential project developers in order to empower these to evaluate the business opportunity. Through this method Pelamis Wave can communicate with many potential customers worldwide without having to spend several hours with every interested party.

Discussion

From analyzing the industry for offshore renewable from an INV perspective we conclude that newly established companies play a major role in the emergence and subsequent development of the industry. Start-ups act as *international carriers of innovations.* This might appear like a trivial point, but when one analyzes the emergency of an industry from an historic perspective there is a tendency that the big actors taking commanding positions in the adolescence of the industry are attributed the industry's success and the multiple entrepreneurial actors that has provided the breath of enabling technologies are neglected. Such are for example the popular tale of the auto-making industry where Ford's mass production technology have been much lauded while the impact of the broad range of entrepreneurial auto-makers that emerged in the late 1890-s are to a great extent neglected.

Today, over 90 percent of the population of firms in the offshore renewable industry is university spin-offs or new independent start-ups. However, this picture is not likely to last as the industry matures. Many (maybe the majority) of these start-ups will seize to exist as they run out of resources in a competitive market, but many of them will survive under the wings of larger actors that will enter the industry as it grows and becomes commercially more interesting. And it is very likely that some of the solutions brought forward by the firms in this study will in a developed form represent the globally dominant industry design in 20 years from now.

However, this study has revealed another good reason why INVs are good carriers of innovation and this is specifically related to the manner in which they grow and internationalize. INVs in the offshore renewable industry do not seek to monopolize their technology. Rather, they actively seek communities and business partners that can help them advance their project. This is an open innovation practice that works in the society's interests

of rapid and extensive dissemination of new energy technologies. Moreover, the open strategy seems to work very well in this industry as both actors are highly motivated to play this game. The new technology providing firm is resource constrained and has few other strategic options than to partner up with a larger international industry actor in order to get access to funds for further research, building prototypes and subsequent full scale implementation. The larger actor sees an emerging industry with very bright perspectives for the future and strong governmental support on all levels and her incentives would be to take her bet on the best available technology regardless of whether it emerges from her own organization or externally. Together they have complementary resources that can spur the global dissemination of new renewable energy solution.

Regardless of which industry structure that will end up dominating the offshore renewable energy industry in the future we find it safe to conclude that the mobility and international ambitions of the newly established actors that have created this industry have also given it the *'born global'* nature that we now see.

Management implications

Now, what managerial lessons are there in this study for managers in new firms in the offshore renewable industry? Regarding the first level of analysis in this study we find that it is of vital importance that the entrepreneurial team consists of people with international experience so that they possess the capability of international business. This capability is very important for new ventures in the renewable energy industry because, as this study shows, international alliances and transactions occur very early both upstream and downstream in the value chain. An industry in its infancy such as the offshore renewable industry has highly dynamic and competitive conditions, governmental support regimes and technological paradigms change rapidly. In order to keep the firm up to date with these changes managers need to connect tightly to organizations and communities that supply relevant information. This study has suggested that research communities in the new energy sector might be one of the most important such arenas for the firms in our study. If any of these capabilities or relations lack in the entrepreneurial team, managers should take active steps in order to recruit it as soon as possible.

That said, the ultimate survival path for most new energy INVs lay through partnerships with multinational corporations, either energy companies or technology providers, that have the financial and technical muscles to push a resource demanding project all the way through to

full scale implementation. These are the actors that ultimately will decide the dominant design of the future industry. It is likely managers that realize that it is the MNCs, and not the grid, that constitutes the primary market for their venture that holds the best cards to win the ultimate game for long term survival and the lion's share of the industry's vast potential future profit.

Implications for policy

To get returns on the social value added is the most difficult part of the business model in renewable energy. Governmental incentives and support is required to reduce the risk for private start-ups and investors. Extensive internationalization among start-ups within renewable energy, combined with the perceived importance of proactive governments, clearly indicates an urge to reduce political risk and seek activities in those nations where they can get hold of required resources. Support schemes should be designed to include start-ups.

By promoting an attractive national innovation system countries are able to guide foreign INVs, in chosen industry sectors, in their direction and by this supply their innovation system with more innovative solutions. This is former known as a strategy to e.g. attract multinational HQs and R&D departments from multinationals, but as far as we know, this strategy has not been used active related to attract innovations in promising new industries. Local industry will be regarded as potential partners and, even if there will be some head to head competitions between national and foreign companies, the national industry as whole will gain on it. As we see with the case of Scotland's 10£m prize it is even possible to be attractive without paying anything before successful innovations have been given. Initiative like these influences the direction of search through word-of-mouth in communities of practice, and through worldwide media attention.

On the other side of the political landscape are those nations who find them self having start-ups with inventions that may compete on an international level, but that clearly fall outside the national priority area (e.g. as with PV in Norway). A wise policy in this case will be to facilitate rapid internationalization as the future market is abroad and other nations might offer better innovation systems. The start-up itself will establish foreign partners, have a better chance of success and learn more. Hence, the national capability will grow as a result of the internationalization.

To be an attractive nation for INVs within renewable energy it is not enough to establish financial incentives, as the perceived barriers also are related to more practical issues. Nations who are able to offer transparent concession procedures and good grid access will stand out as attractive.

On a more international level we regard standardization as a facilitating tool to ease the flow of innovations between nations. However, it should be emphasized that standardization in early stage of an industry should first and foremost be related to the ability to compare innovations and not to short cut the natural evolution of many different concepts.

Future research

Several points for future research reveal themselves from this study. The most interesting are perhaps the interacting between incumbents and INVs. On an analytical level we have described them as good fit and empirical we have shown several examples of partnerships. A detailed analysis would give insight on how these partnerships are perceived from the different sides and thereby give a better opportunity to advise both INVs and incumbents. Further research on effects from (perceived) differences in innovation systems might give very interesting insight on how policy should be made to reach national and international political targets. A study of the intersection between the phases of R&D and commercialization would probably give the most interesting results while this is the area where the differences are biggest and the resource limitations of INVs fully come into force. Research should be done to investigate how intergovernmental agreements could facilitate INVs.

Conclusions

There are four key conclusions from this study;

First, the offshore renewable energy industry is a born global industry – created by international entrepreneurs with global ambitions, using technology that has arisen from global communities of practice, commercialized through international partnerships, targeting global markets from its inception.

Second, we can conclude that start-ups are an extremely important source of innovation within renewable energy. They are many and have strong motivation to succeed. This creates

a foundation for a natural evolution towards more dominant technologies and a strong willingness to internationalize.

Third, international start-ups (INVs) are good carriers of innovative solutions across national borders and actively seek partners with complementary resources. From an incumbents view this makes INVs a sources of business opportunities with built-in international orientation. For those nations with a strategy to build a competitive industry within this sector, foreign INVs step forward as attractive energizers to their national innovation system.

Finally, based on the two former conclusions, we can clearly state INVs as important actors in the global business eco-system who drives the diffusion of new renewable energy technology – increasing the global share of energy from renewable sources.

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