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Business Innovation Observatory

Smart Living

Advanced building materials

Case study 18

Enterprise and Industry

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Table of Contents

1. Executive summary

The construction sector has been impacted dramatically by the global downturn and is currently moving to a more innovative and cross-sectoral model. Advanced building materials are a subsector of the construction sector. This subsector represents a new generation of construction materials which demonstrate exceptional properties. Through advanced building materials, new technologies are integrated into both residential and commercial buildings and infrastructures to make them smarter, more sustainable, energy efficient and secure, thereby addressing environmental and social challenges globally.

Governments are supporting the creation and development of advanced building materials as they provide innovative solutions to achieve the EU 2020 objectives. Customer demand for these new construction materials has also been boosted due to greater environmental awareness and an increase in energy prices across Europe combined with the economic crisis.

However, companies developing advanced building materials are facing several obstacles. The lack of EU standardisation in the sector is one of the main issues for companies to go international and to gain market acceptance quickly. Indeed, different national and European regulatory requirements and standards related to energy consumption, quality of products, security, impact on environment and health represent important and costly administrative burdens for companies.

The diversity and inconsistency in policies and regulations across the EU make it almost hard for small companies to get into foreign markets. So far, these regulatory conditions are perceived as barriers for the development and the competitiveness of the European advanced building materials sector.

Reaching international markets appears to be quite difficult for most of the companies developing advanced building materials and especially for SMEs. Having limited resources, these companies focus primarily on the development and optimisation of the technical properties of the advanced materials. As a consequence, to go international enterprises rely on the development of collaborations with local partners on the targeted markets. Collaborations are typically established with local retailers that have in-depth knowledge of local markets or large companies that have extensive distribution networks. For example, Kebony is clearly a successful model of this strategy. Through collaborations with local distributors, Kebony's products are sold in ten EU countries.

The availability of funding sources remains as another key issue for the companies developing innovative products. There is a major gap for more public and private investments to support the establishment of innovative start-ups and to support R&D&I in this sector. The novelty of these advanced materials poses a risk to the accessibility to public funds and constitutes an obstacle to rapid client acceptance.

The development of public demonstrators offers good opportunities for companies to showcase their innovations and prove the reliability of their technologies. Some already exist in Europe. Even though they have been conceived and designed for large companies, SMEs are occasionally also included in the picture. What is still required though is a more customised approach to the prototyping and pre-commercialisation issue faced by SMEs. In the advanced building materials sector, small demonstrators would be needed, covering small-scale project sizes, and adapted to the needs of a small company.

To support the development of the current and future advanced building materials sector, policy measures could focus on the development and implementation of common European regulation and standards for advanced building materials, and the development of EU certifications for advanced building materials. Besides, the reduction of the administrative burden related to intellectual property would be helpful for small companies. Finally, the adaption of university programmes to the new trends emerging in the sector in which design and architecture have to consider multiple parameters at the same time: materials, aestheticism, building regulations and requirement in terms of security, would be essential.

2. Smart living and advanced building materials

According to the International Energy Agency, buildings account for 30 to 40% of energy use in Europe with a supplement of 5 to 10% being used in processing and transport of construction products and components. This gives rise to around one third of the region's CO_2 emissions.[1] Moreover, the onsite construction industry and the manufacturing of construction materials also consume billions of tons of natural resources, while producing a large amount of non-recyclable waste. Therefore, over the past few decades, this sector has been under increasing pressure to improve its cost efficiency, sustainability, and capacity, pushed by the endeavour and need to face consequences of global warming and climate change. Radical improvements are needed and these have lately also largely been encouraged by governments.

Increased awareness of climate change and other environmental concerns is changing priorities as people transform the way they live to limit the impacts of their daily life on environment. In fact, customers are seeking innovative solutions that would improve their quality of life while being environmentally-friendly. The willingness to use greener building materials for home construction has become a fast growing trend over the last few years, mainly motivated by growing environmental consciousness and cost saving opportunities through better energy management.

The design, height, characteristics, and energy performance of buildings have been deeply impacted by the development of new technologies for new building materials demonstrating particular properties. Traditional building materials such as concrete, steel and plastics have been improved and/or replaced by more advanced materials allowing for unusual and sophisticated architecture and design while assuring energy efficiency, sustainability and security. The development of technologies and new materials to improve building energy efficiency is an important instrument for reducing greenhouse gas emissions and for preserving the limited natural resources in the short to mid-term.

Advanced building materials range from new forms of concrete (lower carbon, with fibres that alter its resistance and durability or with air purifying capabilities), and innovative wooden structures, glass with enhanced qualities (electro chromic glass, photovoltaic embedded construction glass), to automated infrastructure. Green building materials such as cork, bamboo and woven flooring can also be considered part of advanced construction materials. Concrete production from recycled materials is also a dynamic growth area within the industry, along with wood from sustainable forests, energy-efficient lighting fixtures and water-efficient plumbing fixtures.[2]

Increasing urbanisation around the world will continue to drive the construction of innovative buildings, where materials play a key role. Developing advanced building materials for sustainable construction has become not only a vital necessity, but a moral imperative for the next generations.

These new materials and construction technologies incorporate cutting-edge and economically viable sustainable solutions thereby increasing profitability, decreasing construction time and overall favourably impacting the environment. The potential for application of these innovations is therefore wide, and can feed vitality and diversification into an industry sector which so far accounts for a large proportion of the European economy added value.

The companies in this case study have developed new and innovative building materials which support the construction industry in facing societal, environmental and economic challenges. The value proposition of these companies consists in providing solutions to increase the security, durability, design, and energy performance of buildings while decreasing the negative impacts on environment, the cost of construction, and the operational costs related to maintenance and energy.

3. The potential of advanced building materials and socio-economic relevance

Global awareness on environment is growing across the world, especially in industrialised countries where consumers aspire to improve their living conditions whilst also limiting negative impacts on the environment. Further, implementing, into both households and commercial buildings, conducive solutions for energy and cost saving is becoming a crucial focus, given the energy price increases across Europe over the last two years.[3]

European governments are supporting the construction sector to make it capable of addressing both environmental and social challenges. Global efforts have been made through collaborations across disciplines in academia and business, with the aim to develop new types of building materials with outstanding properties: more secure, solid, durable, environmentally-friendly, recyclable and energetically efficient.

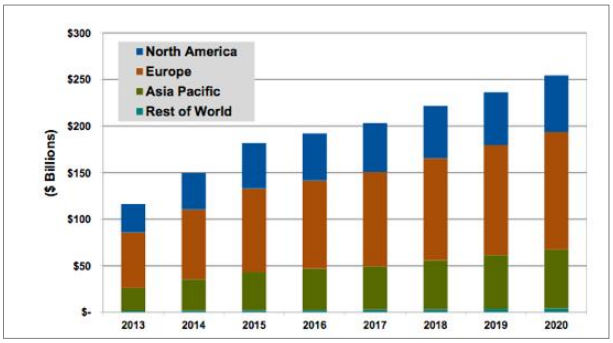
3.1. Advanced building materials market potential as driver of competitiveness

The financial crisis has had a dramatic impact on the construction industry and particularly on the residential property market. The construction sector has strategic importance in Europe as the largest single economic activity offering highest number of employment in Europe with almost 20 million direct jobs.[4] This sector over the years has been integrating its value chain technologies and activities coming from industries specialising in building materials. These are extremely diverse and represent an important part of the industrial base of developed countries. They include a highly diverse range of suppliers, from cement, plastics, and wood manufacturers, to specialty glass, steel, paint and wiring manufacturers.

The advanced building materials market (including green building materials) is constituted by innovative new product types with particular strength, thermal and/or low-maintenance properties. The demand for advanced buildings materials is expected to grow, driven by a combination of challenges related to competitiveness: energy efficiency, green design and sustainability, expansion of voluntary certification programs for green buildings, cost reductions for green materials, consumer demand for environmentally-friendly building solutions, and adaptation of infrastructure to future climate risks.

According to studies published by Navigant Research, Europe accounts for about half of the market, and will be the largest regional market in 2020[5] (Figure 1). The residential market will be a major driver of the forecasted growth of the advanced building materials sector and especially for the green building materials, both aiming at providing innovative products to improve thermal efficiency, or lower energy consumption.

Figure 1: Market value of green construction materials by region, World Markets: 2013-2020



Source: Navigant Research, 2013, Materials in Green Buildings

The deployment of national incentive schemes and regulations, and the development of "sustainable and green" building certifications empower the development of new and innovative advanced materials. Engineer, designers, researchers and architects are under pressure to grasp this opportunity and become more imaginative and innovative. Construction companies worldwide are shifting their business toward green building.

According to a survey led by McGraw-Hill Construction, a research firm, 51% of companies related to the construction industry expect more than 60% of their work to be green by 2015. In 2008 and 2013, their ambition to do so was 13% and 28%[6] respectively. The construction sector is both an ideal test bed for scientific innovation and a powerful economic driver of innovation; where successful products can be taken up in large quantities on a worldwide scale. Thereby, the growth potential of companies specialised in advanced building materials will be mainly boosted by this new emerging context.

With regards to the Europe 2020 strategy and its targets, it appears to be important to boost innovation by supporting R&D in the building materials sector and more globally in the construction industry. Companies have the opportunity to explore new technologies to offer tailored solutions to face the changing social and economic needs of people, businesses and societies.

In order to better understand and assess the potential of the market and identify the impact of advanced building materials on others related markets, the following section of the case-study has drawn based on the information collected via interviews with four companies presented in Table 1. By showcasing their products and services we will demonstrate how their novel business innovation can lead to successful business development and growth.

Table 1: Overview of the company cases referred to in this case study

Company	Location	Business innovation	Success signals
Pro-Teq Surfacing	United Kingdom	Pro-Teq has patented innovative re-surfacing products offering a quick drying, spray applied elastomeric coating that can be applied into a wide range of mediums such as: stone to create a nonslip pathway, or inject rubber crumb to resurface an old playground. Based on this technology, Pro-Teq has created the STARPATH, the world first UV powered pathway. This product can be applied to any type of existing surface, and it absorbs and stores energy from ambient light (UV rays) during the day, then release this energy at night allowing the particles to shine.	The Cambridge City Council has agreed to trial the product in October 2013 on an existing pathway that measures 150 square meters in Christ's Pieces park. The pathway is used by pedestrians and cyclists during the day and night. Pro-Teq has recorded more than three million hits on their web site following the official launch of the Starpath product. The company is a 2013 nominee for the Global Business Excellence Award for the category "Outstanding Innovation".
Designergy	Switzerland	Designergy has recently innovated solar building materials combining in one piece, all roofing materials and a photovoltaic system. The complete system is mounted in one step and with the best possible materials reduction. On top of cost optimization and mounting advantages Designergy's concept has been conceived to avoid standard PV installation roof damage risks as well as to improve fire safety and thermal insulation's long term performance.	Designergy's innovation has been recognised and the company succeeded in raising funding through several initiatives: - Best entrepreneurial idea of Canton Ticino 2010 giving access to CHF 10'000 sponsored by BSI Bank and the access to the Centro Promozione Start-up facility. - Microcredit prize city of Lugano City 2010 consisting in CHF 30'000 prize instituted by the municipality of Lugano to foster the seeding of innovative companies lead by young entrepreneurs. - CTI project "Solar brick" 2011-13: Designergy and other partners (SUPSI…) received an important funding from the CTI in order to develop and test prototype materials, roofs and industrialize the Designergy concept. - Venture kick profile Stage 1, 2 and 3: the company has been awarded for a brilliant business idea and a solid business case respectively, and raised in total CHF 130'000.

Company	Location	Business innovation	Success signals
Kebony	Norway	Kebony has developed an innovative technology named "Kebonization" to produce sustainable wood by increasing its durability, hardness and more stability using liquids from biowaste material.	Kebony has been recognized as one of the world's most innovative technology start-ups for 2014 for its revolutionary process of "Kebonization" by the World Economic Forum. Kebony is FSC ® - Forest Stewardship Council ® - certified and is allowed to apply the Swan eco-label (the official Nordic eco-label, introduced by the Nordic Council of Ministers). Kebony has already delivered hundreds of national projects across Norway with support from 'The Rainforest Association' The company has also received Norway's national environmental prize, the "Glass Bear" for sustainable consumption and production.
Innovative Fire Systems (IFS)	France	IFS is a leader in developing innovative passive fire protection systems for different types of industries: Public Commercial & industrial buildings, Oil and Gas industry, Roads, and Railways Tunnels. Each product developed by IFS, has its specific way to achieve the required insulation. The passive fire protection solutions developed by IFS protect the structure and prevent the building from collapsing when subjected to fire. Such protection buys time for the occupants to escape, and/ or the fire fighting services to safely enter in the building in order to contain and extinguish the conflagration.	Since the implementation of the European directive in 2006 regarding the fire safety, IFS has successfully completed 66 contracts in tunnels in 5 different European Countries and South Korea. Significant references include tunnels in Paris-La Defense, the first immersed tunnel in Oslo (Norway) and in Busan (South Korea).

3.2. Companies offering innovative solutions in advanced building materials

European industry is transforming, pushed by new societal, economic and energy challenges. In this context, the construction industry and its related sectors such as the building materials sector are moving towards a more innovative model. Indeed, the part of R&D and innovation is increasing in the building materials sector that is nowadays looking for offering more innovative solutions integrating new technologies.

The companies described in this case study aim to provide innovative solutions to increase the sustainability, the security, and the energy efficiency of residential and non-residential infrastructures. Companies have found niches in the advanced building materials market and are providing innovative solutions and products to respond to customer needs and governments' political priorities.

Problem 1 – Public expenditure related to energy consumption (street lighting) and infrastructure maintenance is constantly increasing in all countries.

Innovative solution 1 – Pro-Teq Surfacing Ltd. has developed a spray-on coating that makes ordinary pathways glow in the dark. This innovative coat can be applied onto any solid surface including tarmac, concrete and wood. During the day, it absorbs UV rays and releases them at night as a soft blue glow. This solution could replace the need for bright light, not on busy streets, but on pedestrian or cycling pathways where it could be possible to cut costs by eliminating lights. This product would be perfect for reducing the risk of collision between cyclists and pedestrians at night. Besides, thanks to its anti-slip properties, this new coating is safer for cyclists and enhances access for disabled people.

The Starpath is a cost effective solution as it allows to turn off the light at night to realise energy savings; and also because it doesn't require resurfacing thereby eliminating the substantial cost of removal and disposal of the existing surface. This product can be applied quickly and makes the surface anti-slippery, and water-resistant. The Cambridge pathway measures 150 square metres, it took only 30 minutes to spray the material on, and the surface was ready for use less than four hours after the application of the product started. This short installation time allowed minimal disruption to the public circulation. Starpath can be applied both in public and private areas.

The process currently works at around 84€ per m²

Source: http://www.independent.co.uk/life-style/gadgets-and-tech/news/starpath-a-sprayon-coating-that-makes-paths-glow-in-the-dark-8899443.html

Problem 2 – Construction processes are usually complex in terms of type and number of materials to be included in a single element of a building.

Innovative solution 2 – Designergy has developed an innovative building construction material combining both solar exploitation through photovoltaic modules, and energy saving functions through thermal insulation roof materials into a single piece system mounted in one step. This new innovation is making the roof construction process much less complex.

The roof is not only a cost centre but it becomes an income source while producing renewable energy and also saving energy by providing the right thermal insulation. The system designed by the company is more advanced than the traditional system consisting in two separate components (roof and solar PV system) or the standard BIPV (Building Integrated PV) system, having only the most external roof layer (e.g. tiles) substituted by a PV module arrangement. This new and innovative concept allows the customer to reduce the investment cost of the roof, to considerably reduce the pay-back time of the PV system, and to simplify the roofing assembly.

The R&D phase is completed; the first pilot roof and the production line have been installed, so that the Company is now starting its path to market.

Source: http://www.designergy.ch/

Problem 3 – The demand for tropical hardwood is increasing worldwide due to its quality, durability and solidity. However, one third of the world's rainforests have already been disappeared within the last 50 years, corresponding to a loss of around 6 million hectares a year. The global demand for tropical hardwood cannot be met through sustainable means, constituting a major environmental and climate issue.

Innovative solution 3 – Kebony has developed a sustainable alternative to the production of hardwoods from tropical regions providing a global eco-solution to the major environmental challenge of rain forest deforestation. Indeed, the company has come up with an innovative wood transformation process named "Kebonization". This transforms the wood into sustainable species so that they acquire the same aesthetical and physical properties of hardwood, making them more durable, attractive, low maintenance, environmentally friendly, and suitable for use in construction.

In January 2009, Kebony opened a full scale plant, increasing production capability tenfold. The global market for rain forest timber is worth approximately 14.5€ billion a year. Kebony sees great opportunities both in Norway and in the international market.

Source: http://www.kebony.com/en/

Problem 4 – Security is a crucial requirement in building construction. Over recent decades public and private buildings have become larger and more complex. Each year, hundreds of fatal fires occurred across Europe. Smoking, candles, cookers, chemicals, etc. are the causes of at least 60 % of all fire deaths, leading also to important economic losses. Currently, there is a clear need to increase the fire safety in the near future.

Innovative solution 4 – IFS produces and installs innovative insulation systems. It offers a complete range of solutions on passive fire protection products & services to protect lives and industrial assets against fire. The solutions developed by IFS allow contributing to save lives by offering more time for people to escape when fire occurs and protecting industrial & buildings assets by destruction delay.

By combining nanoparticles with refractory cement, the IFS technology demonstrates two key characteristics:

- The technology is less intensive in material consumption;
- The technology offers thinner and lighter material with higher thermal insulation and longer fire protection rating.

IFS is also providing services for the maintenance of the products. The company is currently operating in traditional markets such as the construction market (residential and non-residential buildings) and targets two other markets: Tunnels infrastructure & oil and gas industry. IFS relies on an attractive business model through three different revenue streams (1) from the "end user customer" (sales of equipment + services); (2) from local partner (yearly subscription fees + usage fees); (3) from licencing for use of their intellectual property.

Production workshop at IFS

Source: http://www.innovativefiresystems.com/

3.3. The expected impacts of the development of advanced building materials

In response to customer demand, policy priorities focused on the development of more sustainable and energy efficient infrastructure. The emergence of the advanced building materials has impacted the construction industry and other related sectors such as design and architecture.

Advanced building materials are the result of intensive R&D activities that have been considerably reinforced within big construction companies, and developed as a core activity by start-ups. The necessity to create new types of building materials has transformed the industrial base of the construction sector. Companies have shifted their business model towards a more innovative system, encouraging the collaboration between multiple disciplines: civil engineers, designers, architects, scientific researchers especially on material sciences, new materials, KETs, etc.

"We're getting a massive response from developing countries where power supplies are very hit and miss. The client demand is not just for pathways or cycle ways but also for hard shoulders and central reservations."
— Pro-Teq Surfacing

Advanced building materials offer a wide range of innovation opportunities that are as broad as designers' imagination. Thereby, related to their intrinsic innovative properties, these new building materials have re-boosted the growth of the construction industry that was facing a hard time due to the financial crisis. The construction industry may become a significant economic driver for innovative advanced building materials as the most successful products could be rapidly produced in large quantities on a worldwide scale, depending on the national regulations regarding the materials' components.

Besides, one important impact due to the emergence of advanced building materials are the new challenges faced by designers and architects who are not focusing only on the form of the building but also on its functions. The increasing demand for eco-efficiency, cheaper, smarter, and more durable buildings represents an important element that has deeply impacted architects' work in a sense that they have to take into account both the choice of materials and the design of the building itself.

3.4. Client perspectives and challenges related to advanced building materials

Consumer attitude and awareness towards greening and energy consumption has been changing over the last decades. Awareness on environmental issues has increased with higher recognition of climate change, and the influence of human activities on it. This new way of thinking leads to a shared consensus on taking actions on saving the environment and ecological balance. Consumers are more convinced that individual lifestyles have to be changed. As reported by a UK National Regulatory Authority recognized by EU Directives, 70% of the European consumers agree to do a lot to reduce energy consumption at home.[7]

The increase in energy costs, on top of the economic crisis, encourages people to seek solutions for energy saving. Indeed, across Europe, average electricity cost for households and industries have increased by 29% between 2005-2011, while it was only 5% and 1% in USA and Japan, respectively over the same period of time.[8]

This new way of thinking had considerable influence on customer's interest towards the use of advanced building materials. Convenient solutions for low maintenance, automation, flexibility, health improving features, and optimal environmental integration in the short, medium and long terms are in demand. Customers represent not only households but also companies and governments who are willing to implement solutions for energy saving within commercial buildings and public infrastructures.

For instance, Pro-Teq Surfacing brought an interesting solution for both energy saving and refurbishment of public infrastructure. The perspectives of development of the market are expected to be good. However, the barrier to the client uptake of advanced building materials is the technology and the innovation itself. Many customers are sceptical about the environmental benefits of such new materials and are often hard to convince of their proven efficiency.

Moreover, some of them are simply satisfied by traditional materials and do not see the necessity to shift towards new materials whose efficiency and reliability are not fully proven in the long term yet. Changing client's buying habits is sometimes very hard.

Also, in the common thinking, sustainable and eco-efficient solutions are seen as expensive to buy and to install compared to their traditional counterparts. Although citizens are more environmentally aware and realise the need to act to protect the environment, the recent economic crisis might have negatively impacted their motivation.

According to an independent UK National Regulatory Authority recognized by EU Directives, people are less willing to spend money to tackle environment issues. In 2007, 14% of people believed that the economy was the most important issue, while 30% of people considered that environment is the most crucial issue to tackle. After the European credit crunch, the view has changed. 25% of people believed that efforts have to be put for re-boosting the economy whereas only 7% were still considering that environment is an urgent issue to handle.[9]

*"Getting the market adoption of innovative products is not an easy task. It's very difficult to shift the way of thinking of the customer." — **Designergy***

As a conclusion, despite the advantages, many clients (both companies and end users) are still hesitant to make use of advanced building materials in their construction processes. High costs and a shortage of appropriately skilled workforce are among the reasons for this reluctance. Indeed, the adoption of these new materials requires the recruitment of people with better science-based qualifications. Besides, the money and time that will have to be invested in training the existing workforce can be significant for companies, that would thereby prefer to continue using traditional materials.

4. Drivers and obstacles

Technological developments, growing competitive pressure, and political priorities for sustainability will set the future for the construction sector and related sub-sectors in Europe. Companies are exploring opportunities to provide innovative solutions to environmental, economic and societal challenges through the use of new technologies and processes.

Besides the trend drivers, there are a number of issues that hinder the market uptake of advanced building materials. Complex regulatory frameworks at the EU and national levels are one of the main obstacles faced by companies that are stuck in the plethora and mismatch of requirements to get their product certified for entering into new markets.

4.1. Governmental strategies empower the development of innovative solutions for sustainable growth

European and almost all other governments around the world are implementing national environment programs. For instance, the Europe 2020 strategy is targeting three strategic objectives:

- *Smart growth*: developing an economy based on knowledge and innovation;
- *Sustainable growth:* promoting a more efficient, greener and more competitive economy;
- *Inclusive growth:* fostering a high-employment economy delivering social and territorial cohesion."[10]

According to an estimation of the EU energy efficiency plan of 2011, governments are convinced that the implementation of existing and new energy and climate change policies will transform people daily life and lead to many macroeconomic benefits. The green economy is seen as an opportunity to have a smart and sustainable growth based on energy efficiency, collaborative research, and the development and commercialisation of innovative green technologies. Reducing energy dependency and spending on energy imports will also have a positive effect on the current account balance; in 2011 net imports of fuels to the EU amounted to €388 billion, more than 3% of EU GDP. Moreover, investing in energy efficiency will not only reduce energy consumption costs, but also the social costs related to pollution caused by fossil fuels, such as health expenditures. Considering all these elements, European strategy targets by 2020 to generate financial savings of up to € 1 000 per household every year; improve Europe's industrial competitiveness in the growing global market; create up to 2 million jobs; and reduce annual greenhouse gas emissions by 740 million tons.

For example, some European local authorities are looking for innovative solutions to introduce sustainable materials and innovative solution in new construction. Bristol local authority was keen to increase recycled materials in the construction of four new schools under the PFI programme that represents a value of €145 million.[11] Combined with other waste reduction initiatives, Bristol City Council calculated the reduced waste disposal costs, avoidance of landfill tax and lower material wastage providing an overall cost saving estimated at €820,000 for the total project. Other example, in January 2009, the city of Oslo started to look for renewable, optimal and innovative heating solutions for substituting fossil fuels in Oslo's school. Through the dialogue with several companies on the market, some solutions were selected involving biogas, solid biofuel, heat pumps and solar energy. Through this procurement, the city of Oslo clearly encouraged a new push for the market to innovate and provide new heating solutions.

Also, European regulation will drive the growth of the advanced building materials by empowering companies and academics to collaborate to develop the best buildings materials to make the buildings and private home more sustainable, energy efficient and smarter.

4.2. Certification of building materials may become a driver for client acceptance

Today, "green" labels are more and more co-opted by industry for marketing purposes. As a consequence, customers are becoming confused and even sceptical about the real sustainability of the products. As a consequence, consumers are demanding more relevant information about the products they buy.

In the building industry, consumers are demanding more transparency from suppliers. Renowned certification of products, professional construction services and key processes could become a driver for growth and increased internationalisation of the sector. Indeed, officially certified product may be seen as a real guarantee of quality by the customer. A certification of buildings materials may be an efficient mean to make the client trustier to buy and to use the product, and to strengthen the brand on international markets.

*"Certification is a pre-condition for client's acceptance." — **Designergy***

In many countries around the world, Leadership in Energy and Environmental Design (LEED) certification, developed and managed by the US Green Building Council, is now the recognized standard for measuring building sustainability.

Kebony has been awarded several certifications that have considerably contributed to the reputation of their products on their national market and even internationally. The company has been awarded the "Swan"/Nordic Ecolabel, which is the strictest environmental standard in Scandinavia, and the Forest Stewardship Council certification that helps access international markets for non-timber forest products and leads to better forest management.

Building security is also deeply regulated. IFS technology meets the requirements of European safety directives about tunnels infrastructures and UL & BS standards about oil & gas industry, allowing the company to gain client's trust and acceptance and to get into international market.

4.3. The development of partnerships is crucial to go international

The companies described in this case study have international ambitions and plans to develop licensing packages for the products, brand and technology, and to find out local partners in the most important markets for distributing their products.

Let's take the example of Pro-Teq surfacing and Designergy. Both are start-ups and do not have the capacity and the necessary financial support to access international markets alone, nor the local markets knowledge (e.g. culture, language, regulation, etc.). For instance, Pro-Teq surfacing aims to collaborate first with large companies which have a strong and well-structured distribution network in several countries around the world such as Middle East and North America. These, could serve as first source of revenue, as local landing platform, and as source of knowledge of local specificities.

Kebony succeeded to bring the brand and the technology on international markets. The company has built its international presence focusing on geographical areas which are seeking to new alternative to the use of tropical hardwood due to political pressure or shortage of quality tropical timber. Kebony's products are available in several European countries including: Belgium, France, Italy, Portugal, Sweden, UK, Spain, Germany, Denmark and Switzerland where partnerships have been established with local distributors. Today, Kebony is looking for licensing partners who will be able to reproduce Kebony's technology and production.

*"Developing partnerships is crucial for our development. We need local partners who understand the local market and its regulation, and who will be willing to share the risk with us." — **Designergy***

4.4. Strict EU regulatory environment and the different national standards pose barriers to new materials to gain market acceptance

The European construction sector is subject to various national and European regulatory requirements and standards concerning energy consumption, environmental risks and impact, health and safety, quality of products, etc. These surplus and mismatch of regulations and standards at national and EU level are quite hard for the companies to comply, as they are responsible of high administrative burdens and costs.

*"The different regulation existing in each EU Member State represents a big issue for the internationalisation. The implementation of EU standardisation will facilitate the exportation of products across EU." — **IFS***

The complex regulatory framework can deeply impact the competitiveness of European companies in the construction sector and its related markets such as advanced buildings materials. Indeed, the large amount of administration and documentation to prove the conformity of the product to local regulatory requirements and standards; and the different level of transposition of EU regulation and standards on the national markets make the situation very confusing and complex for the small companies.

As a consequence, construction market is mainly dominated by local companies and reduces both the opportunity for innovative start-ups to go international, and for public procurement to have access to innovation-oriented solutions as decision-makers have a limited view of the existing technologies, and of the investments required for bringing the products to the market. It occurs that investments are generally done by firms on the basis of long term plans and on the basis of policies and regulations. Regulations which are different from country to country and subject to abrupt changes constitute a detrimental eco-system for companies.

*"It took a very long time and too much money to manage to finish off with all the documentation needed for the certification." — **Kebony***

This prescriptive regulatory environment and the multiplication of national standards and approval systems represent an important barrier for the development and the competitiveness of advanced buildings materials sector.

5. Policy recommendations

Despite the significant impact of the current economic crisis on the construction industry, the construction materials subsector is considered to perform well with regard to turnover, value added, and employment.[12] The future competitiveness of the construction industry and its related sectors is likely to be influenced by a number of factors including regulation.

The European construction sector is subject to various national and European regulatory requirements and standards related to energy consumption, environmental risks and impact, health and safety, quality of products, etc. These requirements and standards are costly for companies in terms of administration. Indeed, the documentation of adherence to regulatory requirements and standards and the different approval systems specific to each EU country is leading to important administrative burden.

Moreover, there are different levels of national implementation of European regulations and standards that are making the situation more complicated for companies. The complexity of the regulatory framework is significantly impacting the competitiveness of European construction companies and the future development of the sector and related sectors. These problems constitute a significant barrier for companies to take full advantage of the Single Market and to enter new markets in Europe. Addressing these policy challenges in the future strategic agenda for the sector will be crucial.

Besides, the European construction materials subsector, and more globally the construction sector, is also facing **considerable competitiveness challenges with regard to the rising costs of energy and raw materials**. Policy measures to reduce these costs are welcomed to support the future competitiveness of the sector.

Further, there is a **lack of workforce and especially qualified labour**. The financial crisis has significantly impacted the construction sector leading to a high level of unemployment. Also, the limited attractiveness of the sector to young talents due to uncertain employment perspectives might also induce an important lack of qualified skills and competences whilst, they represent a key element for the use of new materials in construction processes. Indeed, the construction sector integrates more and more new technologies and innovation that require trained workers and experts in these technological and scientific domains who are currently missing and needed.

The Policy and regulations are expected to support and encourage the creation of training and courses to develop expertise and skill sets in the advanced building materials. These courses will have to be transversal and linked to several technological areas such as ICT, engineering, eco-design, etc. that are currently transforming the building materials sector and are crucial for the European competitiveness of the sector.

Furthermore, it would be beneficial to **support the deployment of advanced building materials within the construction sector** by encouraging the take-up amongst construction companies. Indeed, private and public companies might be reluctant to use advanced building materials in their construction projects given their novelty and the related risk and potential quality issues of the material no matter how innovative the material is. Policy measures that encourage the usage of advanced building materials in public construction projects to demonstrate the utility, quality and sustainability of such materials would give to start-ups the opportunity to gain more visibility and to convince new clients.

Finally, the **development of certifications of products, professional construction services and key processes at EU level is still missing**. Certification of new advanced building material could become a driver for growth, increase client acceptance and increase internationalisation of the companies within the sector

The development and adoption of advanced building materials has the potential to improve the performance and competitiveness of European companies within the construction industry. This new generation of building materials is bringing innovative solutions to make residential and non-residential buildings more sustainable and energy efficient. Recommendations to support the development of advanced building materials are provided below.

In order to support the future competitiveness of the advanced building materials sector, **policy makers will have to strengthen the single market rules** by adapting the existing national regulations to comply with the EU Single Market regulations. This harmonisation is expected to allow the **standardisation of administration and approval systems** for the introduction of advanced building materials in the national markets. The development and implementation of European regulation and standards (e.g. the Construction Product Directive/Regulation, the Eurocodes design standards, the ECOdesign directive, etc.) are vital for the future development and competitiveness of the sector.

Policy action should be taken to accelerate the standardisation process at EU level in order to decrease the administrative burden, to reduce the time and costs for applications for business licences and permits, and thereby to facilitate the development and the export of advanced building materials. Besides, **standardisation** and **certification** at EU level of advanced building materials could considerably support companies for entering the international market and thereby getting more visibility.

Indeed, the **Single Market is a significant driver for the internationalisation of companies**. However, most of them being small companies are not able to achieve all **administrative and cultural requirements** related to every specific market. 'That's why, policy makers should ensure to **provide advisory service to SMEs** to help them navigate their businesses within the Single Market, and **encourage economic development agencies to be proactive** in helping SMEs overcome cultural barriers on international markets.

Intellectual property remains a complex and costly process for advanced building materials, above all if companies intend to get their technologies protected across several EU countries. Still, the system and procedures are different from country to country. Policy makers should ensure to provide support to companies by **strengthening the existing IPR support mechanisms** (e.g. through Technology Transfer Organisations), reviewing and simplifying administrative procedures and establishing one-stop-shops providing services for companies, especially for IP matters, and introduce tax incentives on intellectual property protection.

The development of advanced building materials requires a strong financing base that is difficult to access for start-ups. Policy makers could ensure the **set-up of public financial solutions** such as tailored public procurement mechanisms (big tenders split into smaller lots), and loan guarantees to support the research, development, prototyping and innovation in this sector.

Furthermore, the development of **European collaborative projects and initiatives** involving companies, academics, architects and designers across Europe to develop new advanced building materials could ensure access to finance for companies and an exchange of skills and expertise.

Advanced building materials are innovative products that may find difficulty to get into markets because of **client's reluctance**. Policy makers should encourage the multiplication of **public demonstrators**. The trial of the product into public infrastructure could prove the qualities and the reliability of the concept thereby encourage clients to adopt the new products.

Companies in the advanced building materials sector need more **transversal competences**. Technology is an integral part of this new generation of building materials. **Designers, architects and engineers have to shift their traditional thinking and their way to work to include cutting-edge technologies**. Policy makers could ensure that university curricula related to design, architecture or civil engineering include the changes that are currently operated in the building material sector, and more globally within the construction industry, to respond to societal, economic and energy challenges. Thereby, internship opportunities at commercial companies would allow students to have a field experience and to better understand the challenges faced by the companies, while companies will have the chance to hire the students they have trained as regular workers.

6. Appendix

6.1. Interviews

Company	Interviewee	Position
Kebony	Per Brynildsen	R&D director
Innovative Fire Systems	Albert Benhammou	CEO
Pro-Teq Surfacing	Scott Hamish	CEO
Designergy	Daniel Lepori	CEO

6.2 Company websites

Kebony	http://www.kebony.com
Innovative Fire Systems	http://www.innovativefiresystems.com
Pro-Teq Surfacing	http://www.pro-teqsurfacing.com
Designergy	http://www.designergy.ch

6.3 References

[1] Ecorys SCS Group, 2011, "Sustainable Competitiveness of the Construction Sector", available at: http://ec.europa.eu/enterprise/sectors/construction/files/compet/sustainable_competitiveness/ecorys-final-report_en.pdf

[2] QFinance Newsletter, 2013, Construction and Building Materials Industry, available at: http://www.qfinance.com/sector-profiles/construction-and-building-materials

[3] Eurostat, "Energy Price Statistics", 2012, available at: http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Energy_price_statistics

[4] ECORYS SCS Group, 2011, "Sustainable Competitiveness of the Construction Sector", available at: http://ec.europa.eu/enterprise/sectors/construction/files/compet/sustainable_competitiveness/ecorys-final-report_en.pdf

[5] Forbes, 2013, "Building Green Increases Demand For Traditional Materials", available at: http://www.forbes.com/sites/jenniferhicks/2013/07/30/building-green-increases-demand-for-traditional-materials/

[6] Environmental & Energy Management News, 2013, "Green Building Materials '$254bn Annual Market by 2020", available at: http://www.environmentalleader.com/2013/05/02/green-building-materials-254bn-annual-market-by-2020/

[7] Ofgem, 2008, "Consumer attitudes and awareness of green issues and energy", available at: https://www.ofgem.gov.uk/ofgem-publications/57594/environmentalresearch.pdf

[8] EurActiv, 2013, "Soaring energy costs make Europeans poor" available at: http://www.euractiv.com/energy/soaring-energy-costs-europeans-p-analysis-519884

[9] Ofgem, 2008, "Consumer attitudes and awareness of green issues and energy", available at: https://www.ofgem.gov.uk/ofgem-publications/57594/environmentalresearch.pdf

[10] Communication from the European Parliament on the Energy Efficient Plan, 2011, available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0109:EN:HTML:NOT

[11] Waste Resources and Action Programme (WRAP) article available at: http://www.wrapni.org.uk/content/recycled-content-case-study-secondary-schools-bristol

[12] Ecorys SCS Group, 2011, "Sustainable Competitiveness of the Construction Sector", available at: http://ec.europa.eu/enterprise/sectors/construction/files/compet/sustainable_competitiveness/ecorys-final-report_en.pdf