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From demonstration projects to volume market of sustainable construction

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Abstract

Following the good examples of new buildings and renovations with outstanding energy performance, a main challenge is to bring holistic sustainable construction concepts for new and existing buildings into mass market. It is still at an early stage in market development and lessons between residential or non-residential buildings can be exchanged. To better understand the development of the market of highly energy-efficient construction, several International Energy Agency (IEA) Tasks examined opportunities and barriers of market development. This paper summarizes main barriers and drivers detected in the different tasks, involving worldwide insights from researchers and developers. Finally it is discussed how segments interact on each other, and how authorities may influence.

Keywords: Sustainable construction; market development; business models; demonstration projects

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1. Introduction

In most countries implementation of holistic energy efficient solutions for buildings is still at an early market development stage. On the other hand, the state of the art regarding available feasible technology solutions is rather advanced already. An important issue that remains is how to move from demonstration projects to volume market for innovative technologies and systemic solutions.

This market development issue has been studied for several construction subsectors in different international research projects:

- New residential buildings; International Energy Agency (IEA)/Solar Heating & Cooling (SHC) Task 28/Energy Conservation in Buildings and Community Systems (ECBCS) annex 38: Sustainable Solar Housing (April 2000 – April 2005) [1]. One subtask studied how demonstration projects were marketed. The aim was to "*describe the marketable housing for a better environment*".
- Renovation of residential buildings; IEA/SHC Task 37: Advanced Housing Renovation with Solar and Conservation (July 2006 to June 2010) [2]. One subtask looked at how to "*Develop specific market strategies together with companies, authorities, research institutes or other market players participating in the Subtask*".
- Renovation of single family houses; Two spinoffs of IEA/SHC Task 37:
    - SuccessFamilies led by VTT in Finland (May 2009 to April 2012) [3]. The main objective of the project was *"to change the business environment in order to speed up the implementation of sustainable renovation of single-family houses. The resulting new service concepts will combine both the technical solutions, financing services as well as how to promote to overcome the behavioural, organizational, legal and social barriers that exist in sustainable renovation*".
    - ERACOBUILD project 'One Stop Shop' led by the Belgian Passive House Platform (September 2010 to August 2012) [4]. The overall project aim was "*to facilitate market penetration (volume market) of housing renovations for single family houses of very high energy standard while providing superior comfort and sustainability to occupants.*"
- Renovation of non residential buildings; IEA/SHC Task 47: Solar Renovation of Non-Residential Buildings (January 2011 - June 2014) [5]. The objectives of this task are: 1."*Develop a solid knowledge base on how to renovate non-residential buildings towards the NZEB standards in a sustainable and cost efficient way."* 2."*Identify the most important market and policy issues as well as marketing strategies for such renovations*".

This paper discusses differences and similarities of challenges between different segments for market penetration of sustainable solutions, and how segments influence on each other. Most of above mentioned projects have gained experience with the residential sector. Task 47 which is about non-residential buildings is still at an early stage of its project period. In this paper the main findings regarding market barriers and opportunities from each of the mentioned projects are summarized and the authors discuss how different segments interact with each other. It is concluded with recommendations for policy makers.

2. Applied methodologies and main results in the research projects studied

The fundament for this paper is the work done by previously mentioned projects.

Table 1: Summary of methodologies applied in the studied research projects

Research Project	IEA/SHC Task 28	IEA/SHC Task 37	Success Families	One Stop Shop	IEA/SHC Task 47
Research period	2000-2005	2006-2010	2009-2012	2010-2012	2011-2014
Building types	New residential	Renovation of residential	Single family houses	Single family houses	Renovation of non residential
Documentation of demo projects	v	v	v	v	v
Building stock analysis		v	v	v	v
Study of decision processes		v			v
Discussion of market strategies	v	v	v	v	v
Business modeling			v	v	
Business collaboration workshops				v	
Sustainability assessment		v			v

The output of each of the research projects is described below.

IEA/SHCTask 28/ECBCS annex 38:

"A marketing guide based on experiences from 10 countries." [1].

One of the main barriers detected in this project was the one sided focus on investment costs. A good example of how the use of other attributes to promote sustainable solutions is the World Wildlife Foundation (WWF) in Holland which allowed use of their logo in marketing of houses conditioned that they fulfilled specific requirements. One of the main recommendations in the guide is to focus on non energy benefits in the marketing of sustainable housing as a mean to avoid one sided focus on costs.

IEA/SHC Task 37

The reports from this project which have most relevance for this paper are [2]:

- Summary report of building stock analysis to highlight where the biggest saving potential is.
- Handbook: "Market development for advanced housing renovation – From demonstration projects to volume market".

A main barrier identified in this project is that in the early market development phase there are few good examples to motivate how renovation should be done of existing residential buildings. Therefore both home owners and contractors often seem to be focusing on "repairing" defaults of the building instead of seeing it as an opportunity to upgrade it to a "new" home with excellent indoor comfort. The report shows the path for different actors for how to develop the market from the first initial demonstration projects to replication of these to a growing market. A main point that is stressed is that it can not be moved directly from the demonstration projects to the mass market. Different strategies apply for different phases of the market development.

SuccessFamilies

The reports from this project which have most relevance for this paper are [3]:

- Report on stakeholder interests (status analysis)

- Report on business models
- Report on possible market strategies
- Summary report

The main barrier thoroughly analysed and discussed in this project was "the missing link" between the single family home owner and the fragmented supply side of products and services for renovation. In the Nordic countries a few actors developed services with the aim to fill in "the missing link". As two of the five pilots have ceased, it has been learnt that a solid financial structure as well as a long term strategy is required for companies to innovate this market. Subsidies to single energy efficiency measures may undermine a holistic approach. It is therefore recommended that it should be required to have an energy audit with suggested measures made by a certified person before getting subsidies to any single measure.

One Stop Shop

The reports from this project which have most relevance for this paper are [4]:

- Two papers which summarize the experiences from the business gathering events and business modelling.
- Guidelines: How to develop a business model for One Stop Shop house renovation?
- A fundamental barrier for establishing "One Stop Shop" for energy efficient renovation of single family homes is lack of culture for tight and long term co-operation between actors on the supply side. Due to the complexity of renovation projects, training, quality assurance and distribution of responsibilities are important issues to be dealt with before establishing a "One Stop Shop".

The collaboration events which were tested as part of the research project seemed to be very promising means to motivate companies to establish tighter co-operation. Examples from the pilots also showed that home owners increased the amount they would invest in upgrading their house as they learned more about energy efficient renovation.

IEA/SHC Task 47

The planned outputs of this task with most relevance for this paper are [5]:

- Summary report of building stock analysis to highlight where the biggest saving potential is.
- In depth descriptions of decision making processes in case studies.
- Summary of barriers and driving forces in decision making processes for high ambition energy efficient renovation of non residential buildings.
- Discussion of how authorities may increase the number of ambitious energy efficiency projects in the non residential sector.

Important barriers which this task addresses are: tenants are reluctant to pay a higher rent although they benefit from energy efficient renovation, each renovation project is viewed as "new" and higher margins are calculated to cover risk for the contractors; tendering processes leading to strong focus on construction costs. There are interesting opportunities in focusing on the effects of improved air quality on health and work efficiency of people inside buildings.

3. From demonstration projects to volume market for Passive Houses

Even though the biggest theoretical potential in energy savings is in the existing building stock, new buildings serve as examples of what could be expected for the whole building sector in the future. It is therefore natural that the market for very energy efficient solutions first takes place in new buildings.

Regarding the volume market development we noticed in several of these projects the strong influence of the Passive House concept for achieving a market development of highly energy efficient housing. The market introduction of sustainable housing at the Passive House level started with new projects in the

1990'ies in Germany. Today we find a variety of Passive House examples of both new residential and non residential buildings in many countries. The numbers of renovated projects with high energy efficiency performance are still limited in most countries. Rogers' product life cycle curve below illustrates how innovations develop through their lives, exemplified by the Passive House development.

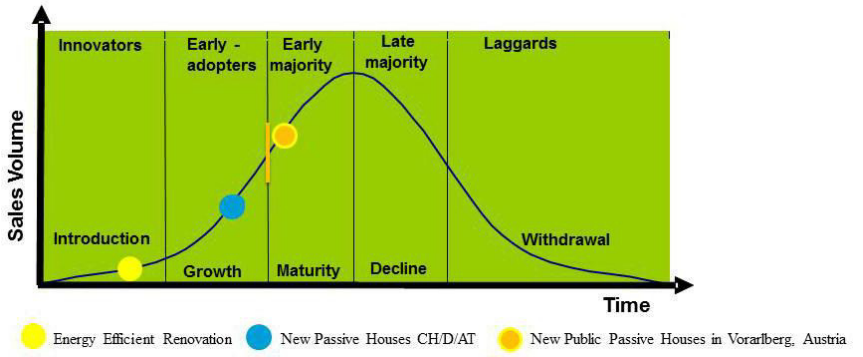

Fig. 1. Rogers' Product Life Cycle Curve illustrated for Passive House development

Mainly in the European countries it is observed a presence of an emerging Passive House market within all segments. A market niche development is led by building owners for residential buildings and contractors and procurers for public buildings. The residential market is very advanced in some countries. In Switzerland, Austria and southern part of Germany new Passive Houses are now in the growth phase and trendsetters now show the path for further development of this market. It is however still a way to go before these countries enter the majority of the market. New public buildings in some regions are very advanced in market development. For example, in Vorarlberg in Austria local and regional authorities require that all their new public buildings will be built according to the Passive House Standard. This means that all planners, contractors, sub-contractors and suppliers with ambitions to survive in this market segment need to possess knowledge of how to supply the relevant services and products at competitive prices for fulfilling such requirements. Such policy generally results in increasing the interest for the Passive House concept also among private home owners and buyers, as well as developers in the non-residential sector, as they learn about the benefits of achieving high energy efficiency. There are now examples of suppliers in some countries which only offer very energy efficient buildings to the market as they now find market segments which are big enough for them.

4. Barriers and driving forces in the different segments for market development

4.1. Barriers and driving forces for new sustainable buildings

In the different projects, important barriers were identified for a faster development of the market for new sustainable buildings, particularly with a focus on energy efficiency were:

- Limited knowledge and experience both on the demand and supply side of the benefits of such buildings.
- Strong focus on the investment cost.
- Very few financing institutions take into concern the energy efficiency of the building for setting the interest level of the mortgage loan.

- Calculations tools for estimating market value of buildings used by real estate companies and banks do not (or too little extent) include energy efficiency parameters.
- Fear among constructors that airtight buildings may lead to bad indoor air quality and moisture problems. It may therefore be seen as risky to take on the responsibility for such projects.
- Inexperienced actors lack credibility in marketing of such buildings. It is therefore needed to invest in competence on all level in-house as well as tight cooperation with research institutes or similar to build trust. This is difficult for small and medium sized companies.
- In the public sector there are two main issues which deserve special attention:
    - Public tenders may lead to less focus on innovative solutions due to strong focus on price.
    - Due to tight budgets, municipalities and other public building owners have problems to choose a more expensive solution even though it is in line with national policies.

Important driving forces identified for a faster development of the market for new sustainable buildings, particularly with a focus on energy efficiency were:

- An increased general awareness of environmental issues and in particular in some market segments.
- Enforced building codes.
- The presence of construction companies which have decided to be frontrunners and position themselves ahead in an expected fast growing market in the coming years.
- Suppliers of new innovations enabling more energy efficient buildings investing in both training for the building industry and in promoting such solutions.
- Authorities on different levels which make policies that they as landlords will only build very energy efficient buildings. By this a market is created for the supply side which then also more easily may offer the same to private costumers.
- Presence in public buildings, as for example a Kindergarten nearby Gothenburg in Sweden built as passive house, motivates private persons to build their homes with the same qualities.
- Companies which want to emphasize a green profile by building energy efficient buildings. Some hotel chains and main offices in different countries are examples of this.

4.2. Barriers and driving forces for sustainable renovation of existing buildings

Many of the barriers and driving forces for new buildings may also play an important role in energy efficient renovation of existing buildings. Instead of duplicating these factors, below the additional arguments specifically for renovation projects are listed.

It was noticed that market development for renovation was slower in different countries, due to several additional barriers. Important barriers identified for a faster development of the market for sustainable renovation of existing buildings, particularly with a focus on energy efficiency were:

- General issues:
    - Complexity of deep renovation projects.
    - General lack of competence about deep renovation and quality assurance.
    - Lack of concepts for holistic approach towards renovation projects.
    - Lack of cooperation and coordination locally and nationally, as there is a missing link between ambitions expressed by politicians and measures implemented.

  - "Added value" or non energy benefits of such ambitious renovation are unclear for both the supply and demand side.
  - The technical innovative solutions used in new buildings have not reached a volume of scale and are therefore still relatively expensive.
  - Governmental regulations such as restriction on increasing thickness of outer walls.
  - Lack of demo projects which document energy savings and costs, and dissemination of such and thereby there a few references.
  - Lack of financing.
- Specific for multi family houses
  - Complex decision making processes as there are many persons involved who have to agree on the decision.
  - Lack of service integrated in the supply side, helping in decision making processes.
  - In some countries the legislation for protecting the tenants makes it difficult to increase the rent and thereby makes it impossible for private landlords to implement deep renovation projects.
- Specific for single family houses
  - Ordinary single family homeowners do not have any competence about choosing the best solutions. Anyway many take on the role as project leaders themselves and coordinate the work.
  - Fragmented offer of single solutions, such as heat pumps or window replacement, are heavily promoted towards the house owner and serve as a major "competitor" to holistic renovation.
  - Lack of companies offering integrated renovation solutions to homeowners.
- Specific for non residential buildings
  - Very few demonstration projects which are well documented.
  - A wide variety of types of buildings which means it is difficult to generalize solutions.

Important driving forces identified for a faster development of the market for sustainable renovation of existing buildings, particularly with a focus on energy efficiency were:

- General driving forces for energy efficient renovation
  - Increased focus on health/comfort
  - A lot of buildings which are too good for demolition and at same time represent a huge energy saving potential. Extreme show cases may serve as eye-openers.
  - Governmental attitude and action, politics
    - Financial incitements do not only serve as cost reduction for the owner, but also as a sign for what are good actions for the environment.
  - Universities and R & D institutions are important innovators and by interacting with actors in the building industry they play an important role in development of the early phase of the market.
  - The "Energy Label" system helps to bring focus to the energy performance of buildings in a similar way as it has done for electrical equipment.
- Specific for multifamily houses
  - Upgrading neighbourhood to avoid decreasing value of real estate
  - The need for more space often leads to a decision towards major renovation including new façades with better energy performance
- Specific for single family houses

  - General upgrade of the house after buying.
  - When façades and/or roofs are in bad shape, the homeowner can more easily be influenced to decide for major renovation including energy efficiency
  - The need for more space often leads to rethinking the whole house layout and energy saving additions.
- Specific for non-residential buildings
  - Expectation of increased asset value as such renovation will keep track with the quality in new buildings.
  - Ambitious renovation projects may be used to build image as a company which are concerned about social and environmental responsibility.
  - Better indoor air quality has an impact on work efficiency of persons working inside buildings. An example from the school Kampen in Oslo, Norway showed that the pupils performed better on concentration tests and responded more positively on health and well-being after renovation than before [6]. The improvements were significantly better than the same tests done at a reference school during a period of three to four years.

Media play an important role in how the knowledge is spread out to a broader public. When journalists get excited by learning about sustainable buildings, they may become a driving force for further market penetration through positive coverage of good examples. On the other side, bad examples illustrating insufficient construction quality (for example moisture problems) or problems with installation (for example resulting in bad indoor air quality) may be destructive for serious actors developing this market. Therefore quality assurance and certification systems are important to avoid "rotten eggs in the basket".

4.3. Discussion of interaction between the segments

We can categorize the main segments of buildings by the following combinations: new/existing, private/public owned and residential/non residential. Residential building is further divided into single family and multi family houses as the decision making processes are very different.

All persons are actors in different segments every day. We are either a homeowner or tenant, performing our job in a building, concerned about our children spending their days in kindergartens and schools, customers in commercial buildings, guests in hotels and so on. What we experience in one place we bring it with us to another place. For example, in Trondheim highly energy-efficient flats for the students at the technical university were built. When the students will finish their studies they will both have a practical experience in living in such a building as well the competence in planning similar buildings elsewhere. The example earlier mentioned about the kindergarten in Sweden also shows that one specific building can inspire several spin-offs. In Austria and Belgium demonstration passive houses, bed and breakfasts and hotels are available for rent for a few days so people may try how it is to live in such an environment. By experiencing the non-energy benefits as described by Skumatz [7] of such houses, the contrasts to their own ordinary house become clear. Several types of buildings may therefore serve as inspiration for private people to invest in energy efficient housing.

The Passive House standard is a way of conceptualizing an energy efficient building. Renovation is difficult conceptualize with one standard. But the concept for new houses may be used to illustrate the idea as such also for energy efficient renovation.

Within each of the main market segments described in the introduction there are several sub segments. Going back to figure 2, the curve illustrates that any new market development is started with the innovators before the early adopters show the way for the early majority. After the innovators have

demonstrated that the solutions are functioning, the early adopters play the role as trendsetters for the volume market. At this stage the interaction with media plays an increasing role. Therefore trendsetters who are good role models could be very good promoters of increased sustainability in buildings.

As already mentioned public building owners may contribute to a faster growth of this market, as the supply side needs a certain volume before they may afford to invest in development and training in how to build more energy efficient buildings. Therefore, the next section summarizes main detected recommendations to authorities to speed up market development.

5. Recommendations to authorities to speed up the market for sustainable housing

In countries where all types of sustainable buildings still are in the introduction phase of the market development international research within the IEA projects recommends:

1. Create arenas (including demo projects) where private actors may learn from research institutes of best practices and to build credibility.
2. Such projects need a fair public funding as they should be thoroughly documented to serve as examples for later projects.
3. Energy efficiency measures should get increased attention through national promotion campaigns.
4. A national agenda should be set – to indicate the ambition level regarding efficiency in each project and in number of buildings.This is also an opportunity to comply with European Energy Performance of Buildings Directive (EPBD), since Member States are obliged to introduce nearly zero-energy buildings in the framework of the recast of the EPBD.

In countries where some of the segments are already in the growth phase international research within the IEA projects recommends:

1. Develop national master plans defining specific goals and timelines for implementation of relevant measures. Several of the points below should be parts of such plans.
2. Take action to make public actors (on all levels) to demand for very energy efficient solutions for their own buildings in order to create local and regional markets. An example is Frankfurt City in Germany which in 2007 decided that all their new municipal owned buildings should be built according to the Passive House standard. Similar decisions have been made in several regions in Europe. [8]
3. Create local/ regional arenas for companies representing all crafts in building projects.
4. Establish post educational programs on all levels and involved professions.
5. Implement Energy Performance Building Directive (or similar) and include procedures for quality assurance which establish a common understanding and reference for what level of performance is expected by all involved professionals. Such a mechanism should be controlled by a neutral body.
6. Offer financial incitements both on the supply and demand side to influence the pace of the development. On the supply side increased collaboration and integrated concept development should be stimulated. On the demand side green loans and tax deductions are adequate measures in this phase.
7. Through financial crisis we have seen examples of how national authorities have introduced special financial actions to stimulate important sectors such as the construction sector. When considering such actions, the measures should not be general but specific directed towards sustainable activities.

The market for renovation of single family houses needs special attention to energy efficiency:

1. Motivate the supply side to establish "One Stop Shop" concepts for energy efficient renovation of single family houses. This means that cross-crafts partnerships must be developed. Creation of such networks combined with training programs for enhancing the holistic perspective in the projects. In countries with subvention programs for innovation processes in SMEs, a special program for the building industry should be offered.
2. Energy audits with recommended measures made by competent persons should be on place before any heavy renovation starts. These audits should also show opportunities of integrated renovations, and not only single measures. In countries where subsidies of single measures are offered, this should only be done when such plans have been made and the measures supported are in line with the recommendations. It may therefore be wise to subsidize such audits.
3. Make sure that tools used by real estate and banks for estimating market value of houses, also include and rely on a parameter of how energy efficient the building is.
4. In many countries substantial renovation may be done without the need of an approval from the municipality. If it instead is required to upgrade more of these buildings to the applied building code for new buildings, it would reveal an untapped potential for energy savings.
5. Potential models for financial incitements (several could be combined):
    a. A subsidized mortgage loan such as is offered in Norway.
    b. Introduction of "White certificates" which certify that a certain reduction of energy use will be attained though implementation of specific measures.
    c. Direct tax deduction on money spent on energy efficient renovation. In Sweden there is such system for the labour costs for all types of renovation with a deduction rate of 50% (within a maximum amount of SEK 50.000 (€ 5700) per person per year). The system has resulted in a reduction of "black work".
    d. Tax deduction on bank savings dedicated to energy efficient renovation measures. In Norway there is a saving system for persons less 34 years old, where they may save an amount of NOK 20.000 (€ 2700) per year and get a tax deduction of 20%. The banks also offer their highest interest rates on these accounts (as it is long term). The aim is to help young people to build up own capital to buy their first dwelling. A similar model could also be applied to all persons but dedicated to energy efficient renovation.
    e. Subsidies of energy audits
    f. Subsidies of single energy saving measures which do not create "energy lock-in".

Any financial incitement should be coupled with a control system ensuring quality of execution and installation. Currently there is an untapped potential to use existing voluntary label schemes and certificates for sustainable construction to this purpose.

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