Creating markets for efficient technologies by establishment of strategic niche markets

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Abstract

Creation of markets for more efficient technologies requires careful targeting of actors that have an interest in driving the process further. Such will both reduce the resources needed and make use of the actors self-interest for development and thus uphold the learning process. This is done by identification of strategic niche markets (SNM) where those suppliers and users, that have the biggest interest and benefit of the change will act. Both the identification and the development is a dynamic process that is better designed and operated by use of a triangulation method introduced by the IEA in its recent work.

Introduction

In spite of all good work and all attempts to harvest the huge technical and economic potential for energy efficiency improvements globally the energy use is still rising and the potential is still in the same order as decades ago. Does this signify a failure or a normal state of development?

In policy making and policy design the ruling concept is still to attack Barriers, though Market Transformation and R&D policies are sometimes mentioned and tested. There is evidence that a more fruitful concept is to combine these three views and develop more complex and enduring Deployment Programmes. One finding of this work is that energy-efficiency programs are highly contextual and cannot easily be transferred among countries and/or sectors; nonetheless, there are common success factors, and measures that have these characteristics can be repeated or transferred. Truly successful programs have been developed over a long period, combine several policy issues (i.e. are coherent), use feedback mechanisms to reflect on their results (i.e. capture the learning effects), and are demand driven which releases the force of aggregated purchasing volumes.

This paper will make use of the IEA developed Policy Triangulation and apply it especially on Energy Efficiency cases to investigate how policy making and design can be improved and have bigger impact in the future. The paper will make use of the material gathered for the IEA but also add more recent material and analysis made for Norwegian cases.

A good intention is just not enough

Society has always a wish to cure the limitations of the market. In the area of energy efficiency the awareness that the sum of individual decisions are not always leading to the optimal energy system has led to several attempts to correct the market misallocation.[1] In many cases society has been prepared to either pay for, or reallocate, investments that cover the difference between the individual willingness to pay and the real cost. Thus there have been numerous programmes for resource acquisition fostered. The real cost of

1. The world misallocation is deliberately used since it is not a market failure in the strict sense of the word.

the product is however not known outside the producer and supplier. The level of compensation is thus not possible to calculate. Even if the compensation method would have been correct it would have been very costly for the society to "buy" the resources needed and also easy to show that this use of resources would create unfair distribution.[2]

A second order of programmes have been created to foster deployment of better technologies and seems mostly based on the knowledge that there is a vast potential for cost efficient improvements that is hampered by slow up-take on the market. Thus if users could be better informed and act, in accordance with his own best interest, optimality would be achieved. The individual is however not acting from an energy perspective alone. He could regard other aspects of the product (positive and negative) or have high transaction-costs. Thus he does not act as the "economic man" on energy. Both profitable investments opportunities and high subsidy (compensations) are foregone.

This latter view has spurred many "Deployment Programmes" where focus has been more or less accentuated on users perspective and on the perspective of those stakeholders that influence the users in their choices.

The traditional view revisited

The traditional view of the policy makers is mostly concentrated on the characteristics of technologies themselves. We will here take the perspective of how the proposed technology look in the eyes of the stakeholders that are supposed to move it further. Such a perspective does not have to mean that the technology per se is new but is perceived to be so from the stakeholder and especially so in relation to his alternatives. The cases will be picked from a recent work at the IEA and from a follow up of this made in Norway.[3] Only those technologies that relate to energy efficiency and to renewable energy sources have been picked here.

Not (yet) competitive technologies

These are mostly such that cannot be argued to be profitable for the user unless under very specific conditions or because they have additional high values except those that show up on the energy bill. The following three tables summarises case studies in the Technology Deployment study made at the IEA (OECD/IEA 2003 & Nilsson & Wene 2002) and identifies the actors in the projects and their relationships.[4] These will be used to illustrate the Triangulation method and the opportunities to identify strategic niche markets.

In this selection we find three cases related to solar and PV-technologies (Solar optimised buildings (Germany), The PV-covenant (Netherlands) and PV Power Generation Systems (Japan)). In all of them the government have declared special interest and specific goals to develop industrial know-how and capacity. Those goals are also very clearly outlined and stated, thus indicating that there is a strong political will and willingness to stimulate the development. The cases from Netherlands and Japan are explicitly driving towards a reduction of costs and a broad involvement of those stakeholders that could form a future business base. The German case is more focused on the systems research component and to get a feedback for learning among crucial categories that have impact on design of systems.

There are two cases (HF-electronic ballasts (Sweden and Sub-CFL (United States)) related to lighting where the explicit government participation was less distinct than with the solar-cases but more driven by user-oriented interest conveyed via government administrations or with these as catalysts. Both have been successful in trigging business interest from the demand side primarily as "carrots" by aggregating demand for the supply side to satisfy.

The two heat-pump cases (from Norway and Sweden) are very different. In the Norwegian case there was a strong government will to subsidise a market development that was then countered by some strong market actors opposing the change. The Swedish case is rather the reverse. The government administration acted catalyst and brought market supply and demand side together for the solution. Again the aggregation of demand was a carrot for the supply side to make a step change in performance of their products both in technical and economical terms.

These programmes show that there are some issues that are not taken into consideration by the broad market especially with early introduction. General subsidising is hence of little importance since the possible users and producers are primarily acting from economic stimulation. The most important thing seems to be targeting of pioneering stakeholders, identification of them and of their reasons for acting. Since so few are prepared to act at this stage the more important it is to get a feedback of their experiences.

The specific problem with the requirement for cost-efficiency is that it depends on the perspective, which could be:

- Static, and only regard present costs and prices.
- Dynamic, and take into account the development of technology that is inherent in the fact that it is produced in larger volumes and subject to learning on the market. These dynamics of learning reduce both prices and costs.
- Holistic, and also take into account that a new (different) product has different performance that should be calculated as well.

In far to many cases the policies stop with the static perspective on cost-efficiency and thus locks in the society in an old technology paradigm.

2. The discussion about free riders as well as free drivers have been extensive.
3. "Creating Markets for Energy Technologies", OECD/IEA, Paris, 2003. and "Best Practices in Technology Deployment Policies", Hans Nilsson and Clas-Otto Wene, IEA Secretariat. Proceedings from ACEEE Energy Efficiency in Buildings Conference 2002.
4. The cases are numbered according to the sources in the OECD/IEA Publication and in the Norwegian background material.

Table 1: Cases that deals with not (yet) competitive technologies.

Case	Actors and relations
9. Solar optimised buildings (Germany). Pilot projects with a total primary energy demand for heating, cooling and lighting below 100 kWh/(m^2a) incl. space heating demand of less than 40 kWh/(m^2a). Target will be achieved by integration of solar (passive and active) approaches, advanced HVAC techniques and innovative thermal insulation measures.	An experts group was set up to develop and design SolarBau's basic concept. The group consisted of representatives from: • university research • private research • architects and engineers • ministry and project management organisation The focus on office buildings; implied strategies based on passive cooling and advanced daylighting measures.
10. The PV-Covenant (Netherlands) Aim: "To direct and guide the initial market introduction of PV-systems in the built environment." The target is to realise 7,7 MWp of cumulative grid connected solar PV in the built environment in the year 2000**.**	The PV-Covenant was signed by 15 parties: ECN, R&S (later Shell Solar Energy), Ministry of Economic Affairs, Energy Distribution Companies and their branch organisation, project developers (building industry), and Novem. In the course of 1998 and 1999, 13 more parties co-signed the Covenant, (also municipalities).
12. Lighting (Sweden). HF electronic ballasts replace the traditional mains-frequency iron-cored choke ballasts in fluorescent lights. Fittings with HF ballasts can result in savings of 20-25%, with a 20% longer life. Savings of up to 70% can be expected if HF is combined with other lighting improvements such as new luminaire designs and control.	14 manufacturers had their products tested for compliance. The "Light Corridors project" disseminated targeted informational material. Incentive agreements where created in which property owners got a subsidy of Euro 0.2 per kWh saved in the first year. To get this subsidy, the programme requirements of 10 and 5 W/sqm installed had to be met. 72% continued to adhere to the programme requirements.
8. PV Power Generation Systems, Japan. Target is to install PV capacity of 5 000 MW by 2010. The target of the Deployment Program is the establishment of a new PV market and demonstration of system endurance.	The New Energy Foundation carries out subsidy programs for residences, while NEDO conducts various model projects and field test programs for industries and local governments. Solar cell manufacturers and housing manufacturers have organized an Association for public relations and dissemination in cooperation with the government.
17. Sub-CFL (U.S). Designed to speed the market introduction of a new generation of smaller, brighter, and less expensive compact fluorescent lamps (CFLs), intending to overcome the barriers that CFLs often do not fit into normal lighting fixtures. The long-term goal was to expand the market for CFLs by inducing manufacturers to develop and sell the new CFLs.	The main actors involved in the implementation of this program were: • Private multi-family housing owners and operators • Multi-family housing trade associations • Consortium for Energy Efficiency (CEE) • Northwest Energy Efficiency Alliance (NEEA) • Retailers • CFL manufacturers • Utilities
21. Energy PLUS (EC). A pan-European procurement project for refrigerator-freezers (Austria, Finland, France, Germany, Italy, the Netherlands, Norway, Portugal Sweden, and the U.K)	Due to the important role of retailers the "buyer group" included retailers, institutional buyers (such as housing companies and holiday resorts), and supporters (such as national and regional energy agencies, and environmental NGOs who in their daily work inform about and push for energy efficient products).
13. Heat Pumps (Sweden). Target: An energy-efficient heat-pump (COP > 3) with payback for installation < 7 years and for pump module < 3 y. The heating energy savings from the heat pump > 8MWh/year. Other requirements: • Refrigerant free from CFC • Simple monitoring, maintenance and service • Low noise level	Technology procurement with the objective to encourage the development of reliable, cheaper and improved heat pumps for detached houses. The purchaser group consisted of a mixture of potential buyers, which also included members from the other Nordic countries. In addition to helping to draft the performance specification, the purchaser group guaranteed purchase of at least 2 000 units of the winning model.
B. Heat Pump Technology Norway In 92-93, there were substantial subsidies for heat pump installations. In these two years, subsidies exceeded 500 MNOK per year. In the years before and after, subsides never exceeded 100 MNOK per year. Some 20 000 Heat-pumps has been installed.	The R&D groups in Heat Pump technology have been able to make heat pump technology as the central energy saving technology in Norwegian policy documents and in public debate. Other actors, especially from the strong utility sector have been negative. Locally, HP have been dependent on "enthusiast" builders, often backed by actors in the R&D groups. There are signs, however, that the use of environmentally friendly heating/cooling solutions for office blocks is picking up momentum. The local "push" has not been helped by cost-benefit issues. Thus, any device used in the end-user energy supply has to show positive cost-benefit, without regard to advantages in terms of e.g. environment or indoor climate.

Table 2: Cases that deals with competitive, but less known/tested technologies.

Case	Actors and relations
11. Heat Recovery (Netherlands) Mechanical Ventilation with Heat Recovery (MVHR) will play a major role in energy-efficiency concepts for houses, complying with the required Energy Performance Coefficient.	In 1996 the Foundation for High efficiency ventilation was established, with the Dutch Ventilation Industry to promote a good and healthy indoor environment as well as energy efficiency by the use of balanced ventilation with heat recovery. Beside six industrial parties also Novem, the Installers Branch Organisation, Gasunie and the educational institute for installers are members of the Foundation.
1. Biomass-District-Heating, Austria Small scale district heating plants that use wood chips, industrial wood waste or straw as fuel. About 2/3 of all plants have a power of less than 1 500 kW.	Plants usually have between 500 and 4 000 inhabitants and are of predominantly rural character. Local promoters of the project both develop and operate the system in co-operation with e.g. agricultural chamber, the state energy agency, the consultant or a person in the state-government.
3. Renewable Energy Deployment Initiative (REDI), **Canada** aimed at stimulating demand for reliable, cost-effective renewable energy systems for space and water heating and cooling by use of: i) solar ventilation air heating, ii) solar hot water, iii) high-efficiency/low-emissions biomass combustion, and iv) ground-source heat pumps. REDI focuses primarily on buildings in the industrial, commercial and institutional sectors.	Participants include the renewable energy industry and their customers. Customers include three distinct groups involved in the procurement decision: • engineers, architects and energy service companies (who specify or recommend the type of systems to be used); • building contractors and construction trades (who install the systems); and, • building managers and owners (who make the final procurement decision). The Strategy identified the supply industry – manufacturers, distributors and installers – as the main stakeholder to deploy renewable energy systems.
15. Best Practice (UK). The Programme is designed to help organisations cut energy bills by 10-20%, by providing the independent advice and assistance needed to persuade them to use cost-effective technologies and management techniques. Covers management techniques, including training, as well as technologies.	Sector approach, with sector managers responsible for particular areas, such as chemicals, non-ferrous metals, housing and schools. On the technology side, sector managers work with equipment manufacturers and users to generate, collate and disseminate authoritative, information to relevant parties.
D. Oslo ENÖK. A Programme to stop growth in the city energy use was adopted by the municipality government in Oslo 1982. A fund of approximately 10 M Euro per year was created (less than 0.1 Eurocents/kWh) and should grow to a revolving fund of some 100 M Euro in ten years. This should fund subsidies and loans for energy efficiency improvements in all building categories in Oslo, comprising: • Training of maintenance staff • Evaluations • Education • Campaigns • R&D and pilot projects	Energy advisors make analysis and give advice to consumers. Contracted and authorised consultants in the areas building, ventilation, electricity etc. Contractors where used in the same fashion but concern over free-ridership and neutrality reduced the use of this service. The operational responsibility was transferred from the city utility to the city 1996 when deregulation took place. Experiences from the training of advisors were: • Crosscutting experience was very low before the training • Energy use was not an issue for building and electricity consultants • Energy issues was more important for consultants in the area of indoor climate • Most active related to household were building consultants • Consultants in the area of electricity and contractors were totally inactive even after training • To many it was important to be a certified energy efficiency advisor • All consultants complained over low profit for work beyond what was free for the user and paid by the fund

Competitive, but less known/tested technologies

These technologies could mostly be justified from a simple calculation of economic yields when investment, energy cost and operations/maintenance are summed together, and if the investment is calculated on the true life time of the product. They still are held back since in many of these cases the user is either uninformed, risk averse or has not the authority within the company to make far-reaching investments.

We find two cases (Biomass District Heating (Austria) and Renewable Energy Deployment Initiative (Canada)) related to more extensive use of renewable energy. The Austrian bio-mass district heating have shown the importance of getting coherence between sectors and sector policies, whereas the Canadian only combines the energy and the climate perspective. Both of them seem however to have identified local determined actors as the champions of change.

The other three cases are dealing with advocating top of the line, and often new, technologies to very fragmented markets. Two of them (Best Practice (UK) and Oslo Enök (Norway)) are dealing with a broad range of technologies. The organisation to get the impact is however segmented to be able to targeted areas separately. The third (Heat Recovery (Netherlands)) is working with one technology only and is thus a bit easier to handle from an organisational point of

Table 3: Cases that deals with competitive mass technologies.

Case	Actors and relations
20. Motor Challenge (US). Careful matching of the elements of a plant system – motors, controls, couplings, and process machinery- to the work to be performed yield more savings than upgrading the individual components. Over 71 percent of total potential savings came from systems-level measures such as improving the configuration and control schemes in pump, fan, and compressor systems.	Partnerships with key industrial trade associations; the American Water Works Association, Compressed Air & Gas Institute, Electrical Apparatus Service Association, Hydraulic Institute, Technical Association of the Pulp & Paper Industries (TAPPI), Consortium for Energy Efficiency, and several regional utility groups. These partnerships enabled the program to develop a very broad reach to industry with a modest level of support.
2. Thermoprofit (Austria) is a "trade mark" for total service packages to reduce energy consumed. It contains the key elements of Third Party Financing and Energy Performance Contracting. It also includes models in which the ESCO optimises energy use on the basis of either an energy saving guarantee or a performance-based fee.	The Graz Energy Agency is in charge of evaluation and of preparing the certification of enterprises as Thermoprofit partners. For an enterprise to be certified as a Thermoprofit partner it must fulfil certain conditions and observe certain quality standards. Certified enterprises are entitled to use the quality label.
6. Labelling (Denmark). Mandatory scheme for all small buildings traded. The major target is to give information to the buyers on the energy consumption and their possibilities to save energy and water.	The seller of a house has to order and pay for the energy labelling. Low rating of the building and if the energy plan includes many proposals can reduce the price of the building. The specific rules for the energy audit, the calculation and the proposals etc. are given in the Energy Consultants Handbook. The quality of the labelling is inspected in a special quality control system.
19. Industrial assessment (US). An information dissemination program through energy audits carried out by university students The Industrial Assessment Centers program enables eligible small and medium-sized manufacturers to have comprehensive industrial assessments performed at no cost to the manufacturer.	The key elements of the IAC program's are: 1. well-trained participating universities; 2. mentor/protégé relationship among students; 3. small team size (8 - 10 students); 4. real world hands-on approach to teaching; 5. positive attitude of students to their industry hosts; 6. practical solutions with proven payback (nothing exotic) to real problems.
E. Energy Efficiency Check (EEC) is targeted at households in existing buildings. The programme is aimed at giving the end user a more concrete relation to his/her own use of energy compared to a norm. The EEC also gives advice about areas for implementing measures.	The EEC consists of a form with a number of simple questions about the building in relation to energy use. The questionnaire is filled in by the customer who then receives a letter where the specific building's energy consumption is compared to preferred numbers for how much energy a household of this type should use. The letter also includes the estimated energy saving potential of the building and a recommendation of specific EE measures.

view. All of them seem to draw quite a bit on the effect that clear signals from the society, and their participating institutions, serves as a bugle call to act!

Typically branch-institutions chose to engage themselves. The concepts are designed for a broad up-take and are mostly business oriented though seed-money is used from various funds. Also in these cases however there is sometimes a reluctance from stakeholders to make energy an issue in their daily activities.

Competitive mass technologies

Common sense and knowledge would say that there is not any need for support to something that is so clearly a good (profitable) thing to do. Yet there are quite a few programmes designed to ensure that dissemination is not hampered by a business-as-usual thinking.

Three of these cases (Motor challenge (U.S.), Industrial assessment (U.S.) and Energy efficiency check (Norway)) are targeting the specific situation of individuals. The main characteristic of the participating "customers" is that energy is either not on their agenda or, if it is, they have difficulties to deal with it. Such could depend on lack of knowledge as well as on lack of time to deal with issues that are a bit far off from their competence and capacity. All these cases are rather traditional in that they are trying to make up for gaps in the demand side reception either generally or of certain technologies.

Thermoprofit (Austria) is a bit more exclusive and develops new partnerships to give credibility to the ESCO-business locally. Though the project certainly is targeting technologies related to buildings and their climate properties the object is to create a confidence for partners that can provide the services and the result for inexperienced user.

The Danish labelling is unique in its approach to cover all end-users with its instrument. In a way it is fair to say that it is an efficiency check, just as the Norwegian case above, but it is mandatory and do not expect to release immediate response from the user. On the contrary one of the results is that response come later but is almost certain. The explanation is that when people have bought the house they lack resources to also change the energy performance but that they will do so later in conjunction with other maintenance of the building.

In all these cases handling is more formalised or the formalisation is the trick.

Table 4: Characteristics for categories of users participating in the dissemination (Nilsson & Wene, 2002).

Adopter type	Characteristic attitude	Role and size	Technology Appeal
Innovators, enthusiasts	Venturesome; Enjoys the risk of being on the cutting edge; Demands technology.	Drivers of the technology market. Want more technology and better performance. (16%)	Not yet competitive.
Early adopters, visionaries	Respectable; Integrated in the main-stream of social system; Project oriented; Risk takers; Willing to experiment; Self-sufficient; Horizontally connected and acts as their peers.		Competitive but less known.
THE CHASM (where marketing and distribution must radically change)			
Early majority, pragmatists	Deliberate; Process oriented; Risk Averse; Want proven applications; May need significant support; Vertically connected and acts as their superiors.	Followers on the market. Want solutions and convenience. (68%)	Mass market.
Late majority, conservatives	Sceptical; Does not like change in general. Changes under "pressure" from the majority.		
Laggards, sceptics	Traditional; Point of reference is "the good old days"; Actively resists innovations.	Could have economic or power interest from "status quo".	

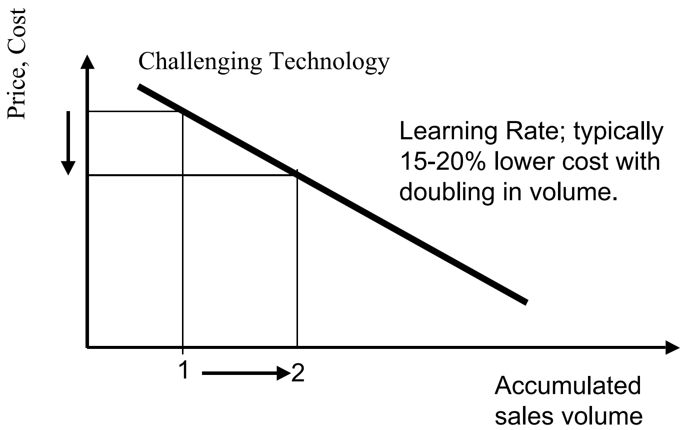

Figure 1: *Learning Curve.*

The champions of market development

Targeting the audience for measures requires knowledge about customer/user attitudes. It seems as if the classification of the cases above according to their present standing on the market corresponds somewhat to the way that the diffusion process is described in literature and is summarised in Table 4 below. The diffusion curve describes the market reactions, the up-take, of innovative products and services and especially enables a structured view on the individual attitudes and how those guide the response and the need for marketing and development of product (Rogers 1995 and Moore 1991). When new technologies are first brought to the market they are attractive primarily to enthusiasts. As they gradually gains ground it appeals also to other sorts of people who may be more interested in the function than in the technology per se. Marketing as well as deployment programmes must take this into account in order to use resources correctly.

But this view on dissemination only relates to the mindset of the buyers and not the producers or for that matter other actors involved in moving goods (creating value) in the distribution. To find the champions we must position them and understand their roles in niches on the market. Their issues are:

1. Alternative technologies available (competing technologies),
2. Attitude to use new technologies (as described above),
3. Available resources to spend (and what could they expect will happen after their spending).

Issue 1 has been dealt with in the presentation of cases above and issue 2 indicated by reference to the diffusion process. For issue 3 we will look on the way and effects of market learning, which is best done by studying the learning curve, see Figure 1.

The learning curve shows the rate of cost-reduction by volume growth (Learning Rate) that is normally in the area of 15-20% by each doubling of the accumulated volume of a technology (OECD/IEA 2000).[5] This is a factor that has been deliberately exploited in several of the cases such as those that deals with large scale market introduction of Photovoltaic, pushing them towards affordability.

If we confront this "behaviour" of the challenging new technology with that of the incumbent old one and further look at the willingness to pay from different actors (depending on the alternatives they face) we will get an instrument to describe niche markets more in detail. We will then find that there are certain stages in the technology development and diffusion there are different entities that will drive the change. We want to know their features better to address them for assistance in making energy efficiency a more wide spread alternative. We need to know who are those that will make the "investments in learning".

When the technology is young (with low volume) it can neither compete with the incumbent nor find any user whose alternative is so bad that there is a willingness to pay for it on rational grounds. The learning investments to drive the process further will have to come from government resources and to some extent from companies in their own research. Later the challenger will be able to exploit the existence of niche markets where customers for instance do not have access to the incumbent technology and hence will

5. This curve is regressive in a linear scale but is often used in a double logarithmic where it looks linear.

be prepared to pay for the new one if made available. And finally the newcomer will be able to compete on its own merits (in terms of cost) against the old technology and thus generate profit for its supplier. In this process we can identify some more details in behaviour of users and producers, see Figure 2.

Thus we find that when a technology is very new the government (or someone with equal interest) must take some responsibility for covering of part of the high cost but also that there is probably some user that have a high willingness to pay and could fill in the rest. Later the government could withdraw and other private resources (users) will take over. And finally when break even is passed the society as a whole will harvest the profit. If the dissemination is brought all the way as the figure shows the first part is a "learning investment" that yields profit in the end and should therefore be distinguished from subsidies that are given for other reasons (OECD/IEA 2000).

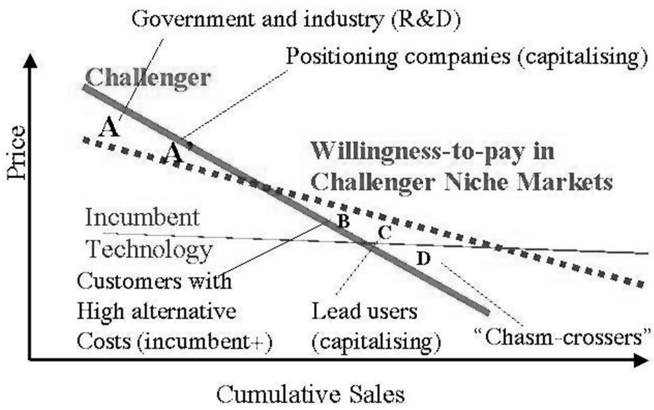

Figure 2: *Learning investments and investors.*

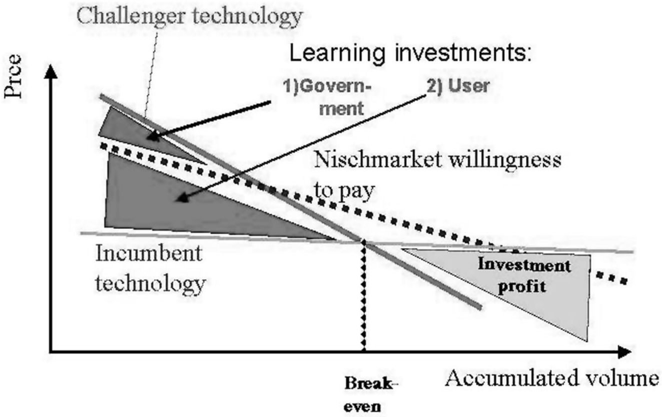

Figure 3. *Interplay between niche markets and the experience curve for a technology challenging the incumbent technology in the market.*

TRACING CASES TO THE NICHE WHERE THEY BEGIN

Figure 3 illustrates how a niche market identification can lead to earlier commercialisation of a technology and that the bill for learning investments can be split between public and private sources. The niche market is fairly well segmented and we will now try to outline more in detail who the "investors" could be that fill in the extra resources needed.

In segment A, the cost of the challenger-technology is still higher than the willingness to pay in the niche market. A "subsidy" (=learning investment) can provide the difference between the actual cost and the price in the niche market. The government acts normally by use of R&D agencies that have as a task to feed back information from the experiences made. They have however to take special care to really do so towards the categories who could be crucial in a future market development. The German Solar optimised buildings case (#9) seems to do so. On the private side the buyers for such new technologies are not generally interested in the economy of the product but in the technology itself and could thus be both willing to pay quite an amount and be resilient with shortcomings in the function!

Segment A' is when the "first mover" company on the market could envisage that the product will be useful to launch. Basically because the costs can be capitalised and gained back in terms of sales, marketing or image.

The only case that is clearly in segment A is the Solar optimised buildings (Germany), but there are several in segment A', such as the PV-cases, the lighting cases and the Energy PLUS refrigerators. In all those there have been from statements from supplying companies that they see a value in driving early market introductions. Japan's programme on Photovoltaic Power Generation provides an excellent example of how niche markets are used to share learning investments between public and private sources. The Dutch PV programme also shows how suppliers can be systematically used to aid technology learning.

In segment B, cost is below the willingness-to-pay in the niche market and no public money is needed to finance learning investments any more, though it may still be necessary to assist with indirect support (e.g., labelling schemes and other information devices). The case most clearly in this segment is the Canadian REDI and maybe also the Dutch Heat recovery, bust several others seem to be touching the segment.

In C and D, the market leader may be in the enviable position of being able both to brand his products for a niche market that is very profitable (C) and to let one of his lesser brands to feature a low-price version of the product that competes with the incumbent technology (D), the early stages of the dissemination curve up to the chasm (and possibly crossing), see Table 4.

Creating and exploiting niche markets is an efficient strategy for a deployment programme, both to provide learning investments from private sources and to stimulate organisational learning among market actors. For instance, the European Union labelling scheme for cold appliances created a niche market for highly energy- efficient refrigerators. This market was exploited by the market leaders. As a result, technology learning has made this originally very expensive technology available on the mass market. The two case studies on lighting, indicate the need to start in small niches and ensure feedback for learning both to market actors and to the deployment programmes involved.

Currently one can find large potentials for energy efficiency improvements hidden in situations in which energy use

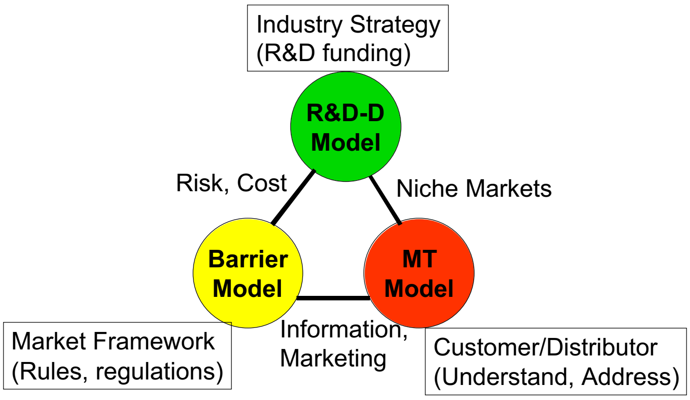

Figure 4: *Triangulation. Models applied and their internal relation.*

appears unimportant to the individual decision maker, though it aggregates into a large amount of energy used by all consumers taken together (e.g., energy used for standby power in computers and other electronic appliances). From the energy technology perspective, the mass markets in such cases appear highly fragmented and the need for joint relearning among market actors is correspondingly large.

The strong need for organisational learning and experimentation favours a niche market approach for deployment programmes in such instances. The ability to correctly identify the niche markets is emphasised by the fact that there is a need for big investments to fuel this learning process that occurs before the products are profitable compared to the incumbent technologies. It is then extremely important to address those entities that could justify their share in the investment burden. A good example is lighting, where energy savings come in very small packages, which have to be bundled together to make a difference from a policy viewpoint.

STRATEGIC NICHE MARKET MANAGEMENT

"Specific characteristics of new technologies can add value that makes potential buyers with special needs ready to pay extra for energy services produced with them instead of with incumbent technologies. Examples of characteristics that may provide the basis for a niche market are low emissions, modularity and compatibility of a new power source with electricity load patterns on the grid. The niche markets may be small relative to the total potential for a technology, but they can be important from the viewpoint of providing learning opportunities. Making use of them in deployment programmes can help both to shorten the time before a new technology will be viewed as a viable commercial endeavour and provide a source of business funding for learning investments. Market leaders often use a niche market in developing a 'challenger' to an existing technology, viewing it as a stepping stone towards a mass market."(OECD/IEA 2003)

In the case study analysis referred to a method called triangulation was developed and will not be further explained here but only indicated by showing how different models combined reveals components of niche market development and instruments to handle those markets, see figure below.

The triangulation will allow a more careful view on the actors involved, their own best interests and on the measures they dispose to drive the process further. This section will deal with the roles of different actors, which depends on the position of the technology. It will further deal with the measures and the combination of measures into programmes. This latter part dealing with programmes will reflect back on the more traditional terms used according to the models (Barrier, R&D+D and Market Transformation). The triangulation gives us three viewpoints that could be applied by:

- Governments (mostly on national but also on regional and municipality level),
- Industry in their capacity as suppliers and inventors,
- Customers (users) and Distributors to the market.

Conclusion

Dissemination of new technologies to the market still needs a lot more development of policies and thinking to be really forceful. The huge potentials that exist can be successfully exploited but it needs a more careful segmentation of the markets to identify both technologies, stakeholders and motives. Such a process has been traced in the analysis of cases and briefly indicated in this paper. Development would not only save resources but also disappointments.

There is room for much more innovativeness in design of policies and measures. The traditional thinking of carrots (and sticks) is too narrow. To be really forceful the feedback from trial and errors (and to allow errors) is necessary for the learning on the market.

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