RICARDO-AEA

Competitiveness of low-carbon energy technologies
Concept assessment and Final report

Assessment of examples of cooperative production, financing and use of low carbon technologies, and recommendations

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Summary

It is becoming widely understood that greenhouse gas (GHG) emission reductions can bring associated benefits for citizens and for European based industry. Ambitious climate action can revitalise local communities, create new business opportunities and pull innovation through into the market place.

One element in the introduction of low carbon technologies is the development of bottom-up concepts for the cooperative production, financing and use of low carbon technologies. These include initiatives such as local energy cooperatives, bike sharing schemes or photo voltaic purchase collectives. Such initiatives can be developed and applied by citizens, municipalities and industry. These tend individually to be smaller scale applications of low carbon technologies often aimed at end consumers.

These bottom-up initiatives can lead to enhanced introduction of low carbon technologies by innovation in markets. This may be associated with innovative business models such as crowdfunding, purchase collectives or performance contracting. These approaches may meet some of the demand for products and services. They will also contribute to meeting targets for reducing greenhouse gases and could contribute to competitiveness and job creation.

This report has been prepared as part of a project[1] commissioned by DG Climate Action and delivered by Ricardo-AEA and Triple-E Consulting. Twelve concepts for cooperative production financing and use of low carbon technologies are included. This set is not intended to be exhaustive, but is intended to illustrate a range of different cooperative concepts. The concepts considered are:

- Low carbon hubs
- Solar schools
- Euronet 50/50
- Local energy cooperatives (LECs)
- Nudge
- Online house renovation community
- Crowd funding
- PV purchase collectives
- Bike sharing schemes
- Used cooking oils
- Energy performance contracting
- Municipal bonds

Scalability and replicability of concepts are considered to give tentative indications of impacts in terms of reducing greenhouse gas emissions, creating jobs and impact on competitiveness by 2050. Five of the concepts are considered to have higher potential impacts:

- Local energy cooperatives (LECs)
- PV purchase collectives
- Used cooking oils
- Energy performance contracting
- Municipal bonds

Specific recommendations are made for fostering the expansion of each of these concepts.

In addition, more general recommendations are made that would encourage the use of cooperative concepts for production, financing and use of low carbon technologies. These are summarised below.

One perception is that there is a lot of activity on cooperative concepts for low carbon technologies but that it is not widely known and hence there is a need for additional **awareness raising**.

Recommendation 1: That the European Union raises awareness of cooperative concepts for low carbon technologies, for instance by supporting work to bundle information to disseminate results and good practice.

[1] Further information on the project including reports and presentations is available at www.lowcarbonconcepts.eu

Cooperative delivery of low carbon concepts can be led by municipalities, by business or by communities. Community groups may have the legal form of cooperatives and are often staffed by volunteers in their spare time. For all groups, and particularly for the latter group, there is a potential need to be able to **exchange information and skills** with other groups delivering low carbon technologies cooperatively. Topics should include specific mention that cooperatives are eligible and welcome as active partners.

Recommendation 2: That the European Union provides more training and support for those involved in cooperative concepts for low carbon technologies by:

2A: Continuing to provide funding for Coordination and Support Actions under the Climate Action sub-programme of the LIFE programme, and by developing topics under the Horizon 2020 programme, for instance in the Secure, Clean and Efficient Energy work programme (and other relevant work programmes such as Smart, Green and Integrated Transport)

2B: Developing a topic or action (or in the long term programme) to provide training through exchange of skills for active citizens in cooperatives, for instance through the ERASMUS+ programme.

It is noted that there is no **dedicated access point** to the European Union programmes for cooperatives or active citizens. This makes it difficult to identify what programmes may be relevant to cooperative concepts.

Recommendation 3: There should be an entry point from the overview page on European Union funding for cooperatives and citizen groups.

Recommendation 4: That DG Climate Action should introduce a webpage that points to programmes, calls and topics that are particularly relevant to cooperative concepts for low carbon technologies.

One mechanism for encouraging the growth and spread of cooperative concepts would be to have a **financial instrument or action** that is specifically for such activities.

Recommendation 5: That the European Union develops or widens an instrument/action specifically to support cooperative concepts for production, financing and use of low carbon technologies, perhaps on access to seed finance at cooperative project start-up.

Cooperative production, financing and use of low carbon technologies can also be fostered by **specification of topics under existing programmes**, rather than new instruments or actions.

Recommendation 6: That the European Union considers a topic under Horizon 2020 or a policy priority under the LIFE programme sub-programme on Climate Action, that supports demonstration of cooperative concepts for low carbon technologies.

Recommendation 7: That the European Union raises awareness with relevant National Contact Points for the Horizon 2020 and LIFE programmes of topics and calls for which applications from cooperatives and for cooperative concepts would be welcome.

Recommendation 8. That the European Union encourages the development of programmes, and that programmes are developed under the European Regional Development Fund and the Cohesion Fund, that include support for cooperative concepts as part of supporting a shift to a low carbon economy.

Recommendation 9. That the European Union considers an inducement prize for successful pioneers in cooperative production, financing and use of low carbon technologies. This could be under Horizon 2020, or possibly under the Climate Action sub-programme of LIFE.

1 Introduction

1.1 Foreword (from DG Climate Action)

The transition to a low-carbon economy will not occur through the development of new or better technologies alone. Although improvements and changes to existing services, technology and lifestyles are necessary, the transition to a post-carbon society also depends on new ways of linking sustainability and competitiveness. The objective of holding the increase in global average temperature below 2°C above preindustrial levels can change the way we develop, produce, finance or use technology. Car sharing, citizen-owned local energy grids and the crowdfunding of green business ideas are among the first examples of pioneering ways to promote and use low carbon technologies and services.

The cooperative production, financing and use of technology are trends that can help realise the shift to a post-carbon society by changing the competitiveness of individual technologies. Before any mass deployment, citizens, entrepreneurs and local governments are often leading innovation and pioneering new post carbon solutions. Innovative business models such as contracting, sharing, leasing or crowdfunding can accelerate market take-up and support early movers. As many European companies are world-leading suppliers of technologies and services to reduce greenhouse gases, pioneering activities could also lead to new export opportunities.

This report aims to provide a better understanding of the concepts of cooperative production, financing and use of technology and explores some interesting case studies. The focus is on bottom-up concepts for cooperative application of low carbon technologies by local communities, municipalities and industry.

1.2 Introduction

It is becoming widely understood that greenhouse gas (GHG) emission reductions can bring associated benefits for citizens and for European based industry. Ambitious climate action can revitalise local communities, create new business opportunities and pull innovation through into the market place. Throughout Europe the competitiveness of many existing companies and business sectors, together with the market development of low carbon technologies and services is founded upon the EU's climate policy legislation[2].

One element in the introduction of low carbon technologies is the development of bottom-up concepts for the cooperative production, financing and use of low carbon technologies. These include initiatives such as local energy cooperatives, bike sharing schemes or photo voltaic purchase collectives. Such initiatives can be developed and applied by citizens, municipalities and industry.

These bottom-up initiatives can lead to enhanced introduction of low carbon technologies, not so much by innovation in the technologies, though some technology innovation may be required, but in the markets. This may be associated with innovative business models such as crowdfunding, purchase collectives or performance contracting. These approaches may meet some of the demand for products and services. They will also contribute to meeting targets for reducing greenhouse gases and could contribute to competitiveness and job creation.

[2] For instance the Europe 2020 strategy (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF), Resource Efficient Europe initiative (http://ec.europa.eu/resource-efficient-europe/) and the Roadmap for moving to a low carbon economy in 2050 (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0112:FIN:EN:PDF)

These bottom-up concepts can be considered as cooperative or as collaborative. **Cooperative concepts** are taken to be based on community cooperation and could be **formal**, for instance in setting up a cooperative business to manage a local renewable energy supply, or **informal**, for instance the use of a community website to share expertise in house renovation to lower energy consumption. **Collaborative concepts** involve some level of collaboration between, for example, individuals; communities, local government, companies or individual entrepreneurs. These could involve activities like crowdfunding of green business ideas, bike sharing schemes or energy performance contracting.

This report has been prepared as part of a project[3] commissioned by DG Climate Action and delivered by Ricardo-AEA and Triple-E Consulting. Twelve concepts for cooperative production financing and use of low carbon technologies are included. This set is not intended to be exhaustive, but is intended to illustrate a range of different cooperative concepts. The assessments in this report include:

- How the cooperative low carbon concepts work, illustrated with examples
- Potential impact on greenhouse gas emissions
- Potential impact on competitiveness.

These concepts have already been applied and tested in some locations in the EU and are considered suitable for wider application. Climate action is a cross-cutting priority in all EU funding programmes, from innovation to regional development. The concepts presented in this brochure may be helpful in generating ideas for different EC programmes in the period between 2014 and 2020.

The concepts can be grouped or clustered in a number of ways. For example they can be clustered by the energy sector[4] to which they apply, as follows:

[3] Further information on the project including reports and presentations is available at www.lowcarbonconcepts.eu
[4] These sectors are four of the six used in the European Commission "Roadmap for moving to a low-carbon economy in 2050". See http://ec.europa.eu/clima/policies/roadmap/index_en.htm

Concept	Power	Residential/ tertiary	Transport	Industry
Low carbon hub	✓	✓	✓	✓
Solar schools	✓	✓		
Euronet 50/50	✓	✓		
Local energy cooperatives	✓	✓		
Nudge initiatives	✓	✓	✓	
Online house renovation community	✓	✓		
Crowd funding for RES / district heating etc	✓	✓		
PV purchase collectives	✓	✓		
Bike sharing			✓	
Use of cooking oil			✓	
Energy performance contracting				✓
Municipal bonds		✓		

A second grouping of concepts is by the mode of cooperation, that is, whether the cooperation is in production, financing or use of low carbon technologies.

Concept	Production	Financing	Use
Low carbon hub	✓		✓
Solar schools		✓	
Euronet 50/50			✓
Local energy cooperatives	✓	✓	✓
Nudge initiatives			✓
Online house renovation community			✓
Crowd funding for RES / district heating etc		✓	
PV purchase collectives		✓	
Bike sharing			✓
Use of cooking oil			✓
Energy performance contracting		✓	✓
Municipal bonds		✓	

The areas of production, financing and use can develop separately, though perhaps, more frequently they may develop in parallel. For example, a community may be motivated to develop renewable energy at a local level. Some of the energy will be used locally and some

will be sold to the market. In parallel, the community may look to finance the scheme, at least partly, through a cooperative arrangement. This cooperative arrangement allows the community to further benefit financially from the scheme, as well as removing a potential barrier to its implementation in the first place.

Cooperative concepts can also be grouped by who is leading the initiative, including whether the concept is based on use of the internet.

Concept	Community	Municipality/ other authority	Internet based	Industry
Low carbon hub	✓	✓		
Solar schools	✓			
Euronet 50/50		✓		
Local energy cooperatives	✓	✓		✓
Nudge initiatives	✓		✓	
Online house renovation community	✓		✓	
Crowd funding for RES / district heating etc	✓		✓	✓
PV purchase collectives	✓			
Bike sharing		✓		✓
Use of cooking oil		✓		✓
Energy performance contracting				✓
Municipal bonds		✓		

1.3 Objective of the work

As in the Terms of Reference for this work, the objective of this study is for the European Commission to achieve a better understanding on how the new approaches of cooperative production, financing and use of low carbon technologies and related services could contribute to competitiveness and job creation in the European Union. In addition, the European Commission wants to achieve a detailed understanding of how these measures could result in the reduction of greenhouse gas emissions.

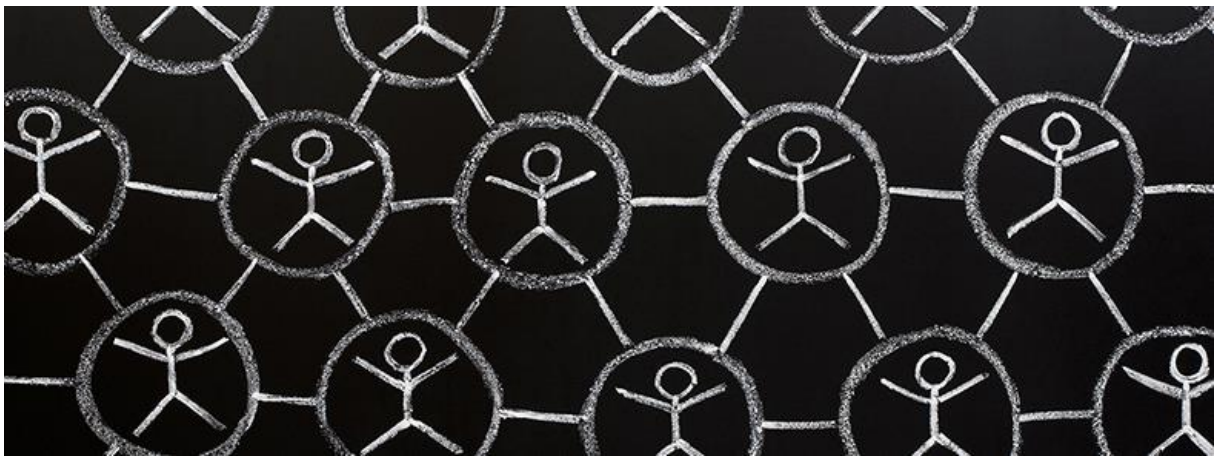
There are four key outputs of the project, all of which will help to inform the European Commission, and participants, on this area. These are repeated in full below:

- The main objective is to review and analyse this area and identify the opportunities at a range of levels including for citizens, local communities, companies and individual entrepreneurs to enter into a number of sustainability and competitiveness driven activities such as cooperative production, financing and use of low carbon technology. These activities have the potential to reduce greenhouse gas emissions and to enhance competitiveness. This project will also suggest how to utilise a number of European Union programmes and initiatives including: the funding programme LIFE; the innovation network Climate-KIC; and other related EU bodies and groups to facilitate these pioneering activities. The information elucidated and identified throughout this work will be summarised and shared with the Commission through the Reports written during the course of the project, and the full content will be present in the final report.

- A successful workshop is another key objective, ultimately to be used as a vehicle to share the knowledge and insights gained during the work with the wider audience in the European Commission, including Member States and experts. This will enable a summary of the current position to be shared with all participants, introduce or update the participants of pioneering work being done in this area, and best practice, as well as discuss the opportunities and challenges that the EU funding available for such activities presents for climate pioneers.
- Alongside the work will run the Communications campaign; a further objective. This will involve the creation of a dedicated website, and the production of a brochure highlighting ideas and examples for pioneering cooperative production, financing and use of low carbon technologies.
- Ultimately the final objective of the work is the production of a set of recommendations to the European Commission considering how cooperative production, financing and use of low carbon technologies and related services could support the EU's climate action and competitiveness targets. These recommendations, through the review process, and interviews with experts and stakeholders, will identify the most favourable options for technology areas, as well as suggest how EU programmes and initiatives, such as Horizon 2020 or LIFE can be utilised to provide support to pioneers.

2 Case studies

2.1 Low Carbon Hubs



2.1.1 Background

2.1.1.1 *Description of the model*

Where does it come from

The Low Carbon Hub (LCH) Oxfordshire is co-funded by the Intelligent Energy Europe programme of the European Union through the OxFutures partnership. It emerged as a local initiative to build renewable energy infrastructure that is community owned.

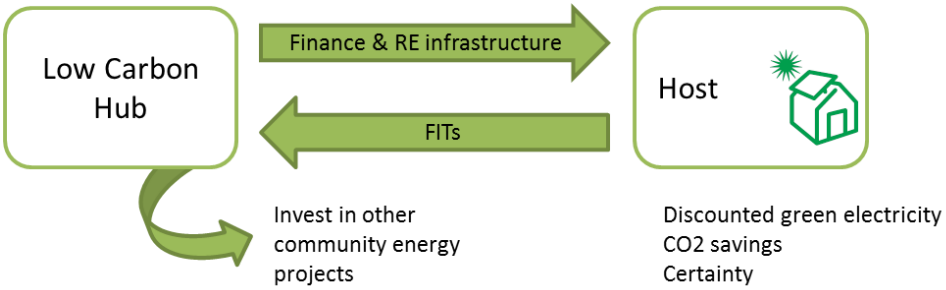
How it works

A Low Carbon Hub aims to lower carbon emissions at a local/community level, by helping to develop local renewable energy projects and reduce energy demand. Since this concept is at an emerging stage, there is no consistency among the different examples.

The **Low Carbon Hub (LCH) Oxfordshire** is a social enterprise launched in December 2011 to support community groups to take action on carbon reduction by **building RES infrastructure that is community owned**. LCH now works with community groups across the County, under an innovative **community benefit impact model**[5]. The concept involves the grouping of RE projects, financing them through equity and then holding a share offer to pay out the loan. The LCH Oxfordshire has been shortlisted for two awards.[6]

[5] **Community Benefit Model:** The LCH forms partnerships with local businesses and the public sector to develop, manage and finance renewable energy schemes. Under this model, the hub raises the finances and installs the renewable energy infrastructure and, in return, the organisation receives discounted green electricity, gets greater certainty concerning the cost structure and saves CO_2. Investors get a fair return and the LCH receives the income from the Feed-in-Tariff to invest in further community energy projects, creating a chain of benefits and carbon cuts.

[6] 2 Degrees Champions Award – Social Value Category and The Observer Ethical Award – Community Energy category



The Low Carbon Hub Oxfordshire has two main streams of activities:

- **Powering down communities (EE oriented) -** working with community groups to recruit households for energy efficiency improvements, and looking at how best to install energy-saving measures in local homes, schools and businesses. The team is currently piloting approaches with grants from the Department of Energy and Climate Change.
- **Powering up communities (RES oriented)–** where the team helps community groups to develop renewable energy projects based on the natural resources of a particular area, providing support to communities from feasibility, planning and tendering through to raising the finance and project completion. Community energy schemes include micro-hydro installations and solar PV on community buildings (schools, churches and village halls).

LCH Oxfordshire provides the following services within their powering-up stream:

- **Community energy service.** The Hub Community Energy Service helps communities to develop renewable energy schemes specific for an area or group. Their expert team of in-house consultants do help with the process, from start to finish. It includes: 1) Initial contact and identifying a project; 2) Feasibility; 3) Pre-development; 4) Project finance; 5) Project development; 6) Operations and management.
- **Seed capital fund**. The Seed Capital Fund is available to community renewable projects that have signed a technical assistance agreement with the Hub. It is a revolving fund that will pay for initial project costs including: project set up; feasibility studies; planning; legals; and consultancy time. The fund is available to community projects at Hub risk but will be reimbursed if projects go ahead. The Hub can also help community projects access grant-funding for energy projects, like the Rural Community Energy Fund.
- **Solar energy for schools**. The Hub solar energy scheme installs solar PV in Oxfordshire schools for community benefit. Schools get solar PV installed with none of usual hassle and have no capital outlay: the Hub has a dedicated project manager, absorb the early viability and assessment costs and raise the funds for the project.
- **Solar energy for businesses.** The Hub forms partnerships with local businesses to develop, finance and manage renewable energy schemes for community benefit. Under the Community Benefit Model, the projects should generate cheap, green electricity for businesses; for the investors a fair return and for the Hub a sustainable income stream to fund their work. The income is used to support local communities to develop renewable schemes, attract local investment and create an income stream to help householders reduce energy use. Their first business partner is Oxford Bus Company.

Aims

The aim of a Low Carbon Hub is to lower carbon emissions by developing renewable energy, promoting zero carbon homes, and carrying out energy reduction projects for the benefit of local communities.

Examples

Low Carbon Hub Oxfordshire - This Low Carbon Hub is a social enterprise whose vision is for the waterways and rooftops of Oxfordshire to be the power stations of the future. Some information has already been given under 'How it works' above. We will use mainly the Oxfordshire example throughout this example given that it has a particular approach towards community energy; has the most information available; and is at a more advanced stage of development.

Manchester Low Carbon Hub. A second example is the **Manchester Low Carbon Hub,** a government initiative that aims to provide a 'one-stop-shop' on the low carbon agenda in Greater Manchester. It oversees low carbon projects and initiatives (and their integration into the city's work programmes); it designs and implements a work programme to implement low carbon strategies, priorities and decisions; it identifies and secures resources and capacity to enable the implementation of the programme; and, it influences local, national and international policies, legislation and programmes in order to deliver a secure, low carbon future for Greater Manchester (among other activities). This concept is quite different from the previous one and we will not focus on it in this analysis given that, even though there is cooperation between the private and public sectors, it is limited.

Developing a low carbon economy is one of the priorities of the Greater Manchester Strategy. The Low Carbon Hub is a central proposition within Greater Manchester's proposals for Deal for Cities and part of their growth strategy. The Low Carbon Hub Board is responsible, on behalf of the GMCA, for developing and putting in place the delivery arrangements for Greater Manchester's Climate Change Strategy and other environmental priorities.

A further example is the Zero Carbon Hub (UK) and its local initiatives (e.g. Wales Low/Zero Carbon Hub). This example focuses on promoting zero-carbon homes. The Zero Carbon Hub was established in 2008, as a non-profit organisation, to take day-to-day operational responsibility for achieving the government's target of delivering zero carbon homes in England from 2016. Since then they've worked with both government and industry with the focus on raising build standards and reducing the risk associated with implementing the Zero Carbon Homes policy.

2.1.1.2 *Key impacts*

Environmental impacts

So far, the Low Carbon Hub Oxfordshire has:

- Installed a 62kW solar PV scheme on two local schools, which will generate 59,000 kWh/annum.
- Installed a 140kW solar PV scheme on the Oxford Bus Company roof in Cowley, the largest in Oxford. It generates 122,085 kWh/annum and will save 1,257 tonnes of carbon dioxide over the lifespan of the project.
- Supported the first community-owned hydro scheme in Oxfordshire, which will generate 159,000 kWh of renewable electricity in the heart of Oxford, enough to power 50 homes, and save 83 tonnes of CO_2 per year.
- Installed a 19kW solar PV scheme on Eynsham Village Hall and adjoining presbytery, which will generate 10,535 kW of green electricity and save 5.8 tonnes of CO_2 per year.
- Installed external wall insulation to 26 of the most poorly-insulated, pre-fabricated BISF properties through the Warming Barton scheme (which is linked with two Government initiatives – the Green Deal and the Energy Company Obligation). A total

of 119 assessments were delivered; 61 of these include full Green Deal Advice Reports. The result was a grand total of 579 recommended actions, 206 t CO_2 potential annual savings and the potential for each household to save an average of EUR540 each on their bills.

Other impacts and benefits

A low carbon hub brings value to their business and public sector partners by:

- Providing secure and resilient local electricity generation for their site;
- Enabling them to reduce energy costs without investing their own capital;
- Removing the need to buy in additional technical skills;
- Reducing risks to a minimum;
- Taking on smaller projects that would not be considered worthwhile by purely commercial providers. This allows achieving maximum efficiency for community projects by working at scale with funders, installers and professional services – saving costs and maximising benefits.

A low carbon hub concept brings further benefits:

- **Use of local resources**: Locally-owned schemes are better at exploiting local resources like solar, biomass, farm waste, water power, or wind sites which may be overlooked by commercial developers. They bring diversity to the energy portfolio, building resilience and security.
- **Attracting new investment:** Community energy schemes attract investment from new sources, often local. Given the significant levels of investment required to renew energy infrastructure, new sources of finance, such as individual and community investment, are needed.
- **Funding energy-reduction initiatives:** Many of these community schemes use the income to fund local energy-saving initiatives.
- **Helping the local economy:** By retaining the revenues from renewable energy projects within the community, there are often significant benefits for the local economy.
- **Increased awareness of climate change:** Community energy schemes can develop "energy literacy" and greater understanding of climate change issues.
- **Local action on a global issue:** These local schemes are a way of communities being able to make a difference locally on an important global issue.

2.1.2 Current development stage

The concept as explained here is not mainstreamed (though certain aspects of it are, such as crowd funding for renewables). The only example we found with these characteristics was the Low Carbon Hub Oxfordshire, though the name is used for other purposes as well (e.g. zero carbon hubs focused on built environment). We believe the UK government and its support to community energy will promote these initiatives further. (See box below)

The UK's Community Energy Strategy

The UK has focused on the role communities can play helping reach energy and climate change targets. For example, the Department of Energy & Climate Change has recently published its Community Energy Strategy (January 2014) which sets out how communities are already coming together to generate electricity and heat, reduce energy use, save money on the energy they buy, and balance supply and demand. Among the Strategy's key recommendations are:

- A new Community Energy Unit in DECC will work with communities and local authorities to provide a step-change in the support offered to community energy projects.
- A new £10m Urban Community Energy Fund (UCEF).

- A doubling of the Feed-in Tariff (FIT) maximum capacity ceiling from 5MW to 10MW for community projects
- A 'One Stop Shop' information resource for community energy, developed with community energy groups using seed funding from government
- The quadrupling of the Green Deal Communities Scheme to £80 million.

2.1.3 Elaboration of the model

2.1.3.1 *Organisational aspects*

Actors involved, their role and interests

The main actors usually involve the scheme operator and the business or local government partner who will implement the low carbon projects. Government authorities are usually also involved, e.g. by providing additional subsidies/funds, and can help mainstream the scheme. Actors are:

- **Scheme operator** – The Hub and its board, its consultants and advisors. (The Oxfordshire Hub is community led, community group partners have a shareholding in the Low Carbon Hub).
- **Host** – the host can be a school, a business, government and other partners with whom to implement low carbon projects
- Local community
- **Government** – Local and national authorities, supporting the initiatives and providing funding
- **Suppliers and installers**, e.g. for PV panels and hydro.

The Oxford Low Carbon hub is also a part of OxFutures and Low Carbon Oxford.

OxFutures

Oxford City Council, Oxfordshire County Council and the Low Carbon Hub, are taking action on energy across Oxfordshire. This partnership is called OxFutures and is co-funded by the Intelligent Energy Europe programme. The reputation of the councils builds trust in the programme and the Low Carbon Hub brings innovation and new skills to existing relationships with local communities.

Low Carbon Oxford - Established in 2010 by the Oxford Strategic Partnership, core-funded by Oxford City Council and managed by the Low Carbon Hub. Low Carbon Oxford is a network that brings together organisations from the private, public and not for profit sectors to collaborate on Oxford's transformation to a sustainable and inclusive low carbon economy.

Set-up of the model

This initiative is supported by Intelligent Energy Europe and by the local government. However, it depends largely on the local community. It is an innovative approach that aims to build RES infrastructure that is community owned.

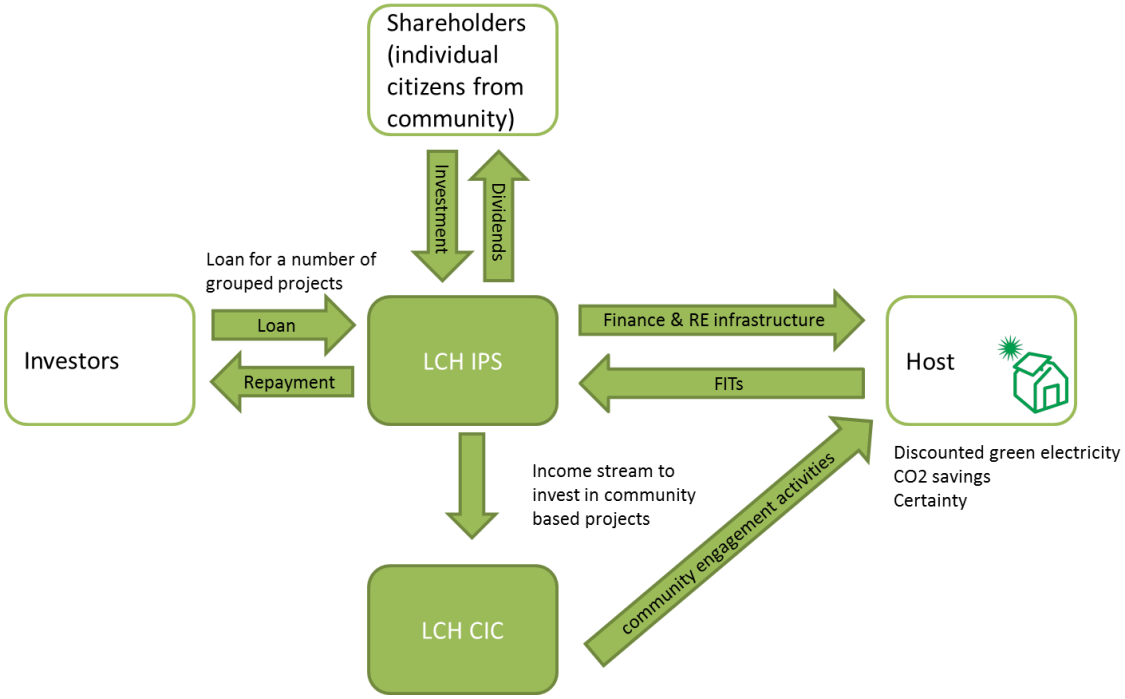
The Oxfordshire Low Carbon Hub is set up as two entities: Low Carbon Hub CIC (Community Interest Company) and Low carbon Hub IPS (Industrial and Provident Society), similar to a co-operative. This company structure enables Low Carbon Hub to keep capital in one entity (IPS) while running services through CIC resulting in some tax benefits. The LCH receives support from IEE – to get the model running, but the aim is for it to become sustainable.

2.1.3.2 *Economic aspects*

The projects are grouped in order to access financing. The IPS arm gets loans to fund the construction of a number of projects (i.e. this summer there will be more than 20 schools and 2-3 businesses). After the projects are constructed, the IPS launches a share offer to replace the financing. IPS mobilises investment in energy infrastructure through special purpose financial vehicles, financed by the local community. Once the projects are running, the electricity is mostly used by the host, but exported electricity, together with the FITs, are income streams for IPS. Shareholders (individual citizens) get dividends on their investment and the surplus money is donated to the CIC to fund community engagement activities.

Low Carbon Hub recognised that renewable energy projects can be more profitable than energy efficiency because of electricity feed-in-tariffs and electricity sales. Upgrade works, such as external insulation, tend to have much longer payback periods. As such, profits from renewable energy projects are used to finance energy efficiency works in the community.

Figure 2.1.1: Working structure of the LCH



Project example: The Osney Lock Hydro project

A recent project supported by the Low Carbon Hub is the Osney Lock Hydro project, a 49kW community hydro scheme which will generate 159,000 kW/annum of renewable electricity in Oxford. The income from the sale of electricity and the feed-in tariff will give investors a financial return for their support and fund future community initiatives to further reduce carbon emissions.

Low Carbon Hub launched a share offer for the hydro project in April 2013 and had 5 weeks to raise the community share of €290,000 from the community and €400,000 from debt financing from a charity bank. The charity bank has a lower rate of return because the money is funding a community project. The final sum raised from citizens was over €600,000, 60% of which was funded by people within a mile of project and 90% from the county of Oxfordshire.

2.1.3.3 *Legal and regulatory aspects*

There are some legal barriers that can hamper the uptake of low carbon technologies in general, but these do not concern the use of this concept. For example, PV support

schemes, such as feed-in-tariffs and subsidies which are being trimmed down or stopped in several EU countries could hamper the uptake of this concept. However these are country related. A summary assessment of European PV support schemes can be found in EPIA's Global Market Outlook for PV 2013-2017 (p. 30).

In the UK, the Low Carbon Hub benefits both from the FITs and from the Enterprise Investment Scheme (EIS). The EIS is designed to help smaller higher-risk trading companies to raise finance by offering a range of tax reliefs to investors who purchase new shares in those companies.

2.1.3.4 *Technical aspects*

PV systems are technically mature, though the lifetime of the inverters could still be improved (e.g. to have the same expected lifetime as PV modules). The same applies for hydro power. There are no technical barriers that would prevent the uptake of these technologies.

2.1.3.5 *Social or cultural aspects*

These are integrated in previous and following sections.

2.1.3.6 *Risks*

The main risks identified for the Oxford Low Carbon Hub include:

- **Uncertainty** regarding whether the community share offer will raise enough to cover the investment. This has been tested at a smaller scale, but it has not been done for a group of energy projects together in a wider community.
- **Aborted projects**. The risks and costs of aborted projects are absorbed by the LCH, and these are higher than anticipated. Some projects are already a long way down the project pipeline when they are aborted, which implies (high) costs in surveys and lawyers.
- **Government changes to FIT tariffs**. The financial model relies on the FIT tariffs, and changes could be detrimental to the well-functioning of the community benefit model.

2.1.3.7 *Key enablers*

The key enablers identified for the LCH Oxfordshire are listed below:

- **Partnership with the Oxford City Council and the Oxfordshire County Council (OxFutures**). The reputation of the councils builds trust in the programme and also provides authority.
- The **Intelligent Energy Europe** funding which has allowed the LCH to get their model going.
- The **experienced team of practitioners**. The Hub team of consultants is made up of people who have worked – and are still working – on community schemes so they understand the challenges of setting up, developing and financing energy projects.
- **Active community network**.
- Availability of the **Enterprise Investment Scheme**, which provides tax relief.
- **Availability and level of FITs.** Feed-In Tariffs have proven to be one of the most effective policy instruments in overcoming the cost barriers to introducing renewable energy and making it economically viable. The simple guarantees that FITs provide – including access to the grid, a set price per Kilowatt Hour (kWh) that will cover the costs associated with electricity production, and a guaranteed term for which they will receive that rate has turned several European countries into world leaders in the renewables sector. Therefore, the availability and the level of the FITs are a key enabler for RES projects in general, and for the Low Carbon Hub in particular.
- **Possibility to pre-register – as local community stakeholder – for the FIT**. This means that the LCH has an advantage over developers, who can only register later on down the project pipeline; while, as a community, the LCH can agree on a FIT beforehand.

2.1.4 Current barriers and potential solutions for up-scaling

2.1.4.1 *Barriers*

Particular barriers that have been identified for the Oxford Low Carbon Hub include:

- Cautionary approach towards long term commitments. Investments in renewables are a 20 year commitment, and the LCH (on its third year of operation) does not have a long track record which might generate mistrust.
- Grid operators try to charge for putting electricity back in the grid, increasing the costs and making the model less attractive.
- Lack of experienced lawyers in this type of contract (and potential lack of legal basis). The few available ones are very expensive.
- Need to invest in preliminary surveys (to assess if the buildings are suitable for PV) even though, after more detailed surveys, the buildings might be found not suitable.

2.1.4.2 *Potential solutions*

Potential solutions addressing the barriers that have been identified for the Oxford Low Carbon Hub include:

- Partnering with the City and County Councils helps building trust in the LCH. This aspect can be exploited and should be highlighted in communications.
- Potentially build in-house legal expertise in the medium or long term.

2.1.5 Future potential

2.1.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

This concept is at a very early stage of development. The LCH Oxfordshire only started its operations on December, 2011. Therefore, only a few projects have been implemented while additional ones are in the pipeline. They expect to have all systems in place by next year such that it will be easier to scale-up their activities. For the moment it is difficult to assess the up-scaling up potential to 2050.

2.1.5.2 *Replicability*

The same concept can be used for other low carbon technologies such as wind turbines and biomass. However, this depends on space availability, while solar panels can easily be placed on roofs. Furthermore, the pay-back period for wind turbines is still very unattractive when compared to PV, limiting the potential on the short to medium term. Another technology to be considered might be heat-pumps. However, incorporating new technologies also implies restarting the learning curve that the LCH Oxfordshire has just acquired for PV and hydro.

In addition, the concept could be replicated in other communities. A limitation would be the availability of feed in tariffs (FITs) and the Enterprise Investment Scheme (EIS – tax relief), making the UK an ideal place to start with additional Low Carbon Hubs before exporting the concept to other countries.

2.2 Solar Schools

2.2.1 Background

2.2.1.1 *Description of the model*

Where does it come from

There are a number of options to help schools overcome financial barriers to renewable energy and become cleaner, greener places for pupils to learn. The most common of these are so called 'rent-a-roof' schemes where a third party effectively rents space on a school roof to install panels that they own - allowing the school to enjoy free or cheap energy, while the panel owner keeps the feed-in tariff (FIT). The Solar Schools initiative aims to use the excitement of a solar installation to leverage a whole range of other benefits. They can enjoy all of the financial benefits themselves (and avoid any long term contracts), build networks, develop new skills and give each and every member of their community the opportunity to feel a sense of ownership over a clean energy project.

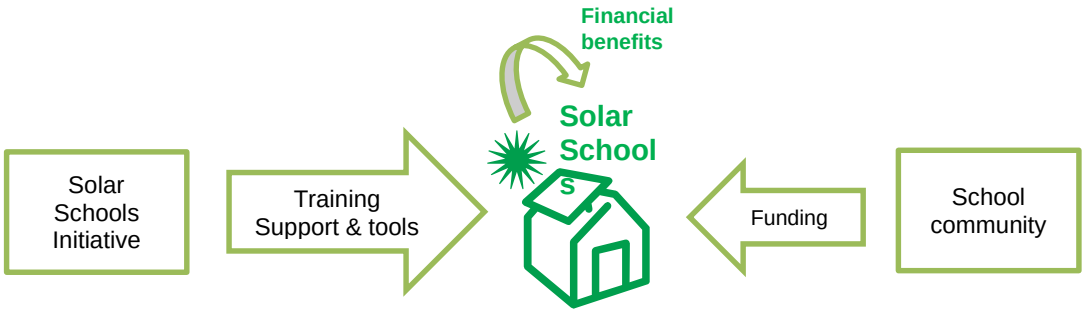
How it works

There are different models for the Solar Schools. However, they all have the following elements in common:

- Installation of solar panels on the school's roof
- Renewable energy in the curricula (usually using the solar panels as an interactive element to get students involved/interested in renewable energy)
- Community involvement

The most interesting and innovative example is the Solar Schools UK. The programme provides schools with the tools, training and support they need to fundraise the cost of panels. Each school set a fundraising target for their very own solar roof, and then everyone chips in to help make it happen.

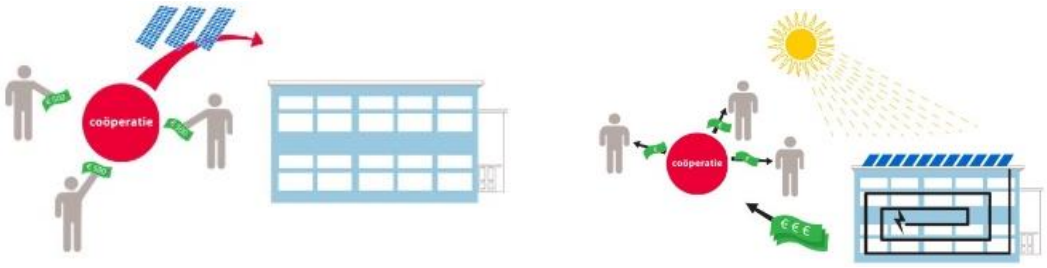
Figure 2.2.1: Working structure of the solar schools initiative



The Solar Schools NL example offers a different approach, proposing to set up cooperatives. Neighbours of the school and parents lend an amount to the Cooperative. The Cooperative invests this amount in solar panels on the school. After that, the Cooperative delegates the ownership to the school. The solar panels save on the energy bills every year. This amount will be the annual repayment to the Cooperative, who pays off to the members.

Figure 2.2.2: How the cooperative works in the Solar Schools NL initiative

Source: http://www.solarschools.nl/en/solar-roof/co-operative



The Solar 4R Schools US program for example provides hands-on activity guides, science kits and demonstration solar electric systems at no cost to schools, by working with local funding partners who want to show their commitment to renewable energy education. To receive a solar-electric system, schools must agree to own and maintain the system after installation. In turn, the school receives an exciting learning tool and all of the clean, renewable electricity it produces. This scheme has installed solar panels on over 250 schools across the USA.

Aims

Solar School schemes are implemented in different contexts. They aim to promote renewable energy by allowing schools to utilize their own roofs to generate clean energy by installing solar panels in order to reduce GHG emissions. At the same time, they serve as a tool to teach and involve students and the school community on renewable energy topics. They also help schools to:

- Reach economies of scale and/or have the support of panel providers. This allows for higher economic benefits and gives the individual schools more negotiating power because they are part of the bigger programme.
- Make the process easier for independent schools, as they do not have to navigate multiple bids and scenarios independently, and give them more leverage (e.g. when there are challenges with permitting or other impediments).
- Share knowledge and experience within the group of Solar Schools.
- Attract attention of donors and press, which increases fundraising potential

Examples

- Solar Schools (UK) A brief introduction is under “How it works” above.
- Solar Schools (NL) A brief introduction is under “How it works” above.
- Escuelas Solares / E.g. Solarizate A programme for solar schools in Spain (ES)
- Ohio Solar Schools (USA)
- Solar 4R Schools (USA) A brief introduction is under “How it works” above.

Similar concepts are:

- Positive Energy schools / Zero Energy schools (Göteborg, SE):
- EnerSchools (Águeda, PT)[7]

[7] Enerschools is an interactive multimedia application, available online, conceived for children between six and 11 years and whose main objective is to sensitize young children to the importance of energy efficiency and to Analyze the school consumption values in order to implement concrete actions for energy savings. It was designed to be used in schools and is

- ZEMedS[8]

2.2.1.2 *Key impacts*

Environmental impacts

The environmental impacts are directly linked to the size of the photovoltaic systems installed and the energy generated by the solar schools.

For example, the Solar 4R Schools initiative in the US has installed 248 photovoltaic systems in schools which have generated over 12,000,000 kWh of solar electricity, avoiding about 7,600 tons of CO2 emissions into the atmosphere.

The UK initiative, on the other hand, has helped 50 schools start their fundraising. 33 of these schools already achieved their fundraising goals. According to our estimates the implementation of their solar panels would allow for an annual generation of 105 000 kWh and 1 364 tons of avoided CO2 emissions.[9]

Other impacts and benefits

Besides the carbon cuts, Solar Schools can provide additional benefits like boosted budgets, and a more confident, connected school community. Other benefits are:

- A positive, practical way to teach pupils about energy, sustainability and climate change.
- New enthusiasm for energy saving, inspiration for further low carbon projects.
- Improved links with parents and local businesses and organisations.
- Brings the school and local community together to invest in the scheme and share the benefits
- A boost to the profile of their school in the local area.
- New skills and confidence for future projects.
- Discounted, green solar electricity
- Supports further local community energy projects

2.2.2 Current development stage

The different programmes are at different stages of development:

- Already in 1997 Greenpeace launched a project to create a network of solar schools in Spain.[10] By 2001 there were 170 schools in Spain participating on the initiative.
- The Dutch Solar Schools have only carried out a pilot so far.
- The Solar Schools UK is in its second year and has helped several schools to raise enough funds and install solar panels, while others are just getting started. Together they've raised over £100,000 in just over one term, been celebrated in parliament and won awards for their efforts!

prepared to read consumption values of measuring equipment related to Electricity, Temperature, CO2 and others. During the pilot phase of the project in Lisbon, Lisboa E-Nova and ISA supported the training of teachers and students.

[8] ZEMedS project (Zero Energy MEDiterranean Schools) is a 3 years project co-funded by the European Commission within the Intelligent Energy Europe Programme (IEE) that promotes renovation of schools in a Mediterranean climate to be nearly Zero-Energy Buildings (nZEB). The main goal of ZEMedS is increase the knowledge and know-how on nZEB renovation of schools in Mediterranean climates and give support to several new initiatives on nZEB refurbishment of schools in Mediterranean climate regions. ZEMedS actions are mainly addressed to involve and commit 2 target groups, school policy makers and building designers, by providing technical and financial assistance on nZEB renovation of schools in Mediterranean climates, and giving support in succeeding in implementing school renovation with nZEB goals.

[9] This is based on the amount raised per school. This is linked to a specific system size (kWp) and the related carbon savings. For example £10 000 would buy a 4.2 kWp system, save 47 ton CO2 and produce 3 615 kWh/year; while £15 000 would buy a 8.6 kWp system, save 96 ton CO2 and produce 7 385 kWh/year.

[10] http://www.energias-renovables.com/articulo/la-red-de-escuelas-solares-de-greenpeace

Over all, there is no one single wide-spread concept of solar schools, and even though there are many examples of Solar Schools up-and-running, the concept has not yet become main stream. Examples remain rather limited as well.

2.2.3 Elaboration of the model

2.2.3.1 *Organisational aspects*

Actors involved, their role and interests

The main actors usually involve the scheme operator, the school itself and the school community overall. Local authorities are usually also involved and can help mainstream the scheme in their area. Actors are:

- Programme manager / Scheme operator – NGOs, companies... Solar Schools UK is run by 10:10, while Solar Schools NL is run by Picosol, and Escuelas Solares in Spain was launched by Green Peace. Solar 4R Schools' funding partners however are a number of private companies.
- Client – School & Building Owner
- School communities – Including teachers, students and students' families.
- PV panel suppliers & installers
- Optional:
  - Local government – As the (partial) owner of the school
  - Consultants and technical specialists

2.2.3.2 *Economic aspects*

The economic aspects are different according to the location and the set-up. The concept makes the purchase of PV systems more attractive, as through the schemes schools can get discount on PV systems and installations, plus additional support from the scheme operator (e.g. on capacity building, maintenance, curricula development for students related to RE, etc.). Scheme operators usually also provide technical support by for instance initiating, managing or administrating.

Financing is usually left to the school community, who either do a fundraising/crowd funding (e.g. UK) or set up a cooperative (NL) and lend the money to buy the photovoltaic systems.

Governments sometimes provide financial support in the form of subsidies (e.g. ES, at the beginning of the programme).

Below we provide different examples:

Example 1: Solar Schools UK[11]

If a school raises £10,000, they can buy a 4.2kWp solar rig and turn the investment into:

- £6,921 savings on electricity bills over 25 years
- £11,739 of feed-in tariff revenue over 20 years
- 47 tonnes of CO2 saved over 25 years

Economic assumptions for the calculations are:

- £10,000 and less we assume an install price of £2,375/kWp
- £10,001 - £15,000 we assume an install price of £1,750/kWp
- £15,001 - £20,000 we assume an install price of £1,375/kWp
- Carbon savings are based on a grid average of 0.52kg CO2/kWh
- Feed-in tariff levels based on levels from 1 February 2013 - 1 May 2013.
- Potential returns are based on an unshaded south facing roof at 30 degrees with a grid electricity price of 15.32p and a school using 50% of the energy they produce.

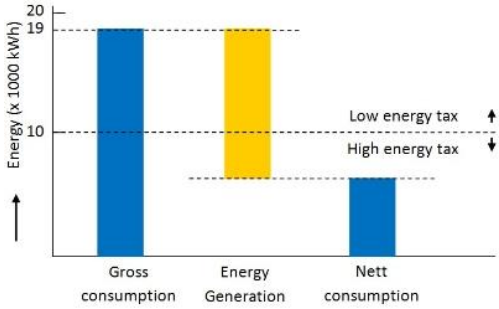
[11] http://www.solarschools.org.uk/about/

To create a picture of overall returns, feed-in tariffs have been calculated over 20 years but carbon savings and energy bills over 25 years - reflecting the usual lifespan of panels. The replacement of inverters does not seem to be taken into account in the Solar Schools UK calculations.

Example 2: The Dutch Solar Schools initiative - Solar panels on the Kubus roof[12]

The solar system built on the Kubus costs 23 thousand Euros including VAT. This amount is raised by 30 members who provide a loan. The budget is sufficient to install the solar panels, including a reservation for replacing the inverter after 10 to 15 years. The loan is paid off in annual instalments which depend on:

- **The generated energy.** The system has a peak power of 15 kW. The expected annual yield is over 12,000 kWh.
- **The financial value of this energy.** Each year, about 19,000 kWh is used in the building. The first 10,000 kWh is subject to a high energy tax rate. The other 9,000 kWh to a lower rate. Based on the year 2012, the average power tariff for the annual settlement to the cooperation will be 14 cents.



- **The reservation** for management and maintenance of the system.

Taking into account various factors, such as a slight increase of the energy tariff, a decrease of efficiency and the expected overhead costs, the system is expected to be paid off in 17 years. The terms of the remaining six years (the contract has a term of 23 years) is the profit (return on investment). Considering that the investment was made in 2013, we find that 17 years payback period is relatively high.

Example 3: The Spanish Solar Schools initiative[13]

The project, run initially by Greenpeace and IDAE, presented the following business case in 2001:

- Installation power: 5kW
- Cost: 30k eur
- Annual energy generation: 5,000 – 7,500 kWh (2000 – 3000 eur)
- Annual profit: 900 – 1650 eur
- Revenue over lifetime (25-30 years): 27000 – 42000 eur
- For every 1 million euro invested, 6 to 8 new jobs are created.

2.2.3.3 *Legal and regulatory aspects*

There are some legal barriers that can hamper the further uptake of PV in general, but these do not per se concern the use of this concept. PV support schemes, such as feed-in-tariffs and subsidies which are being trimmed down or stopped in several EU countries could hamper the uptake of this concept. However these are country related. A summary assessment of European PV support schemes can be found in EPIA's Global Market Outlook for PV 2013-2017 (p. 30).

2.2.3.4 *Technical aspects*

PV systems are technically mature, though the lifetime of the inverters could still be improved (e.g. to have the same expected lifetime as PV modules). There are no technical barriers that would prevent the uptake of this concept. However, the following aspects should be considered when schools plan to install photovoltaic systems:

[12] http://www.solarschools.nl/en/solar-roof/business-case
[13] http://www.energias-renovables.com/articulo/la-red-de-escuelas-solares-de-greenpeace

- **Roof orientation.** E.g. Solar panels provide optimal yield at tilt angle of about 20-40° to the south in the Netherlands. In case of a flat roof, the solar panels are mounted on a construction or consoles with optimal orientation.
- **Shadow effect:** Trees, buildings or other obstacles can have an impact on the power yield. An open sky is optimal.
- **Energy consumption.** You should have to be careful the solar panels don't generate more energy the school needs. This "surplus" is taken at a very low rate by the energy company (in the Netherlands).

2.2.3.5 *Social or cultural aspects*

Community involvement is very important for the success of this concept. This is further detailed under the section 'Key enablers' below.

2.2.3.6 *Risks*

The success of the scheme relies on gathering enough funds to be able to install the PV system.

Another risk is that the PV system does not perform as expected. Selecting a supplier who offers good quality products and a warranty on the system can reduce this risk. This may affect the financial feasibility for the schools.

2.2.3.7 *Key enablers*

Community involvement. In all the different models for Solar Schools, community involvement seems to be a key enabler. This is most clear in the UK model, where the fund raising depends directly on community involvement; and in the NL model, where the investment is a loan from the school community to the cooperative. However, in other examples, the school community has a say and plays a role in enabling the implementation of solar panels.

Availability and level of FITs. Feed-In Tariffs have proven to be one of the most effective policy instruments in overcoming the cost barriers to introducing renewable energy and making it economically viable. The simple guarantees that FITs provide – including access to the grid, a set price per Kilowatt Hour (kWh) that will cover the costs associated with electricity production, and a guaranteed term for which they will receive that rate has turned several European countries into world leaders in the renewables sector. Therefore, the availability and the level of the FITs are a key enabler for solar PV in general, and for Solar Schools in particular.

2.2.4 Current barriers and potential solutions for up-scaling

2.2.4.1 *Barriers*

Main barriers are:

- High up-front costs of solar PV systems and long payback periods.
- Lack of financial means among the school community can be a barrier to the uptake of this concept. This barrier will be more prominent in Eastern and Southern Europe than in North and West Europe.
- There has to be a certain level of awareness about and interest in PV systems.
- Low electricity prices in some EU countries can form a barrier since it would make investments in PV less interesting.
- A lack of trust in the scheme operator can form a barrier for people to sign up.
- Lack of community involvement

2.2.4.2 *Potential solutions*

- By sharing the up-front costs among the school community this barrier is already diminished.

- The financial barrier can be addressed through financial support from governments and deals for attractive arrangements with financial institutions and PV panel providers.
- Governments can also help to raise awareness regarding renewable energy in general, and PV and Solar School programmes in particular. Schemes like the one in the UK can have positive publicity in the media helping to tackle this barrier.
- The electricity prices in most EU countries have been increasing over the last years and, considering the huge investments required in the power sector, is not expected to decrease in the near future. The price gap barrier is thus expected to solve itself over time.
- A reliable scheme operator is an important prerequisite for success of the concept.
- Community involvement can be increased also by raising awareness, using online communities and existing community activities to promote the scheme.

2.2.5 Future potential

2.2.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

There seem to be no fundamental barriers for the uptake of the concept across the EU. The EU-27 has roughly 147,000 schools[14]. For practical reasons we assume only 70% of schools have potential PV capacity[15]. Therefore, roughly 103,000 could potentially be interested in this concept. If 5% of the identified schools would install PV panels, this could lead to 103,000*0.05*10kWp = 51,500 kW installed capacity. (Taking into account a conservative approach, where each school installs a small – medium solar system of 10 kWp.

A back of the envelope calculation shows that the EU wide uptake of Solar Schools could lead to the following:

- Electricity generation[16] of 44GWh per year
- Annual reduction of 23,000t of CO_2 or 573,000t CO_2 over the lifetime of the panels (25 years).
- One MW of installed capacity generates approximately 7.7. FTE (construction & installation only)[17], so the 51.5 MW of installed capacity may translate into roughly 400 jobs. Manufacturing adds a further 4-6.5 FTE per MW, so, if manufacturing is in the EU, this would add about another 250 jobs.

This sort of initiative, if scaled-up, will lead to significant direct sales, and might help drive down the price of individual PV systems, thus providing a further stimulus to the market.

2.2.5.2 *Replicability*

The same concept can be used for other low carbon technologies. The Solar 4R Schools initiative in the US also has some examples with wind turbines. However, this depends on space availability, while solar panels can easily be placed on roofs. Furthermore, the pay-back period for wind turbines is still very unattractive when compared to PV, limiting the potential on the short to medium term. Another technology to be considered might be heat-pumps.

[14] This is based on the total number of students/pupils (93 001 000 in 2011 for EU27, EUROSTAT) and the European mean of 633 students per school (EUROSTAT Report 'Key data on education in Europe 2012').

[15] This figure is based on the findings of a case study (NREL, 2011) where 53 out of the 73 schools assessed had actual PV potential.

[16] To calculate the total energy output of the PV system several parameters should be taken into account. This is only a rough estimate based on the UK Solar Schools initiative data. An EPIA report includes: Solar irradiance, performance ratio (75% - 80%), lifetime (25 years), module degradation (80% of initial performance after 25 years).

[17] Ahlfeldt, C., 2013, The localisation potential of Photovoltaics and a strategy to support the large scale roll-out in South Africa

2.3 Euronet 50-50

2.3.1 Background

The EURONET 50/50[18] project has been working during three years (2009-2012) to engage schools in a 50/50 NETWORK in multiple European countries with the aim to save energy reduce CO_2 emissions and tackle climate change. The project works by incentivising schools and their students to reduce their energy consumption through energy efficiency measures and behavioural change by providing them with 50% of the cost savings by financial transfer and the remaining 50% in cost savings.

The project, which ran from 2009-2012, was supported by Intelligent Energy Europe and had nine European partners involved, with Barcelona Provincial Council as the coordinator of the action. Regarded as highly successful by the European Commission, it has been succeeded by Euronet 50/50 Max, running from 2013-2016, which is working with 500 schools and nearly 50 other public buildings from 13 EU countries. The new programme continues to be funded by Intelligent Energy Europe and supported by the European Commission.

2.3.1.1 *Description of the model*

Where does it come from?

The 50/50 concept originated in Hamburg, Germany, in 1994 where it was designed to incentivise teachers and pupils to take greater responsibility for their school and the environment. It was intended that the trial project would last for three years in different types of schools, with 24 schools taking part initially. Over the course of these three years the number of schools participating expanded rapidly, reaching 60 schools by 1996. The project was extended to schools in other cities in Germany in 1997 and since then has been applied to other municipal buildings.[19]

The project was conceived by the Department of the Environment of the city of Hamburg, which was interested in approaches to reduce energy use in schools and save money in the process while increasing children's awareness of environmental issues.

In 2009 the Euronet 50/50 project was established with the support of the Covenant of Mayors and funded by Intelligent Energy Europe to conduct the project on a larger scale across several countries in Europe until 2012 with 58 schools. The project exceeded its targets and was deemed to be highly successful, winning the European Sustainable Energy Award in 2013.

Due to this success, the project was renewed and extended for a further three years (2013-2016) by Intelligent Energy Europe and the European Commission.

[18] http://www.euronet50-50max.eu/
[19] http://www.display-campaign.org/example477

How it works

With the 50/50 project model, schools and local authorities can work together to implement a methodology for increasing awareness of energy use and how to reduce it, mainly through behavioural change. The model provides an economic incentive for energy saving by the local schools, which receive 50% of the value of energy savings by financial/cash transfer, and the managers of the schools (which are usually the local authorities) in a reduction in energy bills. The school benefits from increased financial resources which it can then invest in other measures, such as renewable energy projects e.g. solar panels. Schools are free to choose where to invest this funding.

The process may be slightly more complicated where the school is also responsible for managing its energy bills, but could still work if 50% of the savings in energy bills are reinvested in the school.

The 50/50 project methodology is comprised of 9 steps, illustrated in the diagram below:

Figure 2.3.1: 50/50 Project Methodology.

Source: www.euronet50-50max.eu

Some schools set up teams of pupils to monitor energy and water consumption, which helps the pupils think about energy waste and how to save energy. Teachers sometimes integrated the project into lessons for the pupils.

Actions taken by participating schools include:

- Monitoring energy use of individual devices (lights, computers, etc.), mapping the temperatures of different rooms, charting consumption of energy and water over the three years, regularly updating relevant persons of results.
- More efficient usage of lighting, changes in behaviour to ensure lights are turned off when not in use, better use of natural light.
- Energy efficient behaviours and use of devices.
- Conservation of heat in classrooms through insulation and more careful regulation of temperatures.

- Competitions, study visits, awareness raising and dissemination practices to promote energy efficient behaviours,
- Non-energy measures such as more careful and efficient usage of water, reduction in waste and increase in recycling, encouragement of greater use of walking and cycling to school by pupils and staff rather than use of cars.
- Cooperation with other schools to exchange ideas and knowledge.

Aims

Education centres have a huge potential for saving energy and encouraging more sustainable habits. Nevertheless, these buildings usually lack a specific energy policy. Best practices such as the ones developed in German schools demonstrate the possibilities to improve energy efficiency at schools engaging pupils, the education community and facility managers in a common project towards a more sustainable use of energy.

The Euronet 50/50 and subsequent Euronet 50/50 Max programmes aimed to apply the 50/50 methodology to hundreds of educational centres across Europe from 2009 to 2016. The programmes are aiming to create a European network of schools in favour of saving energy and reducing their contribution to climate change. The project will seek to reduce greenhouse gas emissions and improve energy efficiency in educational centres, create further education materials and increase pupil's knowledge and awareness of these issues and help change energy consumption habits. It also seeks to promote co-responsibility amongst councils, pupils and teachers.

Examples

In Hamburg, the **Gymnasium Hummelsbüttel Gym** along with several other schools in Hamburg used the money generated through the programme to fund the installation of a 1.8KW photovoltaic-plant on their facilities.

Montmeló Municipality (Spain), which has a school in the 50/50 Network, has carried out a pilot test of the 50/50 methodology in a sports facility and cultural facility, obtaining an exemplary involvement of its workers. The test was complemented with an electrical consumption monitoring. Thanks to both factors, during the first months of the project a 57% electricity savings in the cultural facility and 41% in the sports facility were obtained.

2.3.1.2 *Key impacts*

Environmental impacts (GHG emissions avoided, renewable energy generated)

The primary positive impact of the 50/50 programmes are a reduction in energy consumption by facilities and equipment within schools, which in turns help reduce scope 2 (indirect) GHG emissions caused by the production of electricity. There is also potential for decreasing scope 1 (direct) GHG emissions through reduced vehicle travel to and from schools and reduced scope 3 (other forms of indirect) emissions through more efficient use of materials within schools and water consumption. Scope 3 emissions cover those created outside of the schools, such as those created by the manufacturing of school equipment or the transporting of goods to schools by vehicles, which the school has some influence over.

One of the benefits of the programme is that it provides funding for schools to invest in measures such as solar panels and other renewable energy measures. The effectiveness of these measures will depend upon a wide range of context specific issues (location of school, type of panel, etc.) but should provide an increase in renewable energy production.

While not a primary focus, encouraging pupils to reduce their water use in schools has also been incorporated into the programme. A reduction in water consumption will have an associated reduction in energy use as well.

The various 50/50 programmes have produced a number of positive results since their inception. The initial 50/50 programme in Germany with 470 schools provided the following results[20] after 12 years:

- EUR21.8 million saved in energy costs (approximately 10% total energy costs)
- 100,000t of CO_2 reduction
- 355GWh of heating energy saved
- 49GWh of electricity saved
- 391,000m^3 of water saved.

The Euronet 50/50 project achieved the following results from 2009-2012[21]:

- 58 energy teams were established with schools and cities councils working together to implement 50/50 actions
- 40 schools (70%) achieved energy savings
- A reduction of 339tn of GHG emitted to the atmosphere
- 1.100MWh of energy reduction in one year (2010-2011)
- EUR85,000+ of energy savings at participating schools.

The original target was to reduce CO2 emissions within schools by 2.5% per year. This target was achieved and exceeded in the period 2010-2011, with an average of a 10% reduction by participating schools.

The Euronet 50/50 Max programme, which also involves both schools and other public buildings, is ongoing (2013-2016) and comprehensive results are not yet available. However participating schools and buildings have reported an average of 8% in energy savings so far[22].

Other impacts

Potentially one of the most significant impacts of the programme will be affecting positive environmental behavioural change within children, young adults and their parents. Energy efficiency behaviours are likely to be continued outside of the school, such as at home, and into later life. The scale of this impact is not being measured, however.

2.3.2 Current development stage

The original 50/50 programme in Germany and Euronet 50/50 programme have now been completed.

The Euronet 50/50 MAX programme was launched in April 2013 and is expected to finish in April 2016. Currently there are 500 schools and 50 other public buildings from 13 different countries participating in the programme.

Over the course of the programmes, the 50/50 methodology has continued to be refined and a range of tools and calculators have been developed to aid participants in the process.

2.3.3 Elaboration of the model

2.3.3.1 *Organisational aspects*

Actors involved, their role and interests

There are several main actors involved in the setting up and management of each of the individual projects of the different 50/50 programmes, which have remained consistent throughout:

[20] Source: http://www.display-campaign.org/example477
[21] http://www.euronet50-50.eu/index.php/eng/contents/details/results
[22] http://www.euronet50-50max.eu/en/about-euronet-50-50-max/project-results-and-success-stories

1. The **building managers** (often the local council but sometimes private organisations including the schools themselves) – Their main interest is in the reduction of their energy costs and meeting of environmental targets.
    - Their role is to provide all the schools' energy details (consumption and cost) and report all issues regarding school management which may be significant to the proper functioning of the school.
2. The **educational community** (The school headteacher, administrative staff, individual teachers and staff at the schools) – this community is incentivised to participate through the receiving of financial transfers from cost savings resulting from their behaviours.
    - Their role will be to oversee the implementation of the project at the school, provide all the information that may be necessary for the proper function of the project, ensure the involvement of teachers responsible for the project and send results and actions to various groups (students, families, staff, equipment users outside of school hours, etc.). The teachers will teach and direct the student's activities, transfer necessary knowledge, draw conclusions, spread information.
3. **Pupils and their families** – The activities of this project are integrated into their school activities.
    - The programme is seeking to influence the behaviour of this group by increasing awareness of climate change and positive energy efficiency activities. This group work with the educational community to develop new ideas and implement projects to reduce energy consumption within the schools.

In the case of non-school public buildings, the role of the educational community is replaced by senior directors / managers and the role of pupils is replaced by the general staff working in the building.

Other individuals involved within the process for each individual school include:

- A **government representative** from the department/entity managing the programme within the country.
- An **external auditor** to coordinate and verify the energy diagnosis tasks and provide technical support.

The existing network of participating schools and non-public buildings is managed by the Euronet 50/50 network.

Set-up of the model

In 2009 the Euronet 50/50 project was established with the support of the Covenant of Mayors and funded by Intelligent Energy Europe to conduct the project on a larger scale across several countries in Europe until 2012 with 58 schools. Due to this success, the project was renewed and extended for a further three years (2013-2016).

2.3.3.2 *Economic aspects*

The strength of this model is through its combination of an incentive system and relative overall simplicity.

The 50/50 programme is based upon a simple profit-sharing model which helps provide an incentive for all parties to be involved. It works on the assumption that those who pay the bills of schools will want to reduce these as much as possible while academic establishments themselves would like to receive more funding for projects. It also assumes that pupils are likely to be motivated by a desire to help the environment through their actions.

In this model, a base year for energy consumption performance by a school is set and agreed with participants and then the school will seek to reduce its consumption, usually by a

minimum of 2.5% per year. The value of the energy savings is then split between the school and the local councils.

The main process is to calculate how much energy has been saved in a whole year of:

- Electricity consumption
- Thermal consumption (normally natural gas)

The savings achieved from the energetic supplies will become cash values applying the current energy prices at the time, calculated by how many kWh have been saved by each supply (electricity and natural gas) and multiplying them by the current year average price of each supply of the energy consumed. The city council will provide all the electric and thermal invoices of every year.

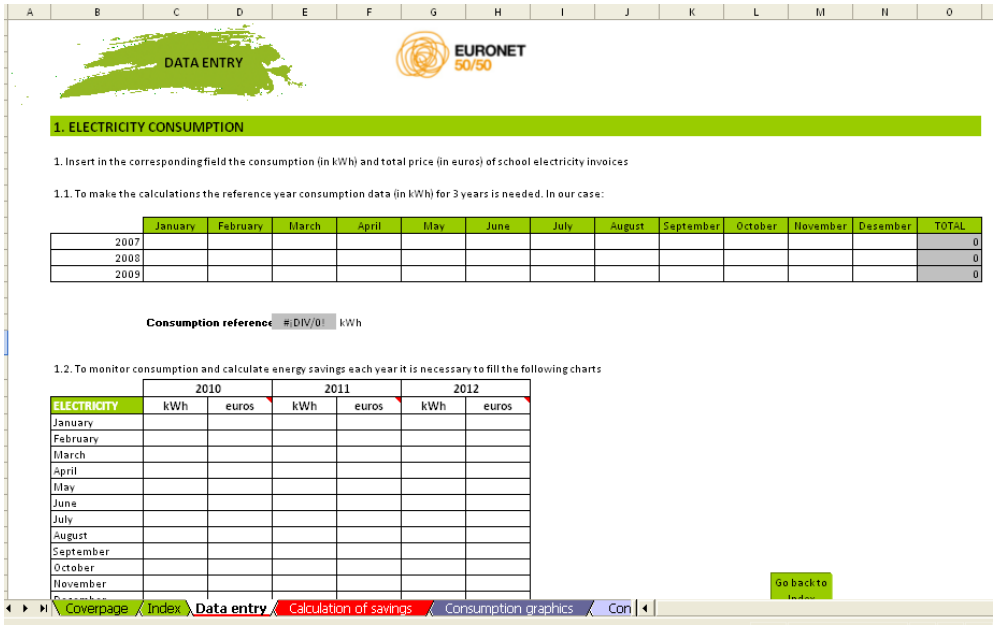
To calculate the kWh saved, participants have to subtract the current annual consumption from the consumption calculated in a reference year. After that, the saved kWh is multiplied by the average price of the energetic supply of the current year.

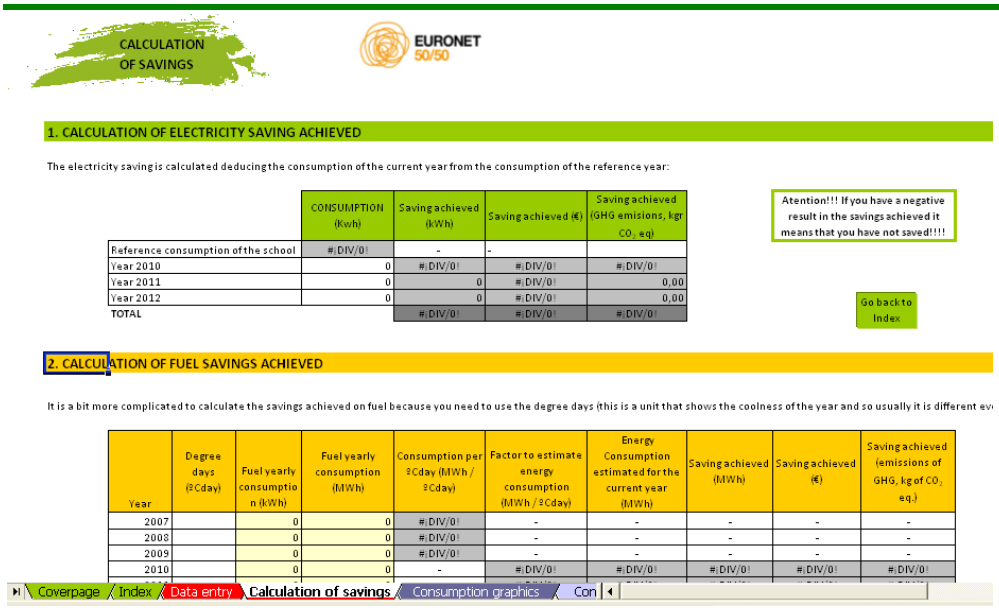
Electricity - The saving achieved will be the difference between the consumption of the reference year and the consumption of the current year. The kWh will then be multiplied by the annual average price of electricity.

Gas - To calculate the energetic saving in heating the fuel consumption must be weighted by the degree days (DD) in heating. A degree day is a unit that indicates the level of coldness of a year. The more degree days it has a year the colder it is. This way, the outside temperature effect, which cannot be controlled by the school and affects directly to the fuel consumption, is extracted from the saving calculation.

The project prepared an excel tool to facilitate and homogenised the calculation of energy savings. During the development of the Euronet 50/50 programmes the calculations were done by each partner.

Figure 2.3.2: Excel based energy calculator tool





Source: http://www.euronet50-50.eu/index.php/eng/contents/details/e-packs-50-50-educational-package

The advantage of this system is that it does not require any particularly complex reporting mechanisms or systems to be set up, nor does it require any legislative/regulatory changes by national/local government to operate, such as the introduction of energy efficiency incentive systems for example.

The use of economic transfer systems to reward participants provides immediate and tangible benefits for participation.

2.3.3.3 *Legal and regulatory aspects*

The 50/50 concept does not have any particular legal requirements for it to be run by local municipalities and schools/public buildings. As such it is possible for this model to be used in a range of different countries, though its implementation may be influenced by the local context of how school's energy consumption is managed and financed.

One of the aims of the concept is for some of the money saved in energy costs to be invested in renewable energy projects, which may not be feasible without certain legal and regulatory conditions. This is, however, an option available to participating schools and is not a core aspect of the project model itself.

2.3.3.4 *Technical aspects*

The main technical requirements for the projects within the 50/50 programme are the following:

- An initial assessment of the energy characteristics of the school buildings and equipment and agreement of an energy/emissions/cost 'baseline' against which future performance will be compared.
- A detailed 'energy tour' of the buildings by participants to create a comprehensive energy assessment and identify opportunities for energy reduction.
- Long term temperature measurements of buildings (every 2 weeks) and an energy use assessment.
- Development and implementation of energy saving measures and behaviours.
- Annual audits, evaluation of performance and reporting including comparisons against baselines by schools and other public buildings.

Local authorities/building owners will be required to provide monthly data about the consumption of fuel and electricity (both historical and current data).

2.3.3.5 *Social or cultural aspects*

Awareness and community involvement are very important for the success of this concept. This is further detailed under the section 'Key enablers' below.

Apart from this, there do not appear to be any significant social and cultural requirements for the 50/50 model beyond a desire for cost-savings and increasing budgets for schools through efficiency savings on the part of local councils and staff and an interest in the environment by students. The project has been successfully trialled in a number of different countries and locations across Europe.

2.3.3.6 *Risks*

Due to the relatively simple nature of the programme, risks and their associated costs of individual projects within the programme failing are relatively low. Beyond the time spent of participants in setting up the system, there are no up-front costs for schools and other organisations to participate in this programme.

The main risks to the effectiveness of the project are likely to be the following:

- A lack of engagement of project participants in the process, leading to ineffective energy efficiency measures.
- Improper understanding of energy efficiency measures by participants, leading to sub-optimal results.
- Key individuals and staff leaving the school during the process, affecting the process.
- Inaccurate reporting and monitoring of energy consumption may result in participants being over or under rewarded.
- An unwillingness of the owners of the schools and public buildings to supply financial incentives/rewards for energy savings, or slow progress in achieving significant reductions. These issues may discourage further efforts by participants.

2.3.3.7 *Key enablers*

The main enablers to increase participation within this project are:

- Awareness of the concept by schools, other public buildings and municipalities.
- Interest in the concept from potential participants and a willingness of key actors to work together.
- Availability of support for schools to get involved, particularly auditing services and knowledge networks.

2.3.4 Current barriers and potential solutions for up-scaling

2.3.4.1 *Barriers*

The scheme is relatively simple in its design and does not require any pre-conditions for its set up and effective running beyond the recording of energy consumption data by the schools and municipal authorities, which is likely to take place in the vast majority of municipalities across Europe.

The most significant barrier will be the provision of training and support for schools wishing to participate in the scheme and its administration. This will be necessary as the staffs of many schools are unlikely to have a high level of experience in the field of energy efficiency measures or participation in these types of projects. As the 50/50 model focusses on achieving changes in behaviour of staff and pupils, which may take a while to embed, a support service will be required to encourage and sustain interest in the activities.

From the work of the Euronet 50/50 programmes it appears that the quantity of support required by individual schools is relatively small and most information can be provided through downloadable documents, provided by the Euronet organisation. For the programme to be rolled out on a larger, national/international scale, a dedicated support function will need to be established.

The 50/50 model may also be of less interest in countries where energy costs are low (therefore reducing the incentives for participation) or where there is less interest in environmental issues or the need to conserve energy. Cultural attitudes regarding the responsibility of the different actors may also prevent successful implementation. For example, pupils and their families may perceive these issues to be the responsibility of the school or municipality rather than themselves. Similarly, wealthier schools (particularly private schools) may not perceive the potential cost-savings to justify the time and effort spent on the programme activities.

2.3.4.2 *Potential solutions*

As the programme has proven to be quite successful in reducing the energy costs and associated GHG emissions of schools and public buildings without requiring any significant regulatory changes or incentive systems to be set up, there is a significant incentive for national and local government support.

National governments could therefore be encouraged to officially support this programme by providing the necessary funding for the training and support services required, possibly through existing energy or environmental governmental bodies. Many of these bodies provide similar services to the public and private sector already in countries across Europe.

A dedicated support service could be created that would provide local authorities with training support to help set up projects with their schools and public buildings. This could also potentially be provided by the 50/50 network if funded to do so, though the network may struggle to achieve the same level of influence or reach.

The cost of this would be offset by overall reductions in local government expenditure on energy. It would also potentially aid governments in achieving their emissions targets and commitments.

2.3.5 Future potential

The 50/50 model could potentially be a powerful tool to help countries across the EU to reduce their energy and GHG emissions while also embedding positive environmental behaviours in their younger population. As energy costs increase in many countries, the incentives for participation may also increase.

2.3.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

As the results of the different 50/50 programmes have been positive so far and do not appear to have been particularly difficult or required significant amounts of support to achieve so far, the potential for up scaling is significant. The results of the pilot projects, which have now been conducted in half of the European member states, can be used to highlight the effectiveness of the method and the relatively short term benefits that can be achieved.

The performance of each school varies in terms of total energy savings and GHG emissions savings which can be attributed to contextual differences such as school size, modernity and design. 50/50 programmes also varied in success by country.

The original 50/50 programme (launched in Hamburg in 1994) was ultimately extended to 470 schools with a total saving of EUR21.8 million (=10% of energy costs), 100,000 tons of CO2, 355 GWh of heating energy and 49 GWh of electricity. Initial costs incurred were perceived to be high though less than the initial savings. Project costs have now dropped to 5% of cost savings.

Spanish schools, for example, saved on average EUR1,800 and 8.9t of CO_2 emissions in 2010 and EUR2,600 and 6.5t of CO_2 in 2011. Italian schools in the project saved EUR550 per 2.2t of CO_2 in 2010 and EUR190 per 47kg of CO_2 in 2011.[23]

The EU-27 has roughly 147,000 schools[24]. If we assume a participation of 5% of these schools in a 50/50 programme, and an average reduction of 4.4t of CO_2 per year (based on the results presented above), the potential would be roughly of 32,000t of CO_2 per year.

The impact of the programme upon the wider economy, such as the creation of jobs or growth in particular industries has not been examined. There is evidence that some schools have invested their savings in purchasing PV and other equipment, though the scale of this has not been measured. It is possible that if the programme was conducted on a large scale, there may be an increase in demand for energy efficiency support services from schools and public buildings, as well as for local renewable energy technologies such as solar panels and small wind turbines.

2.3.5.2 *Replicability*

The 50/50 model appears to be highly replicable across different countries where the model of ownership and management of schools is relatively similar. The evidence of the 50/50 programmes so far suggests that it can be effectively implemented in multiple European countries.

[23] www.euronet50-50.eu/app/webroot/files/contentsfilestranslation/main-data-results-of-50_50.pdf (Accessed 09/06/2014)
[24] This is based on the total number of students/pupils (93 001 000 in 2011 for EU27, EUROSTAT) and the European mean of 633 students per school (EUROSTAT Report 'Key data on education in Europe 2012').

2.4 Local Energy Cooperatives (LECs)

2.4.1 Background

2.4.1.1 *Description of the model*

Where does it come from

Local energy cooperatives have a long history. The cooperative local energy model was developed in Denmark. Denmark's historic leadership in decentralised renewable energy has come from cooperatively-owned and managed wind turbines powering local homes and businesses. In Asia, countries such as Nepal and Philippines have a long tradition of micro-hydroelectric cooperatives, which enable communities to enjoy lighting for classrooms and clean water for homes and agriculture. In Rio Grande do Sul, Brazil, cooperative farmers harvesting sugar cane alongside their crops to power local vehicles are just one example of the different resco-op[25] models providing energy access to millions of people across North and South America.

Not all energy cooperatives provide renewable power supplies, as the US experience shows. Energy cooperatives rapidly electrified rural communities across America in the mid-20th century; more than 900 are still in existence. They were developed to fill a need not addressed by other kinds of businesses, such as single owner, partnership, and investor-owned. Electricity was available only to people who lived in or near cities or larger towns. Private companies could see little profit in rural areas. It wasn't long before rural neighbours joined together to create non-profit cooperatives in their area to invest in electricity infrastructure.

How it works

Local energy cooperatives are "a group of citizens that cooperate in the field of renewable energy, developing new production, selling renewable energy or providing services to new initiatives"[26].

To this end they establish a legal entity, often in the form of a cooperative. These LECs come in all shapes and sizes, varying in the way they organise and finance themselves and in their type of renewable energy activities.

Aims

The aim of a local energy cooperation is typically to contribute to the energy transition and often to become energy independent on a local level. To this end they undertake one or more of the following activities:

- (Re)selling renewable energy
- Producing renewable energy
- Mobilising and organising local stakeholders

[25] renewable energy source cooperatives
[26] http://rescoop.eu/what-rescoop

- Providing knowledge and services in the field of renewable energy and/or energy savings

The production of renewable energy is usually the main ambition for a renewable energy cooperative, but due to financial and regulatory barriers not all cooperatives realise this ambition.

Examples & Links

For a more elaborate description and background on local energy cooperatives, the reader is referred to http://rescoop.eu/. REScoop 20-20-20 is an initiative launched by the Federation of groups and cooperatives of citizens for renewable energy in Europe with the support of the Intelligent Energy Europe Program (European Commission). Twelve organisations in seven countries have joined forces to increase the number of successful citizen-led renewable energy projects across Europe.

There are several databases in Europe where examples of renewable energy cooperatives can be found:

- **Germany**: Energy transition now
  Energy transition now is a training centre that has training courses for project developer for energy cooperatives
- **Netherlands**: HIERopgewekt
  HIERopgewekt is a knowledge platform for local renewable energy initiatives in the Netherlands
- **Scotland**: Community Energy Scotland
  Community Energy Scotland is a registered charity that provides practical help for communities on green energy development and energy conservation.
- **United Kingdom**: SCENE network
  SCENE is a social enterprise focused on growing the community energy sector. It carries out detailed research on the technological, social and financial aspects of community energy, attempting to identify and breakdown the barriers to growth.

Two specific examples

Energy cooperative Odenwald - By means of a District Council Resolution, the Odenwald District has paved the way towards becoming a 100% Renewable Energy Region and has prepared implementation measures using a climate-change protection plan funded by the BMU (German Federal Ministry of the Environment) in order to make it possible to meet its own long-term needs in terms of electricity and heating.

In 2009, to expand renewable energy sources the Energy Cooperative Odenwald EG (EGO) was founded as a platform for the strategic and high-volume implementation of regional energy change. More than 2,000 actors (as of 2013) from among the region's citizens, communes, companies and institutions came together to initiate energy projects. Thus, in just four years, more than 30 million euros were able to be invested in regional projects. Local net value added profits from this, both through earnings and through contracts to local businesses.

Gloucester Community Energy Co-operative (GCEC) - The Gloucester Community Energy Co-operative (GCEC) started in 2010 as FiVE Valleys energy Co-op, formed by a group of individuals who wished to install community based green energy systems in the Five Valleys area around Stroud.

The aims of the GCEC are to enable local communities and individuals to take part in exciting renewable energy schemes across the county, and to encourage energy saving

initiatives. By installing solar panels on community buildings, and developing suitable sites for wind and hydro schemes, GCEC aims to give everyone in Gloucestershire a chance to benefit from low carbon, locally generated electricity.

The Renewable Energy Co-operative, also a South West based co-operative, installed the 44.6 kWp solar photovoltaic system in December 2011, in time to meet the Feed-in Tariff deadline. In order to get the installation completed and commissioned before the tariff change date, GCEC raised £105,000 in 3 weeks in short term loans from well-wishers and supporters. They also negotiated a risk-share contract with the installer to mitigate against failing to meet the deadline.

In the spring of 2012 GCEC published its share prospectus, and the money raised through the share issue was used to pay off the loans. The minimum investment was £240, and the maximum investment was £20,000. Many of those lending money converted some or their entire loan to investment. In less than two months the full sum was raised from local people who automatically became members of the Co-operative when they invested, with the aim of creating a more sustainable, ethical and local system of energy production.

There are 49 members who each subscribed to an average of just over £2000 of share each. Almost everyone lives or works in Gloucestershire.

The income from the Feed-in Tariff is used to pay interest to investors (at 5%), pay an income to Gloucestershire Resource Centre, the registered charity who own City Works, to help them become more sustainable, build a capital repayment fund to repay the original investments, and to administer these activities.

2.4.1.2 *Key impacts*

Energy generated

The impact in terms of energy generated differs strongly from country to country. Capacity in the UK has grown from four megawatts (MW) in 2003 to nearly 60 MW today, but this still represents less than 1% of total renewable capacity. In The Netherlands, the estimated share is a little over 1%. Both countries trail far behind Germany, where an estimated 15% of renewable electricity generation is owned by local communities. In Denmark, about 86% of wind-energy generation is locally owned[27].

Environmental impacts

Renewable energy is carbon free. By replacing conventional fossil generation capacity, it can help lower GHG emissions. Some argue that windmills also have some adverse environmental impacts as they might hinder for instance migrating birds.

Other impacts

The benefits of LECs include a strengthened community engagement[28]. LECs typically also have a community value mission and focus on more than financial gain, such as revitalizing the community, reducing pollution, and leaving a cleaner environment for the future[29].

2.4.2 Current development stage

The cooperative model was first used to develop renewable energy projects in Denmark, and is well established by now. The model has also spread to The Netherlands, Belgium, Germany and the UK, with isolated examples elsewhere. European energy cooperatives grew from 1200 in 2012 to some 2000 in 2013.[30]

[27] The Guardian, 2013, Community energy: power to the people, Friday 13 September 2013
28 Bilek, A., Revitalizing Rural Communities through the Renewable Energy Cooperative,Series on the German Energy Transition (3 of 6), Published by the Heinrich Böll Stiftung Washington, D.C., June 2012
29 Calderone, L., 2012, Are Green Energy Co-ops in Our Future?, eMagazine Issue Oct / Nov 2012
[30] http://www.energypost.eu/crowdfunding-renewables-game-changer-energy-sector/

The amount of local energy cooperatives in The Netherlands alone is estimated at 250-300[31] and in Germany there are more than 600 energy cooperatives[32]. Despite a long tradition of cooperatives, Spain just gained its first in the energy sector – Som Energia. By June 2013, this cooperative had 8000 members and had invested more than €3 million in renewable energy production projects – an impressive result in an acutely recession-struck country in less than two years.[33]

2.4.3 Elaboration of the model

2.4.3.1 *Organisational aspects*

Actors involved, their role and interests

A wide range of (local) actors can be involved in a local energy cooperative, but most are owned and run by citizens. Local actors that can be involved include:

- **Citizens**: Citizens are often the initiators and managers of an LEC. At the same time, they usually act as member, participant and customer of the LEC. Besides a financial contribution, citizens often also provide a large part of the required knowledge.
- **Local government**: A local government, typically the municipality, can act as initiator, (launching) customer, (co-)financer, service provider, motivator and/or facilitator
- **Utilities:** Utilities often supply energy that is sold by the LEC to their own customers/members.
- **SMEs:** Local SMEs can initiate an LEC or participate in one, if the LEC allows it. SMEs can also partner up with LECs as preferred supplier of for instance solar panels, insulation materials or knowledge.
- **Financial institutions:** Financial institutions can provide not only funding but also knowledge. Some banks profile themselves as 'green' and may be more likely to cooperate with LECs.
- **Distribution System Operators (DSOs):** Energy produced by LECs has to be connected to the grid and distributed by the DSOs.

Set-up of the model

These initiatives are bottom-up, cooperative and collaborative and are often seen as an important force in the transition from centralised fossil energy generation to decentralised renewable energy.

The cooperatives are relatively new concepts. Many innovative approaches are seen among these diverse pioneering initiatives.

2.4.3.2 *Economic aspects*

There is a wide variety of business models, mostly based on the following aspects:

- **Membership fee:** Members often pay an annual fee for their membership, in exchange for energy services of the local energy cooperation, such as the supply of renewable energy and energy advice.
- **Profit margin on energy supply:** The supply of renewable energy to their members/clients is the most important part of the business model of most energy cooperatives. Three main models are used to sell energy[34]:
  - *Resale:* The majority of the energy cooperatives collectively buy energy from one of the major utilities and resell this to their members. The energy cooperative receives a discount because of the collective purchase. This discount may or may not be shared with the clients/members.

[31] http://www.hieropgewekt.nl/initiatieven
[32] The Guardian, 2013, Community energy: power to the people, Friday 13 September 2013
[33] http://www.energypost.eu/crowdfunding-renewables-game-changer-energy-sector/
34 Hieropgewekt, 2013, CONTRACTEN MET ENERGIELEVERANCIERS: WAT ZIJN DE OPTIES?, 25/04/2013, http://www.hieropgewekt.nl/kennis/energie-leveren/contracten-met-energieleveranciers-wat-zijn-de-opties

- *White label:* White Labels are unlicensed companies that have a contractual agreement with a licensed supplier to sell gas and/or electricity to consumers using the white label's brand. This provides the local energy cooperative with better marketing opportunities because they can sell the electricity under their own name. But the white label construction also comes with extra risks, such as the risk of defaulters.
  In The Netherlands, the white label construction is now forbidden. It is deemed not to be transparent enough, and the local energy cooperatives are thought to be incapable of carrying the risks. The bankruptcy of the largest supplier of white labels, Trianel, was the immediate cause.
- *Own energy supply permit:* A local energy cooperative that wants maximum control over its production and supply of energy can file for an own energy supply permit at the regulator. To obtain the permit, the energy cooperative has to comply with a list of rather strict technical, organisational and financial criteria. These criteria should ensure the clients that their energy supply is guaranteed. For most local energy cooperatives, this model appears to be too ambitious. The profit margins are small, and the risks substantial, so this model is only feasible for the largest energy cooperatives, with at least a few thousand clients.

- **Taking a margin on partner's services and products:** The energy cooperative can serve as a middleman for retailers of energy products or services, such as solar panels or insulation material. Discounts provided by the retailers can either fall on the energy cooperative or the client.
- **Government support:** Governments can support local energy cooperatives by providing finance or acting as a (launching) customer. The cooperatives can often benefit from a range of government subsidies or regulations. Government aid is restricted by EU competition law.
- **Pro bono services:** Local energy cooperatives rely heavily on volunteer work from their founders and members. Financial, legal, organisational and technical knowledge are usually provided without financial compensation. Local SMEs often also provide services pro bono or for reduced rates.
- **Participations:** Many local energy cooperatives are open to their members, companies or the government to participate in the cooperative or its projects, thus attracting finance.

2.4.3.3 *Legal and regulatory aspects*

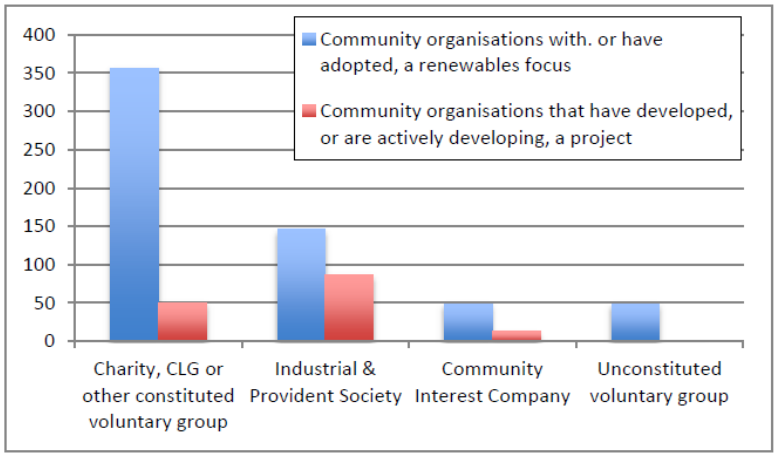
Choice of legal entity - Local energy cooperatives are not always cooperatives in the legal sense of the word, although this was the most popular legal entity when the concept emerged. Many of them also use other legal entities now. After establishing a local energy initiative, the founders have to choose under which legal entity they wish to operate. The nature of legal entities differs per country.

The choice of legal entity depends on the ambitions, status and nature of an energy initiative. A cooperative form often fits the activities during the initial phase, but once the initiative becomes more professional, it might benefit more from establishing a limited liability. The choice for legal entity has implications for the operational and financial management of an LEC. A more commercially oriented LEC may be inclined to choose a different legal entity than an initiative that prioritises the cooperative and collaborative character.

An inventory from the UK shows that the initiatives that actually develop projects move away from CLG[35] (charity) legal entity towards more professional entities.

[35] Public Company Limited by Guarantee

Figure 2.4.1 Estimated breakdown of community renewables groups by legal form



Source: Capener, 2014[36]

Enabling policy - Around 1980, the Danish parliament provided incentives for wind cooperatives to encourage individual action toward meeting the nation's energy and environmental policies. This program enabled virtually any household to help generate electricity with wind energy without necessitating the installation of a wind turbine in their own backyard. There were three key components to the Danish wind initiative[37]:

1. The right of renewable energy project developers to connect to the electrical grid
2. The legal requirement that utilities purchase the renewable electricity, and
3. A guaranteed price for the renewable electricity production.

Other countries, such as The UK and The Netherlands, have introduced similar schemes but thus far without the German and Danish success.

Net-metering - Net metering allows LECs who generate their own electricity from solar power to feed electricity they do not use back into the grid. The electricity production may be used to offset electric energy provided by the utility to the consumer. Net-metering policies can vary significantly by Member State e.g. whether net-metering is available and how much the sold electricity is worth (retail/wholesale).

Current regulations in for instance The Netherlands only allow community energy projects to sell limited amounts of electricity back to the grid or to its members, and under strict and complex regulations. This prevents many initiatives from realising their own renewable energy projects.

Centralised power system and regulations - The current energy market and regulations are tailored to large-scale centralised power generation by a limited number of market players. Integrating local renewable energy players will require a paradigm shift and a remodelling of the energy system. This is a slow and difficult process, not in the least place due to vested interests of large corporations. Many LECs argue that community energy will keep playing a marginal role as long as the monopoly of the big energy companies continues. "The obstacles to people who are outside this energy fraternity are almost insurmountable," according to one of them.[38]

2.4.3.4 *Technical aspects*

It is the aim of most local energy cooperatives to generate their own renewable energy through windmills, PV panels or a biomass plant. The preferred technique depends on factors like the size of the local energy cooperative, local setting and geography and arising opportunities. Flat and coastal areas may be fit for wind energy development, whereas

[36] Capener et al., 2014, Community Renewable Electricity Generation: Potential Sector Growth to 2020, Methodology, Detailed Assumptions and Summary of Results, Report to the DECC, January 2014
37 http://www.chelseagreen.com/content/a-case-study-in-community-wind-denmark/
38 The Guardian, 2013, Community energy: power to the people, Friday 13 September 2013

agricultural areas supply organic waste streams that can be used for energy generation. There is also an example of a waste heat network that was taken over by a local energy cooperative.

2.4.3.5 *Social or cultural aspects*

There are several drivers for initiators of a local energy cooperative. These include:

- Climate change concerns
- Independence of the major utilities
- Impatience with the energy transition
- Economic considerations (profit)
- Social cohesion, community value

Which motivation prevails can be partially culturally driven but is also to a large extent determined by local conditions. The community feeling is a key value for many participants in LECs in The Netherlands. In Denmark and Germany however, there is much more money to be made in this business. Projects there can grow larger and can be more commercially driven.

2.4.3.6 *Risks*

Founding and running a local energy cooperative comes with certain risks. These risks can involve finding the right partners, changes of government policy and operational risks. Examples are[39]:

- Political risks: many countries lack stable long-term government support
- Default risk: developers, installers or customers can go bankrupt
- Investment risks: Projects can fail or suffer delays, for instance due to technical problems
- Operational risks: technical failure, claims
- A participant can withdraw

2.4.3.7 *Key enablers*

The most relevant enablers for LECs include the volunteers and pro bono services; the community feeling and existing enabling policy.

2.4.4 Current Barriers and potential solutions for up-scaling

2.4.4.1 *Barriers*

LECs in The Netherlands encounter other barriers than LECs in Denmark or Germany. With a fixed feed-in tariff, the economic conditions for LECs are substantially improved, and many of the barriers below are less prominent. The following barriers are particularly relevant for countries without a fixed feed-in-tariff for renewable energy:

- Running an LEC is very time consuming (a large portion of time to administrative tasks), and LECs rely heavily on volunteers and subsidies. The profit margins on their products and services tend to be too small to base a viable business model on.
- To be economically viable, a LEC should have at least 4000-5000, but preferably 8000 members[40].
- Few LECs actually realise their own renewable energy generation. Reasons for this include the complicated regulations and the difficulty to find a location for wind projects.
- There is a tension between the required scale for economic feasibility and the local small-scale character that is important for the community feeling, which is a key value for many participants in these LECs. The most successful LECs from an economic

39 Agentschap NL, 2011, Wetten en regels lokale duurzame energiebedrijven – AgentschapNL Energie en Klimaat, Oktober 2011

[40] Personal communication with Rolf Steenwinkel, founder of local energy cooperative 'Amsterdam Energie'

perspective start to look more and more like the traditional utilities that they wanted to get rid of in the first place.
- Inconsistent government policies hinder the development of a sustainable business model that allows for replication.
- LECs are locally oriented and many initiatives are keen on developing their model in their own unique way (partially due to the policy inconsistency). This hinders the development of a standardised, replicable business model.
- The regulator ban on white label electricity sale is a barrier for cooperatives that relied on this model.
- A barrier on the long term might be the engagement of volunteers/members. The concept is currently new and exciting, at least in The Netherlands, but on the longer term people may lose interest and 'drive'. Without volunteers, the concept is in its current form not viable.
- Currently, the core-business of most LECs is resale of energy produced by one of the large utilities. They risk being perceived as merely a front-office of the traditional utilities.
- The current energy market and regulations are tailored to large-scale centralised power generation by a limited number of market players. Integrating local renewable energy players will require a paradigm shift and a remodelling of the energy system. This is a slow and difficult process, not in the least place due to vested interests of large corporations.
- The concept is still new and meets a lot of scepticism
- Financial support by the government is restricted by EU competition law.

2.4.4.2 *Solutions to the barriers*

- LECs start to join forces for certain time-consuming activities such as administration. By doing so, the LECs can scale up without losing their own identity.
- Government support with complex tasks, such as legal and administrative issues.
- Improvements in the regulatory framework, to better accommodate LECs
- Government support in finding the right partners and stakeholders to realise renewable energy projects.

2.4.5 Future Potential

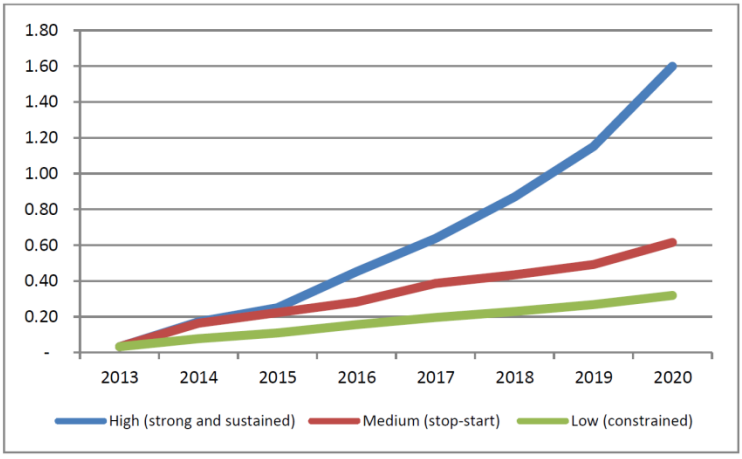
2.4.5.1 *Preliminary educated guess of up-scaling potential up to 2050*

Local energy cooperatives could play a major role in the EU climate strategy, bridging the gap between high-level international climate talks and smaller actions taken at an individual level. They can also provide huge social benefits, bringing people together and providing an opportunity for local ownership and investment. But the sector remains a long way from fulfilling its potential.

By definition, these initiatives have a local character and, therefore, their installed renewable capacity is typically moderate. The largest wind cooperatives manage around 40 MW of installed capacity[41]. Given their large numbers, when more of the existing cooperatives could scale-up to these sizes, their combined impact could be substantial. Capener (2014) modelled the up-scaling potential of LECs in The UK to 2020 for three scenarios (see figure below).

[41] VNG, 2013, Lokaal energiek: decentrale duurzame elektriciteit - Business case en maatschappelijke kosten-batenanalyse, Vereniging van Nederlandse Gemeenten, 16 januari 2013

Figure 2.4.2 Average Annual Installation Rate per Community Energy Organisation (MW/yr)



Source: Capener, 2014[42]

These installation rates could in 2020 lead to the following shares in installed capacity.

Figure 2.4.3 Modelled outcomes by 2020 – Capacity (MW)

By 2020	Capacity Installed (MW)	Wind (MW)	Solar (MW)	Hydro (MW)	% of solar, wind & hydro capacity	% Total Renewable capacity	% Total electricity capacity
High (strong and sustained)	2,998	1,000	1,914	83	14%	8%	2.9%
Medium (stop-start)	649	248	384	17	3.0%	1.8%	0.6%
Low (constrained)	475	190	272	12	2.2%	1.3%	0.5%

Source: Capener, 2014[43]

The high, medium and low scenarios lead to 14%, 3% and 2.2% of wind, solar and hydro capacity from community energy installations by 2020. In turn, the high scenario represents 8% of total renewable capacity and 2.9% of total electricity capacity by 2020.

Extrapolating the above trend lines to 2050 suggests that average installation rates per LEC of between 1MW and 3MW per year seem reasonable. If these installation rates are multiplied with 600 LECs in the UK and Germany, this implies annual installed capacities in these countries of between 600 and 1,800MW. LECs thus have the potential to bring several gigawatts of installed renewable capacity online on an annual basis in the EU.

A back of the envelope calculation could translate this into annual CO_2 emission savings across the EU in 2050.

The upper range of 1800 MW annual installed capacity may only be reached in the Western European countries in the high scenario. Even in a high scenario, the lower range of 600MW annual installed capacity as an EU average seems the highest achievable rate, given the low attention for local energy cooperatives in large parts of the EU.

Assuming a linear growth of installation rates, the average over 40 years is 600/2=300MW/yr. The average population of the UK and Germany is about 70 million. The installation rate per capita is then 300/70=4.3 MW/yr/person. For the EU this would mean an average installation rate of 4.3*500= 2,175 MW/yr. The total installed capacity between now and 2050 is then 40*2175 = 87000 MW installed capacity. Assuming an average capacity factor for solar PV of 12% across the EU, the annual generated electricity by those PV panels could amount to

[42] Capener et al., 2014, Community Renewable Electricity Generation: Potential Sector Growth to 2020, Methodology, Detailed Assumptions and Summary of Results, Report to the DECC, January 2014
[43] Capener et al., 2014, Community Renewable Electricity Generation: Potential Sector Growth to 2020, Methodology, Detailed Assumptions and Summary of Results, Report to the DECC, January 2014

91,500 GWh/yr[44]. Multiplied with the average EU grid emission factor of 0.3768t CO_2/MWh[45], the total annual emissions saved could be around 34.5 Mt CO_2/yr.

2.4.5.2 *Replicability*

The number of LECs that has been established in only a few years is impressive. LECs are easily established, and can be used for a variety of activities. Thus far they are mainly seen in Western Europe, but initiatives are also seen in Italy and Spain. The concept could easily be exported to other countries. The potential for replication is therefore huge.

Demand for local renewable energy is certainly there: hundreds of community groups in mainly the UK, Germany, Denmark and The Netherlands have expressed an interest in generating their own energy and many have already begun. Urban or rural projects range from solar panels, wind turbines and hydropower installations to renewable heat sources, such as solar hot water, heat pumps and biomass.

[44] 87*365*24*0.12
[45] EEA - http://www.eea.europa.eu/data-and-maps/figures/trends-in-energy-ghg-emission

2.5 Nudge

2.5.1 Background

2.5.1.1 *Description of the model*

Where does it come from?

A 'nudge' is any attempt at influencing choices and behaviour without limiting the original choice set or making alternatives appreciably more costly in terms of time, trouble and so forth[46]. For instance choices can be improved in the domain of energy and sustainability, where nudges should lead to higher energy efficiency or a lower carbon footprint.

Although nudging is nothing new the concept has received renewed attention due to the release of the book "Nudge"[47]. One of its readers, David Cameron, followed up by the initiating the British 'Nudge Unit' in 2010, which to date designs via a top-down approach "nudges for the British cabinet. The concept of behavioural nudges for public policies is now slowly implemented across European Member States, which also has been noticed by the Economist[48].

A successful example of how sustainable nudges can be created and implemented by the local community is shown by Nudge B.V. Nudge is a Dutch social venture launched by Jan van Betten on the 11 November 2010. Today, Nudge is a successful professional (bottom-up) consumer-based platform which launches sustainable initiatives into the society, thereby contributing to a more sustainable country.

How it works

The company consists of a small core team (8 FTE) that, via their online platform[49], brings together both consumers as well as companies:

- Consumers register to become a 'Nudger' and be part of the community. The Nudge team approaches active members via mail, for example to fill in questionnaires, or to be part of feedback sessions or focus groups, and sometimes to participate in a project.
- Companies register to become 'Friends of Nudge', where they present and review their new and innovative concepts to the Nudgers in an area of the platform called the 'Nudge lab'.
- Ideas that are created from within the community are facilitated in an area of the platform called the 'Breeding place'. Each member of the community posts their ideas, tips and suggestions for a nudge. The nudge is shared with and can be voted and commented on by the community.
- Whenever a nudge receives a disproportional amount of attention – the Nudge core team can decide to put a project team in place that can further explore, accelerate

[46] Shortened version of definition from www.inudgeyou.com/whats-a-nudge/
[47] Thaler and Sunstein (2008) Nudge: Improving decisions about health, wealth and happiness
[48] The Economist (2012) Nudge nudge, think think, March 24th 2012; The Economist (2014) Nudge unit leaves kludge unit, February 7th, 2014
[49] See nudge.nl

and eventually supervise and deploy the concept into a multitude of real initiatives (e.g. projects, activities, and/or events).

The idea is that the collective opinion of multiple people is likely to produce better solutions to a problem than a single expert.

More detail on some of these aspects is given below.

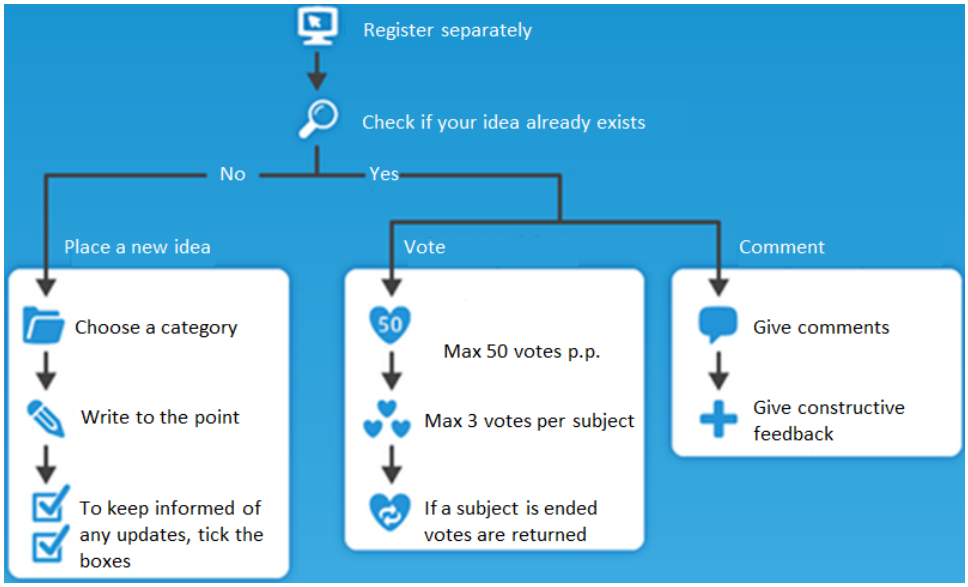
Consumers need to register to Nudge, they do so by adding a green spot to the (online) map of the Netherlands. The spot represents the consumers' location and acts as a symbol of the consumers' willingness to support Nudge in terms of (practical) knowledge which can be called upon and be put in place whenever there is a need for it. This is dependent upon the "nudges" that are created within the community. Once a consumer has added a spot they become a "Nudger" and are part of the Nudge community. Nudgers are asked whether they would like to play an active role in the community (about 4.000 currently) and want to be register to a monthly newsletter. The Nudge team approaches active members directly via mail, for example to fill in questionnaires, or to be part of feedback sessions or focus groups, and sometimes to participate in a project. The nudgers who have indicated not to be able to actively contribute to the community will have to approach the nudge team themselves whenever there are projects they are interested to contribute to. They can do so by keeping track of the Nudge website, social media (e.g. Twitter, Facebook, and Pinterest) or email subscriptions. Apart from the consumers there are companies, which are called "Friends of Nudge", who can also register at Nudge. Currently there are over 220 companies who support Nudge.

These two actors are able to interact and collaborate with each other via two different sections of the online platform:

- A "***Breeding place***"[50], which facilitates ideas that are created from within the community (see also the figure below). Each member of the community can post their ideas, tips and suggestions for a nudge. The nudge is shared with and can be voted (each Nudger can support an idea with 1, 2 or 3 votes) and commented by the nudge community. Whenever a nudge receives a disproportional amount of attention – either based on their evaluation, or potential impact – the Nudge core team can decide to put a project team in place that can further explore, accelerate and eventually supervise and deploy the concept into a multitude of real initiatives (e.g. projects, activities, and/or events). The project team can be created by making use of the man-power and knowledge that is available within the nudge community.
- A "***Nudge lab***"[51], in which companies can present and review their new and innovative concepts to the Nudgers. The idea here is that the collective opinion of multiple people is likely to produce better solutions to a problem than a single expert. Next to this, companies are very much interested to hear feedback from potential clients.

[50] http://broedplaats.nudge.nl/
[51] https://www.nudge.nl/nudge-lab

Figure 2.5.1 Schematic overview of how the Breeding Place works



Aims

The core business of Nudge is to connect, amplify and accelerate sustainability initiatives which evolve and are led by (local) communities. Knowledge and hands-on experience is shared and facilitated via the Nudge platform. The Operational Director Tieneke Breemhaar states that: "*There isn't just one solution for a more sustainable world. We must all make sure we take little steps and we must do it together. That's what Nudge provides*." Founder Jan van Betten states that he "*believes in drops into the ocean, at least if there are just many*". Nudge aims to expand within Europe within the next five years after the initial start-up phase[52]. Currently the team is exploring how their platform, which is about to be completely renewed this year, can be expanded to Belgium. As the online platform is set-up in the Dutch language Nudge also receives ideas from Belgian (Flemish) consumers.

Examples & Links

The notion that the collective opinion of multiple people is likely to produce a better solution to a problem than a lone expert has been proven in numerous Nudge sustainable initiatives (projects, activities and events). To date, a total of 467 initiatives have been set-up of which some are still operational. One example of such a initiative, the Love-to-Load project, is further elaborated and incorporated in this concept review of Nudge.

Similar concepts, of which most use a top-down approach, are:

- UK: Behavioural Insights Team (British Nudge Unit)
  This unit's responsibilities include encouraging and supporting people to make better choices for themselves and considering the application of behavioural science to policy design and delivery
- Denmark: Danish Nudge Network
  This is a network of researchers, practitioners, stakeholders and policymakers interested in using, but also cautious about, the nudge approach.
- Germany: Utopia
  Nudge is inspired by a German, consumer-based platform called Utopia.

One example of Nudge is the Dutch Love-to-Load project, outlined below.

[52] http://www.huffingtonpost.com/chris-deary/crowdsourcing-save-the-world_b_1939451.html

Project example: Love-to-load

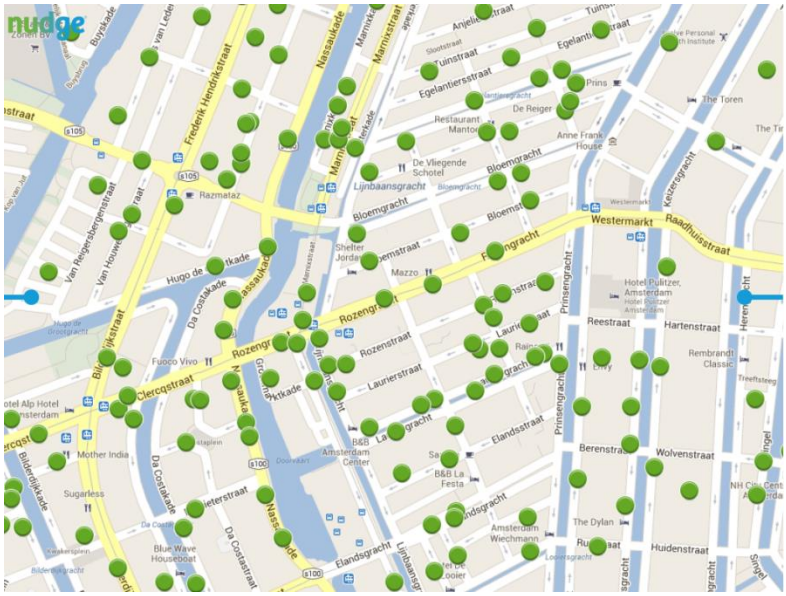
The company and friend-of-nudge "The New Motion" (TNM) came in May 2012 to Nudge with the request to find a minimum of 10 suitable charge point locations for electric vehicles (EV) in the Netherlands (and with the objective to realize many more). Nudge distributed the question (along with the company's wish list from the company of all the criteria that needed to be met) among its Nudgers. The Nudgers had an incentive to put some effort into it as the "The New Motion" together with their professional partners (Opel[53], Liander[54], and Urgenda[55]) offered two free charge points (the so-called "lolo smart") per 10 locations that satisfied all of their conditions. Those of the Nudge community who were interested in solving the problem actively searched for suitable locations based on their network. However, already within four weeks' time 221 locations were found that met all criteria. Together with TNM this list was checked and fed into the "breeding place" section.

The Nudge community had to decide which of these location suggestions would be best by giving votes and comments. In the end 32 locations were selected. Some of these spots which were already identified by the "New Motion" company. An example of such a location was at Schiphol Airport. Before the project was started "the New Motion" already tried to come into contact with Schiphol to set-up a deal, but to no avail. Due to the media attention and the bottom-up approach of the "love-to-load" project, Schiphol Airport was notified again. This time the airport authorities were very much open to negotiate the placement of a load location.

2.5.1.2 *Key impacts*

For Nudge, one of the milestones for 2014 is to set-up a new and improved consumer-based platform to replace the current one. The new platform will have an impact module to visualise and show its users the impact of each of the Nudge initiatives, an aspect which is insufficiently highlighted on the existing platform.

Figure 2.5.2 Nudgers in the area of Amsterdam, *see: https://www.nudge.nl/kaart*



The different spots which are added to the map (green = Nudger, blue= company, yellow = initiative) represent the Nudge community in each area.

[53] Opel had at that time the most EV on the road in the Netherlands
[54] largest DSO of the Netherlands
[55] Dutch sustainable network organisation

Energy generated / GHG emissions saved

The New Motion has currently a total of 14,862 charging points installed. These points account today for nearly 3.5 million charging sessions and over 55,000 kWh charged. According to their website this amounts to over 45 million electric kilometres and over 7,500t of avoided CO_2 emissions.

Using these assumptions the 32 charging points that have been realized add up to 16t of avoided CO_2 emissions. This figure will increase over time.

Other impacts

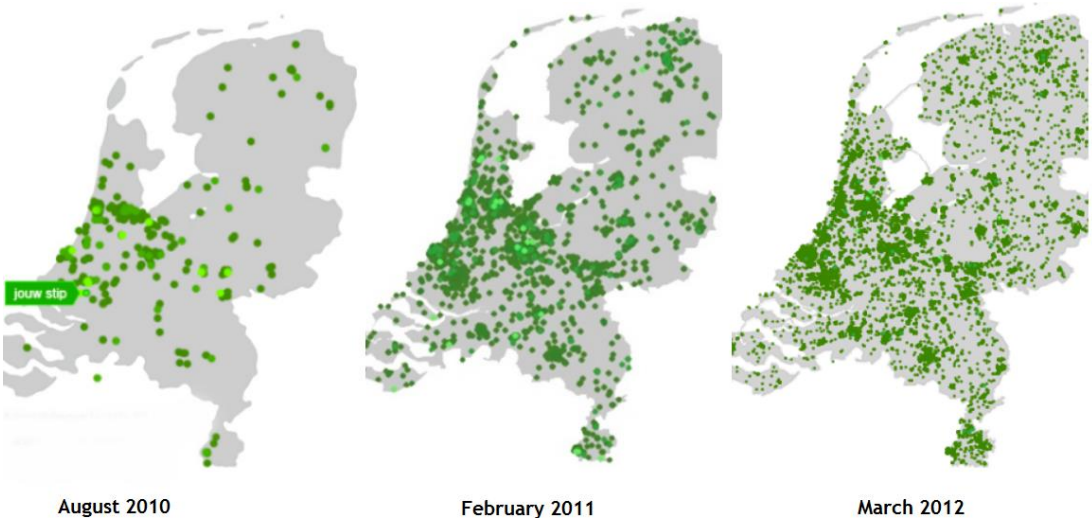
The love-to-load project involved numerous nudgers and received positive media attention, which further supported the development of EV in the Netherlands. Because the more charge points out there, the more attractive it can become to purchase a EV. After the project the New Motion developed a free “Love to Load” application for Android and iPhone which has received over 5000 downloads. The app shows all public and shared EV charge points for your electric car in The Netherlands, Belgium and Germany (in most cases including real-time availability). The app uses your location to show charge points near to you. Next to that you can use the search functionality to look up available charge points at a specific location.

Currently the New Motion’s charge network is with over 14,000 charge points one of the largest, fastest growing and most intensely used charging networks in Europe. Two out of three electric car owners in The Netherlands uses The New Motion products and services. The lolo-smart charging point is now the most widely used charge point throughout Europe, partly thanks to the effort that has been put into the Love-to-Load project.

2.5.2 Current development stage

Nudge.nl is fully commercial. Using the initial network of the founder, the community rapidly expanded to 26.000 Nudgers after 18 months. To date, over 32.000 people come together via the Nudge platform, each in their own and unique way. Furthermore, expansion to Belgium is planned for 2014.

Figure 2.5.3 Evolution of the Nudge community in the Netherlands



2.5.3 Elaboration of the model

2.5.3.1 *Organisational aspects*

Actors involved, their role and interests

Both consumers as well as companies are involved. Currently, the community consists of over 32.000 nudgers and 225 companies. The companies are of different size but overall

have a common denominator: support sustainability initiatives. The founding partners are: Liander, Greenchoice, Hill + Knowlton, Accenture and ING.

For the development of initiatives through the Nudge platform, the actors involved are:

- The Initiator: The Nudge team, in collaboration with the nudgers who came up with the idea
- The Nudge community
- Project investors: companies, which are usually a friend of nudge

2.5.3.2 *Economic aspects*

Nudge B.V. is financed by its shareholders who consist of private funders (33%), founder Jan van Betten (41%), the foundation Nudge (1%) and the Social Impact fund of the ABN AMRO bank (25%). The recent contribution by the Social Impact fund makes it possible to develop a new and improved community platform in which the impact module is going to become a key part.

Revenues are created via the friends of nudge, the projects and the yearly Nudge leadership event. To become a "*friend of nudge*" companies are obligated to pay:

1. A yearly contribution in-kind. This can either be via a service in hours (e.g. the offer of guest lectures on specific nudges) or a product (e.g. conference rooms). Via matchmaking these services or products are matched to questions or specific demand from Nudgers such that the best nudges can be further developed.
2. A yearly fee, based on the size of the organisation.

Company size	Yearly service in-kind (2/3)	Yearly fee (1/3)
Self-employed	8 hours	€120
< 20	€500,- of products, services or hours	€250
21 – 50	€1000,- of products, services or hours	€500
51 – 250	€2000,- of products, services or hours	€1.000
> 250	€4000,- of products, services or hours	€2.000

To provide interested parties the possibility to become a friend of Nudge open table meetings are organized every now and then. Friends of Nudge have the opportunity to attend business meetings of which four are organised every year. During these events organisations are able to expand their network.

2.5.3.3 *Legal and regulatory aspects*

Not relevant for this specific case study.

2.5.3.4 *Technical aspects*

Not relevant for this specific case study.

2.5.3.5 *Risks*

Nudge is dependent on its community for generating revenue, because its community is its key selling point. Continuing to understand and inspire the community can become challenging and therefore, Nudge always listens to the changing needs of its community. The new platform plays an important role in continuing to inspire and activate current nudgers and attracting new people to its community.

Maintaining current and attracting new organizations is vital for the financial sustainability of Nudge. Since Nudge is not dependent on grants and subsidies, the link with business is crucial. Nudge is in close contact with its 'Friends of Nudge'. The matchmaking process – linking organizations to sustainable initiatives – is one of the areas where Nudge is learning continuously.

2.5.3.6 *Key enablers*

Community involvement is the key enabler of the concept. Further engagement is amplified using different channels such as email, newsfeed, blog, social media Twitter, Facebook and Pinterest.

2.5.4 Current Barriers and potential solutions for up-scaling

2.5.4.1 *Barriers*

Nudge mostly works together with private and not so much with public entities. In order to expand their business to other European Member States they look for additional private investors. Since Nudge is a private entity it cannot apply for European subsidy schemes[56].

Another barrier for up-scaling is that the content that is available on the platform is only available in the Dutch language.

2.5.4.2 *Solutions to the barriers*

Nudge can check whether consumers elsewhere in de EU are interested in Nudge. A similar (online) country map has to be created which can track the number of Nudge supporters. Nudge can use this information to show to potential investors whether a market/ critical mass do exists.

Additional language sets have to be added in order to explore other European markets.

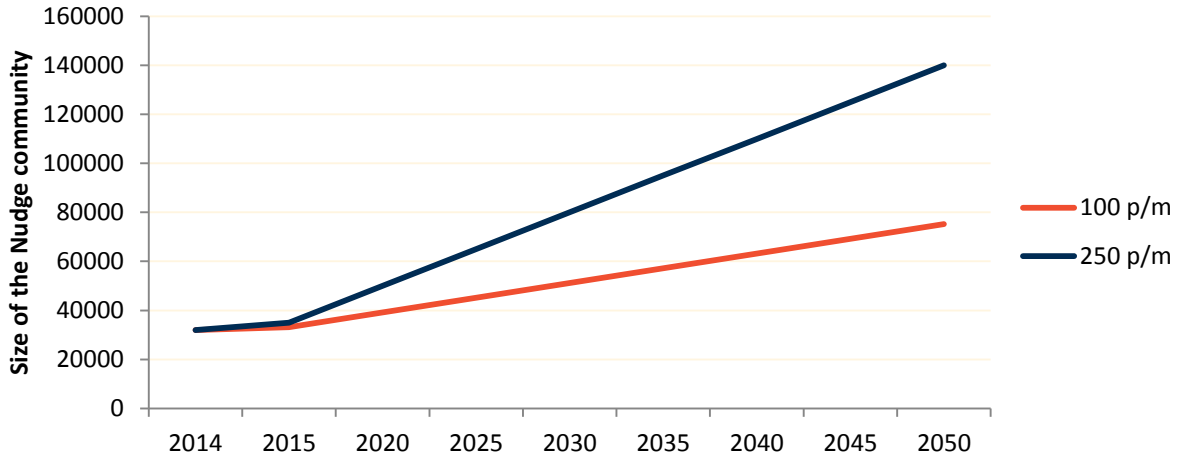
2.5.5 Future Potential

2.5.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

The question that needs to be addressed here is how large is the group of sustainability-oriented consumers? And is this group growing in the Netherlands, and outside of the Netherlands? Sustainability is a rather vague but increasingly common concept. Given this trend, what will be the role of Nudge in the future? Nudge believes that sustainability can become an old-fashioned concept, but that connecting people and organizations in a bottom-up manner is timeless[57]. Currently the natural growth of the Nudging community is about 100 per month. Through the organization of additional actions this number can be increased up to 500. A simple extrapolation using 100 and 250 new Nudgers per months shows us that the community can grow from 32,000 Nudgers now to somewhere between 75,000 and 140,000 Nudgers by 2050. When the concept of Nudge will be copied to other European member states this figure could be possibly even bigger.

[56] INTERREG could be an option, although funds would only become available after 1,5 -2 years.
[57] This information is obtained through an interview with Tieneke Braamhaar (Operational Director, Nudge) and Geert van de Linden (Impact Analyst and Functional Designer, Nudge)

Figure 2.5.4 Potential growth of the Nudge community



However, it is difficult to assess the impact in terms of GHG avoided or jobs created, as this would depend on the type of initiative.

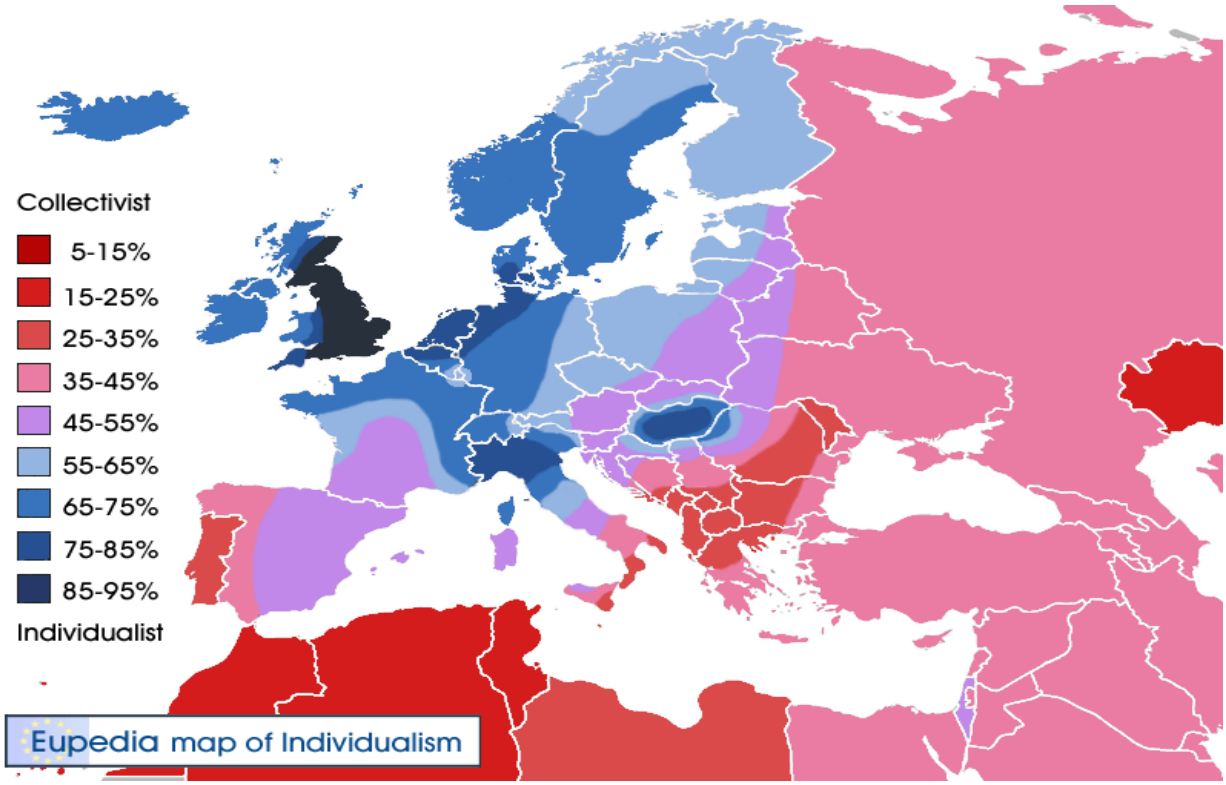
2.5.5.2 *Replicability*

Nudge can be replicated in other European Member States, although some countries provide a better (cultural) fit for the concept than others – see Figure 2.5.5. The Netherlands has proved to be an excellent concept cradle, partly due to the fact the Dutch people like to be collaborative whenever there is ample room and opportunity to excel on an individual basis. The Nudge concept starts with individual ideas, which fits with the Dutch who are strongly individualistic, but ideas are eventually spread-out, strengthened and amplified via the collaborative Nudging community. Based on the cultural aspects of one country, other countries that could be a good fit are the UK, Germany and the Nordic countries (see Figure 2.5.5).

To date the website content is only available in the Dutch language. This language allows only for expansion into the Flemish market. Additional language sets have to be available to explore other European markets.

The initiatives and related concepts can be translated into other languages. The content and tone of voice will however need to be adjusted to the country.

Figure 2.5.5 Map of individualism vs. collectivism based on Geert Hofstede's scale of individualism vs collectivism[58]



[58] http://geert-hofstede.com/countries.html

2.6 Online house renovation community

2.6.1 Background

2.6.1.1 *Description of the model*

Where does it come from?

In order to achieve the Dutch government's target of an energy-neutral built environment in 2050, many homeowners will have to adapt their homes. This is not easy to achieve: few have the desire to make their homes more energy-efficient, and the select groups who do want to still have insufficient knowledge about how they can go about it. It is from this background that a frontrunners house renovation community called "A house full of energy", is set-up[59]. The initiative started in October 2011 and is one of the 25 initiatives originating from the innovation program Energy Leap[60]. All initiatives under the program have a common denominator: to stimulate and accelerate the market of energy neutral buildings in the Netherlands. In important resource to bring along this innovation is that both supply and demand parties in the built environment collaborate intensively with each other.

The "House full of energy" initiative is part of the private housing section of Energy Leap which has the aim to generate market-ready propositions for an energy neutral built environment for house owners. More specifically, the "House full of energy" initiative aims in given the innovators and early adopters in this market an additional boost. There are other initiatives that are more active in improving market conditions (e.g. financing, value determination, demand support, development of propositions) and market deployment (e.g. renovation shops, public campaigns, or via the recruitment of intermediaries).

How it works

The frontrunners platform connects and brings together house owners who have the ambition to renovate their own home into an energy neutral residence. Via community, house owners are able to share their experiences with energy-neutral renovation or new construction projects with others. This has potentially three effects:

1. The proud occupants receive publicity for their frontrunners project. This publicity is reinforced and magnified via two mechanisms, these are "open door days" and the "House full of energy" signs house owners can place next to their doors. These two mechanisms are more briefly explained in the key enablers section.
2. House owners with the same ambition can draw on a wide knowledge of others' experiences and can ask questions of those with experience.
3. It will give the often still-isolated individuals with an energy-neutral ambition a sense of belonging to a group, and the knowledge they are not alone in their ambitions.

[59] https://www.huisvolenergie.nl/
[60] More initiatives can be found at: http://energiesprong.nl/blog/category/onze-initiatieven370/

Altogether, this should result in more and better-implemented energy-neutral renovations. This also becomes a tempting target for attractive actions among house owners. In addition, it should help house owners dealing with practical questions such as “How can I renovate or build an energy neutral residence?” “Who in my neighbourhood has experience on this and can help me with this aim?”

The website is divided into the following structure:

- **Building stock**
  In this section users can find the buildings that are registered by the participating energy pioneers. The buildings serve as examples and sources of inspiration. Currently, there are 116 house owners who have uploaded information about the status towards an energy neutral residence, 47 of them already succeeded. When you click on a building you can find additional information on that specific residence:
  - Short description and introduction by the house owner (opportunity to interact)
  - General info (e.g. owner, place, address, available for visits, type of residence, household size, pictures, etc.).
  - Which energy saving measures have been taken?
  - Impact of renovation or construction (energy label, electricity use, natural gas use, water use)
  - Comments, questions and discussions on the house from within the community
- **The energy-pioneers** (the community)
  Every community member has share personal information and his motivation to join the community. Currently there are 512 energy-pioneers contributing to the community portal.
- **Knowledge square**
  This is the place where the community members can pose questions to each other (via fora), share additional information about their renovations (via blogs) and thereby acquiring more practical knowledge on energy neutral building in the private housing sector**.** Next to this, the knowledge square contains information in the form of reports, and a broad range of organised events. As the majority of these events are organised professionally, the organizer usually asks a (low) fee in return for participating. Event examples are: “What is important when you want to purchase solar panels?”, “How to construct a green roof” and “Workshop house isolation”. Usually more than one event is organised every week.
- Energy saving measures
  In this section the user can find a list of all the measures that are taken by the community and how many times they have been applied in total. The measures are, whenever possible, grouped per room type (e.g. bathroom, garden, living room, kitchen etc.). When you click on one of the measures that have been taken in the house more information is given about the measure. The content of each of these energy saving measures are administrated by a member of the community. Typical content that can be found per measure is:
  - What does the measure do?
  - How does the measure work?
  - How much energy can I (potentially) save?
  - What are the costs and payback-period?
  - Are there synergies with other energy saving measures possible?
  - Important considerations
  - Instruction videos
  - Recommendation rate, given by energy pioneers that have applied this measure (0 to 100 score)
  - Tips, given by energy pioneers that have already applied this measure. Their comments give a fair indication whether they are satisfied with their implementation of the measure?

- Suppliers
  This section of the website contains a list of all market suppliers who implemented energy saving measures for the community members. The members of the community can give a rating based on their experience with the supplier. Currently 210 suppliers have been listed.
- **Hot shot** (temporary campaign launched in 2013)
  Every week one member of the community could use of thermal heat camera to capture the degree of isolation of their house and of their environment. Currently this measure is however not available anymore.

Aims

Energy Leap aims at accelerating innovative initiatives in the field of the construction and residential housing. Their ambition is to, step-by-step, come to an energy neutral built environment. “A house full of energy” is one of such initiatives contributing to that aim. The aim of the frontrunners’ programme “House full of energy” is to give motivated owners the tools to realise their energy-neutral ambitions. The belief behind this approach is that clients lead the market. Their demand spurs the supply side into action. But there are many barriers to overcome to actually realise renovations and new construction. A great deal of practical knowledge is needed to make the right choices, you need to find the right building parties and bring them together, and you need the financial means. At least, that is the hypothesis.

Energy Leap assumed that about 10,000 homeowners in the Netherlands have a latent desire to renovate their homes to an energy-neutral level. This comes down to 0.25% of the total market[61]. By identifying these owners Energy Leap’s hopes to find their primary target group. Providing these people with the proper information, and the right assessment frameworks, and perhaps most importantly, bringing them into contact with one another, will create a group that in addition to motivation, also has the knowledge to realise their energy-neutral ambitions. For 2015, Energy Leap wants to have 200 private homeowners (currently 47 via this project) to make the step towards energy-neutral housing. They will become examples for other homeowners, pilot projects for builders and suppliers, and ambassadors for energy-neutral housing. This should lead to a further scaling up throughout the rest of the market.

Examples & Links

Although Energy Leap is primarily aimed at achieving Dutch national objectives with national actors, the programme also has an international dimension. Energy Leap was created in the light of both national and international developments. The major international developments in this area are the European ambitions around CO_2 reduction in general and European regulations concerning new construction and renovation of buildings through the EPBD and EPBD-recast in particular. Several European countries have enthusiastically set about the development of high ambition energy concepts for the built environment. Consider for example the development of passive houses in Germany, Austria, Belgium and the Scandinavian countries, and also specific technological developments such as heat pumps, micro-CHP and PV solar panels. Besides these technological developments, there are also interesting non-technical examples, such as private commissions in Austria and Belgium and construction process innovation in the UK. The subject Energy in the Built Environment also features strongly in European framework programmes (RD&D), including through the establishment of the E2B (Energy Efficient Buildings) Initiative. A number of Dutch research institutes (TNO and ECN) and market parties play a prominent role in the latter.

Links:

- House full of energy Further information is given under “Aims” above.
- Office full of energy

[61] In the Netherlands there are four million privately owned homes

2.6.1.2 *Key impacts*

Energy generated / GHG emissions saved

Part of the registered buildings in the platform have filled in their energy and water statistics, before and after the renovation, as can be seen from an example from the table below.

Table-2.6.1: Example statistics of a building that has been renovated[62]

	Before	After
Energy label	G	A++
Electricity (kWh/ year)	3500	-8632
Natural gas (m3 / year)	3800	0
Water (m3/ year)	127	52

Of the 47 buildings that are reported as energy neutral, 19 of them have given a more detailed description in terms of their change in energy and water usage. Since part of the buildings are not renovated but newly constructed, no before and after statistics could be submitted. Based on average of these 19 buildings, one can say that the renovation of these houses led to an average decrease of: 6,621kWh, 2,142m^3 of natural gas, and 88m^3 of water per year. For the 47 buildings reported as energy neutral, a simple calculation leads to the following energy and water savings on an annual basis: 311MWh of electricity, 100,000m^3 of natural gas, and 4,000m^3 of water.

Other impacts

- Self-Image. It can be favourable to display and signal one's pro-environmental behaviour or lifestyle through buying and displaying green consumer goods or living in an energy-neutral residence. Or as one of the authors of book Freakonomics, Stephen J. Dubner, puts it: "*helping the planet is nice; but being seen helping the planet is really nice*"[63].
- Attention of the media
- Generation of jobs
- Market development
- Knowledge creation

2.6.2 Current development stage

The project is fully in operation, and the community grows stability. Started in 2011 with almost no members, the community grew to about 400 members and 100 houses in Q4 of 2013. In May 2014 there were 512 registered users, and the registered building stock expanded to 116.

2.6.3 Elaboration of the model

2.6.3.1 *Organisational aspects*

The two main actors that are involved in the community are the community members (the energy pioneers or frontrunners) and the (local) energy professionals. Only professionals that have been involved in a renovation for one of the community members are allowed to be listed on the website. Visitors of the website can click on each of the suppliers to see what kind of renovations they have performed and what their rating and review was from each of the community members.

[62] https://www.huisvolenergie.nl/woningen/renovatiewoning-energiecentrale/, Energy Neutral building of the year 2012 in the Netherlands.
[63] Dubner, S. J. (2012). "Freakonomics radio: Show and Yell." Freakonomics radio Retrieved 15-06-2012, 2012, from http://www.freakonomics.com/2012/03/15/show-and-yell-a-new-freakonomics-radio-podcast/.

2.6.3.2 *Economic aspects*

The Energy Leap innovation program is executed by Platform 31 and financed by the Dutch Ministry of the Interior and Kingdom Relations, which falls under the responsibility of Minister for Housing and the Central Government Sector[64]. Projects supported financially by Energy Leap will have to meet the following criteria:

1. They will contribute directly or indirectly to the principles specified in the energy-saving targets (45, 60 and 80%).
2. They are innovative in the manner in which that happens.
3. They have a high impact on the thinking about energy use in a sub-segment of the built environment (building type with a target group).
4. Stimulated innovations can find their own way from the experimental stage to the market.
5. Stimulated innovations are scalable to other situations elsewhere.

2.6.3.3 *Legal and regulatory aspects*

National laws and regulations concerning the energy performance of buildings currently only provide requirements for new buildings. A number of parties believe that without similar regulations for existing buildings, potential improvements in the built environment will come about too slowly to achieve the national and European targets.

Municipalities have also few possibilities to realise building concepts with higher ambitions. Regulatory frameworks and decreasing land holdings give them little room for this. These projects are however necessary for them to achieve their energy ambitions. The opportunities that exist are not always taken due to local regulations: a part of the local legislation is even counterproductive. Examples include building aesthetics bills, zoning, the setting of property tax, licensing procedures and the like.

Laws and regulations have, especially in the field of Energy Leap, therefore had a significant impact on innovation development and energy performance improvements in buildings. Legislation establishes what the minimum standard should be. This needs not only to apply to building performance in new construction, but also to renovations. It could also be about other things that hinder or stimulate projects. The fact is that the regulations determine the movement and tempo of the masses. The scaling-up potential of a good package of measures may therefore be assumed to be enormous.

2.6.3.4 *Technical aspects*

In this initiative the technical aspects are tried to be overcome through the transfer of knowledge and interaction within the community.

2.6.3.5 *Social or cultural aspects*

Are integrated in previous sections.

[64] http://www.platform31.nl/ Platform 31 until the end of 2014

2.6.3.6 *Key enablers (availability will depend on maturity of the concept)*

There are several key enablers that lead to extra visibility of the concept:

Open doors day

Two or three times per year the energy pioneers open up their "energy neutral" residence to the interested public. Tours are usually organised and questions about the residence can be answered by the owners.

Energy-neutral badge/shield

A building that is officially been recognized as energy-neutral by the Energy Leap organisation received a small metal badge or shield which can be pinned on next to the front door.

Yearly elections

The best, most fun and most appealing energy neutral residences are elected every year, based on the votes of the community and a professional jury.

Promotion packages

If you are planning to set steps to an energy neutral building you can apply for a promotional package. The package contains all kinds of promotional material (window posters, cards, stickers, pens, memo-block to let your neighbours or relatives know of your plans.

2.6.4 Current Barriers and potential solutions for up-scaling

The most interesting scaling up opportunities lie in increasing the sales market for developers and manufacturers of new products and services, alongside the creation of a new home market, using the knowledge gained abroad. Importing knowledge can also accelerate the implementation of new technologies, concepts, services and processes, and moreover also make these economically cheaper.

2.6.4.1 *Barriers*

Although there is interaction between the community members, it is likely that additional effort is needed to come to 200 energy neutral houses under the initiative before 2015. A possible barrier for this is that the community platforms are not the most obvious routes for gaining more experience in renovations. People want to see how measures work and get hold of it. A more obvious informational channel could be a renovation shop.

2.6.4.2 *Solutions to the barriers*

The platform would benefit if (interactive) links are offered to renovation shops that have experience in the energy neutral built environment. Think for example of live chat support. There are ample opportunities for Energy Leap to do so as renovation shops are since recently also part of their project portfolio[65].

2.6.5 Future Potential

2.6.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

Setting up a community of frontrunners on household renovation now can form a knowledge platform that will provide those interested in the future with a multitude of insights. In addition, owners with lower ambitions can also find out how they can go one step further. This gives both a quantitative and a qualitative scaling up. The purpose of this community is to be able to follow people as they travel the road towards an energy-neutral house. With their contacts in the community they can build on the knowledge of others. This will accelerate the innovation process, bringing about a qualitative scaling up. Accelerating the innovation

[65] http://energiesprong.nl/blog/renovatiewinkels/

process will reduce the costs and effort required for manufacturers who follow. Since the target group of this community is very small and widely dispersed, there will be no relations between those with energy-neutral ambitions. They simply do not know each other. Through this community they will get the feeling of not being alone, and will be more willing to take the steps required. Moreover, the platform allows owners to join together in order to achieve economies of scale. For the supply side, the platform gives a rough picture of what demand is like. That makes them better able to determine their portfolio.

The Energy Leap program will run until the end of 2014, by which time the acceleration in the energy transition in market developments towards an energy-neutral built environment must have gained a critical momentum. It is not precisely clear what will happen from 2015 onwards but this will most definitely be linked to the SER Energy Agreement for Sustainable Growth[66].

2.6.5.2 *Replicability*

Energy Leap is currently exploring the possibility of interacting with other European Member States. Energy leap travelled to the UK, Austria and Norway to present the Energy Leap approach and learn from the programmes that are active in these countries as well. The conclusion that was drawn from these meetings was that the Energy Leap approach was the most integral approach; other countries were not that far yet. Currently Energy Leap is examines whether there are opportunities for European funds to come with a similar program in other European countries. Their visits and experience in countries such as Germany and Belgium also taught them that some of these regions have even more knowledge on energy-efficient buildings.

[66] http://www.ser.nl/en/publications/news/20130712-important-step-energy-agreement-sustainable-growth.aspx

2.7 Crowd Funding

2.7.1 Background

2.7.1.1 *Description of the model*

Where does it come from

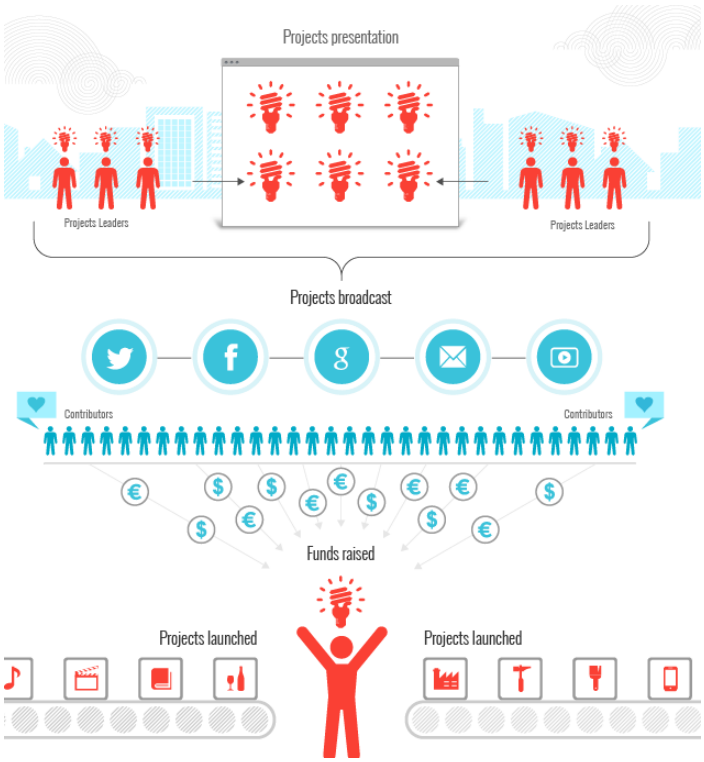
Crowd funding began with the concept of small enterprises engaging in online capital-raising through social media and raising funds from people they did not previously know (and were not likely to meet). If we accept the "web" and the "crowd" are two essential elements in defining crowd funding as an activity, the very first examples could perhaps be observed in the late '90s, when some Internet campaign funded projects and charity fundraising platforms started to appear. Michael Sullivan is credited with coining the term crowd funding back in 2006 with the launch of fundavlog, a failed attempt at creating an incubator for videoblog-related projects and events including a simple funding functionality. This scheme was "*based on reciprocity, transparency, shared interests and, above all, funding from the crowd,*" but the term crowd funding only really began to be used by the masses a few years later with the advent of the platform Kickstarter.[67]

How it works

Crowd funding is the mechanism by which a project or venture is funded by raising small amounts of money from a large number of people. This is usually done via or with the help of the Internet.

[67] http://socialmediaweek.org/blog/2011/12/a-social-history-of-crowdfunding/#.U4hmRfmSxH4

Figure 2.7.1: Overview of a crowd funding system



Source: MIPISE

For example, when a wind turbine is financed using crowd funding, the wind turbine shares can be bought, and the purchaser's share in the turbine's output is subtracted from the annual energy consumption.

There is a need to tap new sources of clean energy finance to move things forward at an accelerated rate. In many countries a combination of community energy generation and crowd funding has been a key part of the answer.[68] Accelerated through social media and online communication, crowd funding is a financial power tool for energy cooperatives.

Aims

Crowd funding is usually paired with community (renewable) energy projects. It helps fill the financing gap, in response to the failure of the existing major commercial banks to lend to community energy businesses.

Ramsay Dunning, General Manager at Co-operative Energy said: "Global investment in clean energy has dropped over the past two years, and there is little to fill the gap. Crowd funding could be the turbo-boost that renewable and community energy needs."[69]

Examples

Some examples of platforms that focus on crowd funding are presented below:

- Abundance Generation launched in 2011 as a way for small investors to put money into UK renewable energy schemes and receive a share of the profits from the energy produced. Describing itself as a 'community finance platform', it represents a variant of the crowd funding model, putting investors in touch with community groups and companies that want to build environmental projects. Abundance Generation collects the money and organises the payouts in return for a 1.9 % fee paid by the body that builds and operates the project. Individuals can invest as little as GBP5, or as much as GBP50,000, to buy debentures in a particular project.

[68] http://www.theguardian.com/sustainable-business/corwdfunding-renewables-straglehold-big-six-energy-companies
[69] http://www.respublica.org.uk/item/Community-Energy-Unlocking-Finance-and-Investment

- Solar Schools is a UK project that seeks to "help schools overcome financial barriers to renewable energy and become cleaner, greener places for pupils to learn." This has raised GBP275,000 so far for 45 schools. This project is presented as a separate case study.
- Village Power, a Palo Alto, California-based platform, allows community organizations to finance and manage solar power projects through investments from individuals in the local community. There is no minimum investment amount, but SEC rules regulate how many investors can participate in crowdfunded projects like these.
- https://www.windcentrale.nl/ The 'winddelen' scheme is for people who want to produce their own renewable energy but are unable to do so in their own area. A wind turbine is financed using crowdfunding. Wind turbine shares can be bought, and the purchaser's share in the turbine's output is subtracted from the annual energy consumption[70].
- https://joinmosaic.com/ The crowdfunding platform for solar, Mosaic, has raised more than USD8 million in investments through crowdfunding with a 100% payback rate since its initial launch in 2010. Mosaic charges a 1% fee on each investment and a small percentage fee on each origination loan. Investors can earn a 4.5% to 7% return on rooftop power plants. The loans are typically paid back over 10 years. Investors pay a minimum of USD25 to fund one of these projects, so most of the investments are small to medium scale. According to Mosaic, most of the projects cost a couple of hundred thousand dollars and have an average of a couple of hundred investors. [71]
- http://greencrowding.com/
- http://www.trillionfund.com/
- http://sunfunder.com/
- http://www.windvogel.nl/
- http://crowdenergy.org/

2.7.1.2 *Key impacts*

Energy generation and environmental impacts

The amount of energy produced and CO_2 mitigation depends on the amount and size of the projects available on the specific crowd funding platforms. For example, the crowd funding platform for solar energy, Mosaic, has implemented projects that have so far (June 2014) generated over 13,000,000kWh.

Other impacts and benefits

Crowd funding has several things going for it compared to traditional funding:

- Crowdfunding can provide **finance to small business and community organizations** otherwise excluded from formal finance.
- **Speed in mobilising funding** is a another characteristic of crowd funding– as neatly demonstrated in the recent new world record where €1.3 million was raised in just 13 hours by selling shares in a wind turbine to 1700 Dutch households in a deal brokered by Windcentrale.
- **Risk-taking**, necessary for marketing novel renewable energy products which still need to be tested in large scale, can also be addressed by crowd sourced finance as it taps into a more risk-tolerant segment of lenders or investors.

[70] See 'Power to the people. Local energy initiatives as seedbeds of innovation' M Arentsen and S Bellekom, University of Twente at www.eura2013.org/media/Full_papers_Track_2/186_Arentsen_Power_to_the_People_Local_energy_initiatives_as_seedbeds.pdf

2.7.2 Current development stage

Many refer to crowd funding as a “new phenomenon”. However, it is not as new as we may think; as a concept, it has been around for some centuries already. The novelty lies in the technologies and the mind-set that are giving it a new momentum.

Crowd funding of renewable energy projects is growing fast in Europe. Compared with the cost of transition to a low-carbon economy at €270 billion (or 1.5 % of its GDP) annually, crowd funding at present is pretty insignificant – although growing exponentially. In 2012 crowd funding in Europe saw an estimated 65 % growth compared to 2011 and reached €735 million.[72] Industry insiders Massolution forecast an 81 % increase in global crowd funding volumes in 2013. [73]

‘Worldwide, crowd funders contributed $2.7 billion in 2012, which has helped to fund more than one million projects. In the UK, £5.2m has been invested in renewable energy projects through Abundance Generation alone – an intermediary platform founded in 2011 which brings together people and businesses to raise money for their projects. Seven projects have attracted an average investment of £1500, with many investing as little as £5.’[74]

In the US, the country's largest solar power provider has predicted that crowd funding will provide rooftop solar projects with $5bn of investment within five years.[75]

2.7.3 Elaboration of the model

2.7.3.1 *Organisational aspects*

Actors involved, their role and interests

The main actors involved are:

- Initiator/project developer
- Crowd funding platform (optional) – which serve as a "network orchestrators". They create the necessary organizational systems and conditions for resource integration among other players to take place.
- Investors

Set-up of the model

Individual projects and businesses are financed with small contributions from a large number of people, allowing innovators, entrepreneurs and business owners to utilise their social networks to raise capital. This is usually done via crowd funding platforms which make use of the internet and social media.

2.7.3.2 *Economic aspects*

The Crowd funding Centre's May 2014 report[76] identified the existence of two primary types of crowd funding:

- **Reward-based crowd funding**: entrepreneurs pre-sell a product or service to launch a business concept without incurring debt or sacrificing equity/shares.
- **Equity-based crowd funding**: the backer receives unlisted shares of a company, usually in its early stages, in exchange for the money pledged. The company's success is determined by how successfully it can demonstrate its viability. Equity crowd funders would typically earn their fee from a percentage of the capital raised, meaning they get nothing if the offer doesn't meet its target.

In addition, there is:

[72] http://www.energypost.eu/crowdfunding-renewables-game-changer-energy-sector/
[73] http://www.energypost.eu/crowdfunding-renewables-game-changer-energy-sector/
[74] http://www.respublica.org.uk/item/Community-Energy-Unlocking-Finance-and-Investment
[75] http://www.theguardian.com/sustainable-business/corwdfunding-renewables-straglehold-big-six-energy-companies
[76] http://thecrowdfundingcentre.com/?page=report

- **Donation-based crowd funding:** The GoFundMe website (launched in 2010), the world's most prominent donation-based crowdfunding platform, introduced a third form of crowdfunding, whereby people can raise money for personal matters, such as healthcare costs, or social causes. In May 2014 is the top-ranked website for this type of crowdfunding, with over US$290 million raised.
- **Credit-based crowd funding:** In the U.S., credit-based crowdfunding from non-banks became more prominent as a form of crowdfunding in 2012, with the launch of the the Lending Club, which had advanced more than US$500 million in loans via its website by April 2012. Prospective borrowers of the Lending Club first submit their requirements, and are then matched with pools of investors who are willing to accept the credit terms. Platforms such as the Lending Club gained popularity, as banks increased interest rates or reduced their level of lending activity. Another credit-based platform, Prosper.com, was established in 2006 and had funded nearly US$325 million in personal loans by April 2012.

Mosaic, an example
The crowd funding platform for solar, Mosaic, has raised more than 8 million USD in investments through crowd funding with a 100 percent payback rate since its initial launch in 2010. Mosaic charges a 1 percent fee on each investment and a small percentage fee on each origination loan. Investors can earn a 4.5 to 7 percent return on rooftop power plants. The loans are typically paid back over 10 years. Investors pay a minimum of $25 to fund one of these projects, so most of the investments are small to medium scale. According to Mosaic, most of the projects cost a couple hundred thousand dollars and have an average of a couple hundred investors. [77]

Some examples of other platforms are presented below.

Platform	Supporters	Amount invested
Abundance generation	1300	5,938,701GBP
Solar Schools	NA	363,770GBP
Mosaic	NA	8,555,400USD

2.7.3.3 *Legal and regulatory aspects*

Regulation should allow smaller and more innovative crowd funding and 'peer to peer' initiatives to thrive, not hold them back. Because of ambiguous crowd funding investment laws, companies are trying to navigate the murky waters through experimentation. Various models of crowd funding, as well as several models of payback and return on investments, are being used.

The current actions at European level to encourage crowd funding are listed below.

[77] http://www.techrepublic.com/article/how-crowdfunding-solar-power-is-democratizing-the-way-we-finance-clean-energy/

Figure 2.7.2: Actions at European level to encourage crowd funding

	Regulation	Education	Research
Public Bodies	• Review Legislation • Expert Groups • Political Cause	• Foster sustainability • Crowdfunding as Funding Tool • Create Incentives	• Fund Impact Research • Support European/ National Industry Body
Industry	• Code of Conduct • Reporting Guidelines • Customer Protection & Due Diligence	• Train Customers • Promote Success • Showcaser Benefits and Risks	• Benchmarking, Transparency & Data Provision • Collaborate in R&D
Outcome	Professional and globally competitive industry with established set of rules in the best interest of EU Economy	Public awareness and understanding of citizens' ability to innovate and help economic development	Public and transparent data repository and understanding of social and economic impact

Source: Presentation 'Crowdfunding: Risk or opportunity?'[78]

2.7.3.4 *Technical aspects*

Not applicable in this case.

2.7.3.5 *Social and cultural aspects*

Role of the crowd

The inputs of the individuals in the crowd trigger the crowd funding process and influence the ultimate value of the offerings or outcomes of the process. Each individual acts as an agent of the offering, selecting and promoting the projects in which they believe. They will sometimes play a donor role oriented towards providing help on social projects or will become shareholders and contribute to the development and growth of the offering. Each individual acts as a promoter when disseminating information about projects they support in their online communities, generating further support.

Motivation for consumer participation stems from the feeling of being at least partly responsible for the success of others' initiatives, striving to be a part of a communal social initiative, and seeking a payoff from monetary contributions.

2.7.3.6 *Risks*

A report from the Canada Media Fund (2012)[79] mentions the following potential risks for crowd funding:

- **Reputation** – failure to meet campaign goals or to generate interest result in a public failure. Reaching financial goals and successfully gathering substantial public support but being unable to deliver on a project for some reason can severely negatively impact ones reputation.
- **Donor exhaustion** – there is a risk that if the same network of supporters is reached out to multiple times, that network will eventually cease to supply necessary support.
- **Public fear of abuse** – concern among supporters that without a regulatory framework, the likelihood of a scam of abuse of funds is high. The concern may become a barrier to public engagement.
- There is some research in social psychology that indicates that people don't always do their **due diligence** to determine if it's a sound investment before investing, which leads to making investment decisions based on emotion rather than financial logic.

[78] Midi de la finance inclusive, 27 March 2014
[79] http://www.cmf-fmc.ca/documents/files/about/publications/CMF-Crowdfunding-Study.pdf

- **Crowd funding draws a crowd**: investors and other interested observers who follow the progress, or lack of progress, of a project. Sometimes it proves easier to raise the money for a project than to make the project a success. Managing communications with a large number of possibly disappointed investors and supporters can be a substantial, and potentially diverting, task.

Additional risks identified – for the investors - include:

- **Loss of investment -** Most start-up businesses fail and therefore investing in these businesses may involve significant risk and it is likely that investment is lost.
- **Lack of liquidity -** Liquidity is the ease with which shares can be sold after they are purchased. Buying shares in businesses pitching through crowdfunding platforms cannot be sold easily as they are unlikely to be listed on a secondary trading market.
- **Rarity of dividends** - Dividends are payments made by a business to its shareholders from the company's profits. Most of the companies are start-ups or early stage companies, and these companies will rarely pay dividends to their investors. Profits are typically re-invested into the business to fuel growth and build shareholder value. Businesses have no obligation to pay shareholder dividends.
- **Possibility of dilution -** Dilution occurs when a company issues more shares. Dilution affects every existing shareholder who does not buy any of the new shares being issued. As a result an existing shareholder's proportionate shareholding of the company is reduced, or 'diluted'.
- **The need for diversification -** Diversification involves spreading money across multiple investments to reduce risk. However, it will not lessen all types of risk. Investors should only invest a proportion of their available investment funds via crowd funding and should balance this with safer, more liquid investments.

The success of the scheme relies on gathering enough funds to be able to install the renewable energy infrastructure. Another risk is that the project does not perform as expected. Selecting a supplier who offers good quality products and a warranty on the system can reduce this risk. This may affect the financial feasibility of the projects.

2.7.3.7 *Key enablers*

- The liquidity/financial crisis urged people to look for additional forms of financing
- The low threshold levels compared to traditional forms of funding
- The marketing side benefit of crowd funding
- Crowd funding is still associated as an innovative form of funding and communicating

2.7.4 Current barriers and potential solutions for up-scaling

2.7.4.1 *Barriers*

The major barrier of crowd funding is a lack of harmonization in the national legal framework

Lack of a EU legal framework. There is no all-encompassing legal framework for crowd funding in Europe. There are some reasons for this:

- Unwillingness of crowd funding platforms, for most are quite small, to engage complex regulatory proceedings. The existing regulatory framework does not allow innovative start-ups with a small budget to scale their business in the crowd funding sector.
- Large financial institutions who do possess the financial and administrative resources to deal with existing, complex regulatory frameworks have no incentive to see the existing administrative and regulatory burden partly lifted.
- Lack of quality labels. There are no internationally accepted quality labels or certificates for crowd funding platforms.

- In Europe, crowd funding is largely regulated by national law, as most platforms circumnavigate pan-European legislation due to the high administrative and financial costs involved[80].

This fragmentation of the European Union, a result of failed European harmonization in favor of national and member state interests, is the key hurdle for crowdfunding. As long as this situation persists, cross-border transactions will remain impossible or prohibitively expensive for SMEs, and the real value of the common market will be unavailable to them, as well as to crowdfunding. Potential investors are currently excluded from crowdfunding opportunities solely based on their geographic location within the Union.

2.7.4.2 *Potential solutions*

Produce a pan- European regulatory framework in order to allow the sector to grow.

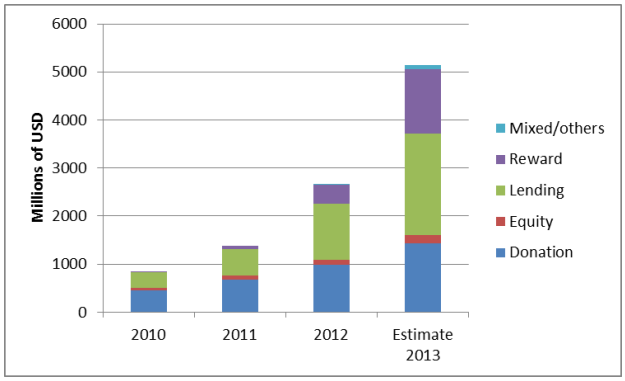
2.7.5 Future potential

2.7.5.1 *Preliminary educated guess of up-scaling potential up to 2050*

Crowd funding can help to get more renewable projects off the ground, at a time when governments in many countries are cutting back on subsidies and banks seem reluctant to loan money to small businesses. The ambition is there, the British energy crowd funding site Abundance for example, has set a target of raising EUR1.2 billion over the next ten years.

The Crowdfunding Industry Report (Massolution, 2013) provided the following information:

Figure 2.7.3: Growth in funding volume by crowdfunding model in millions of USD



Source: Crowdfunding Industry Report (Massolution, 2013)

2.7.5.2 *Replicability*

The potential list is endless. (Small scale) wind turbines, energy efficiency retrofits, solar arrays, and urban gardens are all possibilities of crowd funding projects.

[80] Toniic, 2013, Crowdfunding for impact in Europe and the USA

2.8 PV purchase collectives

2.8.1 Background

2.8.1.1 *Description of the model*

Where does it come from

The first large-scale initiative of a photovoltaic (PV) purchase collective in the EU was set-up on the 11th of November 2010[81] by two national organisations called Urgenda (sustainable network organisation) and De Betere Wereld. Their PV purchase collective was called "We want the sun" [82]. The initiative received a lot of publicity and interest from other EU member states. The first collective purchase action appeared to be a great success as around 40.000 to 50.000 solar panels (or 10 MWp) were installed via the collective purchase of PV modules from China, which were installed from May 2011 onwards.

The initiative was followed by similar action by Natuur en Milieu, Vereniging Eigen Huis and many others.

How it works

PV purchase collectives offer an innovative way for private customers to buy a residential PV system. In this way, a price reduction can be achieved by bundling customer purchase power, and the hassle of selecting a suitable system and in some cases even the installation company is taken out of the hands of the customer. The more technically oriented customers can chose to install the panels themselves, whereas PV novices may choose to a collective in which an installer is already contracted.

Several types of PV purchase collectives can be distinguished:

- PV purchase collectives initiated by the supplier of the solar panels. These initiatives are mainly commercially driven.
- PV purchase collectives supported by local governments. The organiser is typically a local renewable energy non governmental organisation (NGO) or a working group that is founded for this purpose. These actions often include a subsidy programme. These purchase collectives can be part of a larger energy programme.
- PV purchase collectives for members of (interest) organisations or employees of companies. These are typically large scale bulk purchases.
- PV purchase collectives organised by a group of homeowners or neighbourhood. These are typically smaller scale initiatives.

There are a number of ways to structure a solar bulk purchase. Typically, one of the above mentioned groups goes through the process of purchasing solar systems together. The group selects a single contractor to install systems on each of their buildings, but each

[81] The organisers chose this specific day to launch their campaign as it coincided with the national sustainability day in the Netherlands
[82] http://www.wijwillenzon.nl/

participant owns their own system and has their own contract with the installer. Another approach is for a group to purchase solar a bulk batch of solar panels directly from the manufacturer. They can then contract an installer to install the panels, or complete the installation themselves.

Aims

Buying PV panels through a purchase collective has several advantages.

1. Economies of scale enable the installers to purchase panels for less. Larger projects attract more bids, increasing competition and driving prices down. The group has more negotiating power because they've created a larger project for installers to bid on.
2. Each single group member does not have to navigate multiple bids and scenarios independently (transaction costs). The group can take advantage of the different strengths, skills, and background of its members. A group has more political leverage if you run into challenges with permitting, local incentives or other project impediments.
3. Large projects attract the attention of donors and press, which increases fundraising potential.
4. Better protection against malicious suppliers and systems.

Examples

Since the start in 2010, there are a large number of initiatives to promote the purchase of solar panels in short time. With regard to these actions, we conclude that these initiatives have accelerated the home market for PV systems in the Netherlands, by providing an economically attractive alternative and creating a stronger general attention and awareness of the application of PV systems. The purchasing action Zwolle sun city is a good example of a local initiative with a strong social solidarity (2011-2012, result 0.5 MW installed and price reduction approximately 20 %). The Vereniging Eigen Huis (National House Owners Association) with 1.2.3. Solar Energy has a thoughtful approach and the best results in terms of quality and price when purchasing the PV system and in particular for the use of the system over a period of 10 years (2011-2012, result 10 MW, price reduction approximately 20%).

The Vereniging Eigen Huis (VEH, Home Owners Association) is the largest home-owner organization in The Netherlands with over 600,000 members. In 2012, VEH organized 2 collective purchases of residential PV systems for their members. To select the supplier of these systems, a reverse auction was organized during which potential suppliers could bid against each other for the exclusive right to offer and sell the participating VEH members a PV system. Oskomera Home Solar (OHS) won the auction for both collective purchases and therefore became the supplier of the PV systems. Because of the reverse auctions, 11-33% reduction of the prices set by VEH was achieved.

Links

- http://www.eigenhuis.nl/webwinkel/energie/collectieve-inkoop-energie/ A summary is given above under "Examples" 123zonnenergie
- http://www.wijwillenzon.nl/
- http://www.zoncollectief.nl/
- http://www.zonzoektdak.nl/ Stichting Natuur en Mileu

The US Department of Energy has released a community guidebook to collectively purchase residential PV systems in 2012[83]. The guidebook indicates that similar concepts already existed in the US in 2003.In Europe, the concept does not seem to be diffused elsewhere.

[83] US Department of Energy, 2012, The solarize guidebook: A community guide to collectivel purchasing of residential PV systems

2.8.1.2 *Key impacts*

Renewable energy generated

A residential PV system in The Netherlands has a typical capacity of around 2kWp, which would yield an average 1,600kWh of electricity annually[84]. A 2kWp PV system covers around 45% of the electricity consumption of an average Dutch household. Two large PV purchase collectives in The Netherlands are known to have resulted in the installation of between 40,000 and 50,000 panels, or around 10MWp of installed PV capacity, each.
The vast majority of purchase collectives are notably smaller than the two mentioned above. The aggregate result of the numerous smaller initiatives has never been calculated. A one year old (February 2013) inventory of PV purchase collectives counted by then already more than 100 of such initiatives[85].

Other impacts

- Helps raise solar awareness
- Helps lower down solar soft costs (e.g. installation) for participants
- Helps decrease solar costs in the areas in which they operate by creating increased competition and by bumping up economies of scale

2.8.2 Current development stage

The concept is in its commercialisation phase. The concept has really taken off since the price of PV-systems for households recently reached grid-parity. There are currently several larger and numerous smaller collectives in The Netherlands alone.

As mentioned earlier, the amount of purchase collectives in The Netherlands alone is estimated to exceed 100. Elsewhere in the EU, there is very limited experience with this concept. Some local and regional initiatives are seen in Belgium, the UK and Germany, but not nearly on the same scale and with the same success as currently seen in The Netherlands.

It is not clear why this concept has taken off in The Netherlands instead of another country. Part of the explanation may be that many comparable countries have had PV support schemes in place that made the purchase of PV systems attractive enough without a collective purchase action. PV support schemes have been complex and limited in funding capacity, and had an on-and-off character in The Netherlands. This has caused the country to lag behind in the installed PV capacity, but it has also made its citizens inventive and urged them to find other ways to create attractive business cases, such as these purchase collectives. The complex financial support scheme and the grid connection administrative process in The Netherlands may also be a reason that citizens group themselves to try to tackle these legal and administrative barriers together. The 'one-stop-shopping' service of purchase collectives, providing support also in these processes, is thought to be an important reason for the success of this concept.

Interest for the concept outside The Netherlands may increase now that PV support schemes, such as feed-in-tariffs, are trimmed down or stopped in several EU countries.

2.8.3 Elaboration of the model

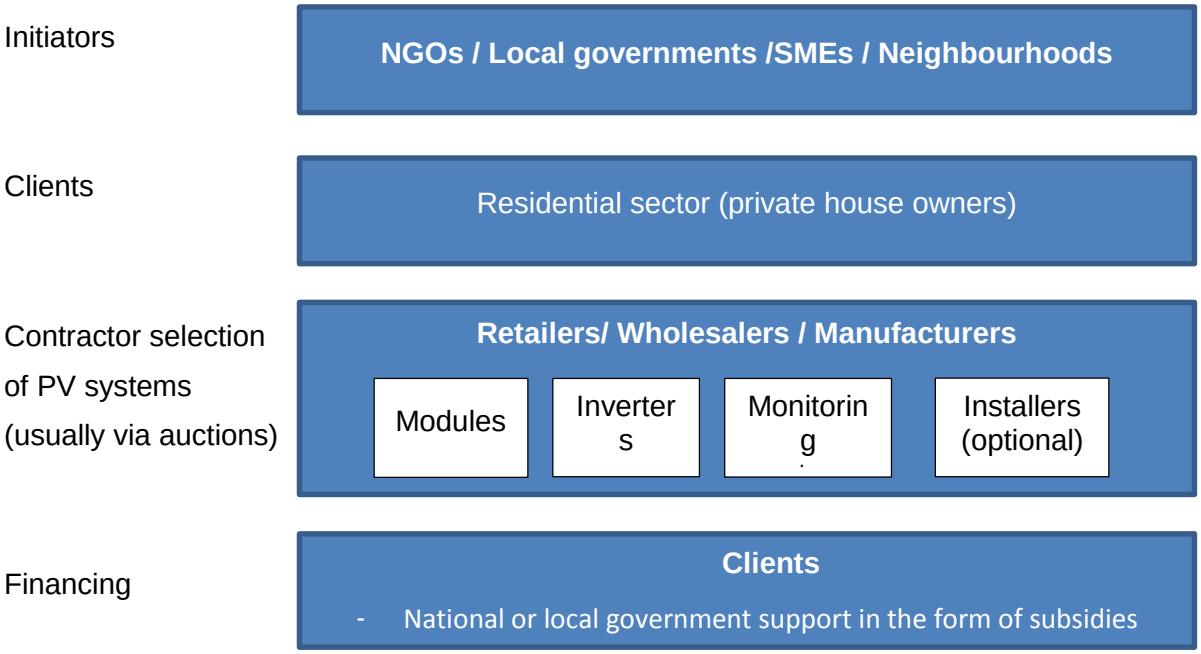
2.8.3.1 *Organisational aspects*

The following actors can be involved in PV purchase collectives:

- Organiser of collective purchase: NGOs, companies, neighbourhoods, local governments

[84] http://www.zonnestroomnl.nl/nieuws/performance-nederlandse-zonnestroomsystemen-gemiddeld-784-kwhkwp/
[85] SMZ, 2013, Grootschalige inkoopacties, Ervaringen en leerpunten. Onderzoeksrapport SMZ2013001 Utrecht, 22 februari 2013

- Clients: Home owners
- PV panel suppliers: retailers, wholesalers, manufacturers
- Optional:
- Local government
- Consultants
- Technical specialists
- Marketing bureau
- Certification bureau
- Financial institutions



Existing purchase collectives have focused on home owners. In principle, the concept could also work for SMEs for example. Organisers are often NGOs, local communities or companies organising a collective purchase for their personnel. Depending on the scale of the collective, PV systems can be bought with retailers, wholesalers and, in case of very large initiatives, directly from the manufacturer.

Most of the actors mentioned as optional may be relevant in case of large scale collectives. For small scale collectives this would also be too expensive.

2.8.3.2 *Economic aspects*

The concept makes the purchase of PV systems more attractive. PV purchase collectives have been able to negotiate up to 20-30% discount on regular prices for PV systems.

Financing is usually left to the participants in the collective purchase. One of the largest initiatives had set up an arrangement with Greenloans (a subsidiary of ABN AMRO bank) for an attractive financing scheme for the PV systems. Participants were also given the opportunity to finance their PV systems through their mortgage.

Local governments sometimes provide financial support in the form of subsidies. They can also provide technical support to a purchase collective by for instance initiating, managing or administrating. The first PV purchase collectives, like “We want the sun”, took advantage of the ongoing national subsidy schemes which were set-up for solar PV for households. This financial incentive made the house owners recognize the window of opportunity, as the subsidies had a limited timeline and fixed cap.

2.8.3.3 *Legal and regulatory aspects*

There are some legal barriers that can hamper the further uptake of PV in general, but these do not per se concern the use of this concept[86].

Contracts between PV system suppliers and purchase collectives can be straightforward and simple. Purchase collectives may negotiate additional advantages besides the financial discount, such as certain guarantees. This could make the contracts more complex and external legal expertise may be required in this case.

2.8.3.4 *Technical aspects*

PV systems are technically mature. There are no technical barriers that would prevent the uptake of this concept.

2.8.3.5 *Social or cultural aspects*

There are no evident cultural conditions for the success of this concept. There needs to be a certain level of trust between the initiator and the clients.

A culture of collective action may partly explain the success of this concept in The Netherlands.

As long as the financial incentive to buy PV systems is limited, a certain level of 'green' awareness will be required for the uptake of the concept. In The Netherlands it was an environmental/sustainability NGO who pioneered the concept.

2.8.3.6 *Risks*

PV purchase collectives that negotiate a price before they have subscribed participants run the risk that they will not attract as many clients as agreed upon with the supplier of the PV systems. This can be avoided by negotiating the price after clients have signed up, but then the offer to the clients is less clear.

Another risk is that the PV system does not perform as expected. Selecting a supplier who offers good quality products and a warranty on the system can reduce this risk. However, this risk also exists when a PV system is individually purchased, and is arguably even larger in this case. Avoiding this risk and the hassle in selecting a good supplier is one of the main reasons for people to join PV purchase collectives.

2.8.3.7 *Key Enablers*

The US's Solarize Guidebook[87] mentions the following key enablers:

- Tap the Grassroots - Successful campaigns tap the grassroots to design and market the program. In a positive feedback loop, the process of creating and deploying the program builds community pride that encourages higher levels of participation in the community.
- Involve the Community in Decision Making to create an empowering statement of values.
- Use Community-Based Marketing - Information reaches people through face-to-face encounters with friends and neighbours, house parties, and other social interactions.
- Collaborate with a Trusted Local Organization and Assign a Project Manager
- Financing - By offering some form of program financing, campaigns are able to tap a larger market for PV. Options vary but some combination of the following should be considered: Municipal Loans, Bank or Credit Union Loans, Solar Leases or PPAs, utility loans.
- Absolute Price is less important than the Perception of a Good Deal - As long as a consistent price is set for everyone, and it is demonstrably less expensive than the "going rate" for individual solar installations, people perceive the cost as "a good

[86] „Barrier has been removed from the 1st of Janurary onwards (Salderen)
[87] US Department of Energy, 2012, The solarize guidebook: A community guide to collectivel purchasing of residential PV systems

deal." In fact, many RFP committees selected final bids that were not the lowest price, but the best value, providing a reasonable price for high-quality service

2.8.4 Current Barriers and potential solutions for up-scaling

2.8.4.1 *Barriers*

1. A lack of financial means among private home owners can be a barrier to the uptake of this concept. This barrier will be more prominent in Eastern and Southern Europe than in North and West Europe.
2. There has to be a certain level of awareness about and interest in PV systems.
3. Low electricity prices in some EU countries can form a barrier since it would make investments in PV less interesting.
4. The financial advantage of collective purchase initiatives may become smaller over time, as increased competition in the markets drives prices of individual systems down. In such a competitive market, there is less room for suppliers to offer a discount on their regular prices.
5. A lack of trust in the initiator can form a barrier for people to sign up.
6. Solar PV installers are not happy with the initiatives, as their margins are being cut. In the last three years this has led to market disruptions as a number of installers went bankrupt. Next to this unrealistic price indications for installation were given, as the industry claimed. The industry even called for a petition, for which over 800 autographs were gathered[88].

2.8.4.2 *Solutions to the barriers*

1. The financial barrier can be addressed through financial support from governments and deals for attractive arrangements with financial institutions.
2. Governments can also help to raise awareness regarding renewable energy in general, and PV and PV purchase collectives in particular.
3. The electricity prices in most EU countries have been increasing over the last years and, considering the huge investments required in the power sector, is not expected to decrease in the near future. The price gap barrier is thus expected to solve itself over time.
4. A decreasing financial advantage of PV purchase collectives due to more competitive PV system prices is inevitable. However, even without large financial gains, the concept could remain attractive as it would still provide an easy way for home owners to buy a reliable PV system without too much effort and risk.
5. A reliable initiator is an important prerequisite for success of the concept.
6. The unrealistic installation prices have been readjusted. The second point, concerning competition, indicates that the market for solar PV was very competitive in 2010.

2.8.5 Future Potential

2.8.5.1 *Preliminary educated guess of up-scaling potential up to 2050*

There seem to be no fundamental barriers for the uptake of the concept across the EU. The EU-28 has more than 200 million households, of which approximately half are privately owned, and half of these have their own roof. This would leave roughly 50 million households that could potentially be interested in this concept.

There is also up-scaling potential towards other techniques. If this works for PV, why not try it for heatpumps as well?

The collective PV purchase concept can provide a significant boost to a PV market. The current boom in the Dutch PV market is often attributed to the success of collective PV purchase initiatives. The initiatives have not only led to significant direct sales, but are also

[88] http://www.petities24.com/forum/73363
and international attention by Photon here: http://www.photon.info/AxCMSwebLive_PremiumSample/photon_news_detail_en.photon?id=82925

thought to have driven down the price of individual PV systems, thus providing a further stimulus to the market.

The residential PV market is a labour intensive market, particularly 'downstream' in the installation sector. A large residential PV market can provide a boost to this sector.

A back of the envelope calculation suggests that the EU-wide uptake of PV purchase collectives could lead to the creation of thousands of jobs in the installation sector alone. If 5% of the EU households would apply for a collective PV purchase initiative, this could lead to 50[89]*0.05*2,000Wp = 5,000MW installed capacity. One MW of installed capacity generates approximately 7.7. FTE[90], so the 5000 MW of installed capacity may translate into roughly 40,000 jobs.

If we assume electricity generation of 5.260 GWh per year[91] and consider the EU27 average grid emission factor (in 2008) of 0.3768t CO_2/MWh[92], the GHG reductions would be roughly 2 Mt CO2 per year.

2.8.5.2 *Replicability*

The first PV collective purchases were unique in a sense that they took advantage of the ongoing subsidies for the residential sector. New initiatives throughout the EU will not gain from this financial back-up. On the other hand, solar irradiance levels may be more favourable for the pay-back time of PV collective investments.

Apart from these conditions, it seems to be that the PV collective purchases can be easily replicated in other EU-countries if banks are willing to support similar initiatives and an adequate PV installation sector is in place. Furthermore, this concept can be replicated for other technologies such as small-scale wind and heat-pumps.

[89] As above, the EU-28 has more than 200 million households, of which approximately half are privately owned, and half of these have their own roof. This would leave roughly 50 million households that could potentially be interested in this concept.
[90] Ahlfeldt, C., 2013, The localisation potential of Photovoltaics and a strategy to support the large scale roll-out in South Africa

[91] To calculate the total energy output of the PV system several parameters should be taken into account. We assume an average capacity factor of 12% for Europe, based on country averages. An EPIA report includes: Solar irradiance, performance ratio (75% - 80%), lifetime (25 years), module degradation (80% of initial performance after 25 years).
[92] EEA - http://www.eea.europa.eu/data-and-maps/figures/trends-in-energy-ghg-emission

2.9 Bike sharing

2.9.1 Background

2.9.1.1 *Description of the model*

Where does it come from

Bike sharing schemes (BSS) are a well developed concept, although they had a slow start. They were first experimented in Amsterdam in 1965[93] (with a very small number of "white bicycles", free and to be used for a single trip, then left unlocked for the next person to use) and, more widely in 1974, in the French city of La Rochelle (Yellow Bikes). In terms of public usage and acceptance, the latter is regarded today as one of the first truly successful bike-sharing programmes.

The second generation was introduced in Copenhagen in 1995. This was the first large-scale scheme with thousands of bicycles available[94]. The main differences with the first generation of BSS was the possibility to lock the bicycle and the use of a system of "coins refund" in order to promote the return of bicycles and decrease the number of stolen bicycles, as well as the introduction of an annual membership and fee.

The third, and current, generation of BSS has been the biggest step in the development of BSS and the fourth generation is building on new, smart, IT solutions to build more efficient and more flexible schemes which are better run and provide better service to users.

How it works

Bike sharing schemes (BSS) are short-term urban bicycle rental schemes that enable bicycles to be picked up at any self-serve bicycle station and returned to any other bicycle station. BSS offer a low cost, flexible transport option particularly adapted to cities given the short distances usually travelled.

In most systems, after paying a daily, weekly, monthly, or annual membership fee, riders can pick up a bicycle locked to a well-marked bike rack or electronic docking station for a short ride (from a few minutes to several hours) and return it to any station within the system. Most schemes offer the first 30 minutes for free and operate 24 hours a day, 7 days a week, all year round (although some do close at night and in the winter months).

The current generation of BSS usually relies on smart card access, automatic docks and stations, and real time information on the location of available bikes and spaces across the network in order to optimise bike use.

[93] http://www.ecf.com/advocary/mobility/bike-sharing-scheme/
[94] http://www.ecf.com/advocary/mobility/bike-sharing-scheme/

Aims

Bike-sharing schemes are usually implemented as part of city-wide sustainable transport strategies. They are seen as a complementary transport offer to buses, trains and tramways and aim to encourage mode shift away from cars in order to reduce congestion and transport-related air pollution and improve mobility. They also support wider goals such as improving the residents' quality of life and health, and making town centres more attractive and liveable.

Examples

In 2013, there were 472 BSS in Europe, across large and medium-sized cities. A few examples include:

- The Bicing scheme in Barcelona. This scheme is used as illustration throughout this document because attempts have been made to quantify its impacts. By 2012, there were 420 Bicing stations and 6,000 bikes available with an average of 40,000 daily journeys.
- The Velib in Paris, launched in 2007 like the Bicing scheme. These two schemes triggered a renewed interest in BSS in Europe. Velib has over 20,000 bikes and 1,800 stations.
- Villo! in Brussels, the only BSS in Belgium. Belgium is one of the few countries where one BSS has been replaced by another with different conditions. The first scheme (Cyclocity) was unsuccessful for a number of reasons: the high number of bikes per inhabitant; the duration of rents was too high to be efficient; the bikes were said to be too heavy; and free rent was not offered for the first 30 minutes. The system was eventually redesigned, renamed and launched in 2009.
- Stockholm City Bikes in Sweden. Cycling is a popular mode of transport in Sweden but the Stockholm City Bikes scheme suffers from sluggish expansion because of limited urban space, a slow and complicated planning process, political unwillingness to put street parking at its disposal, and other infrastructure projects competing for funding.

2.9.1.2 *Key impacts*

Environmental impacts (GHG emissions avoided, renewable energy generated)

As mentioned above, one of the aims of BSS is to support a mode shift away from cars for small distance journeys and as such reduce emissions for CO_2 and air pollutants.

A recent study by the University of California[95] suggests that bike-sharing schemes do indeed reduce car use. An online survey of users of BSS in Montreal, Toronto, Washington, D.C. and the Twin Cities in Minnesota found that:

- The main purpose of bike sharing trips is commuting, followed by social / entertainment and running errands.
- The majority of trips last less then 20 min.
- Between 30 and 50% of respondents agree or strongly agree that they have made trips by bike that would previously have taken place by car.
- 40% use their car less often as a result of the scheme.

However, it is important not to over-state the benefits in terms of modal shift. An attempt at quantifying modal shift found that between BSS replaced between 2-10% of car trips. They mostly replaced trips made by public transport or walking[96]. The survey also showed that BSS generate more use (18% use public transport more, 39% use it less), highlighting the need to integrate cycling with the public transport network.

[95] Transportation Sustainability Research Centre, University of California Berkeley (2012) Bikesharing in North America: understanding the social & environmental impacts
[96] United Nations Department of Economic and Social Affairs (2011) Bicycle-sharing schemes: enhancing sustainable mobility in urban areas

The British Medical Journal[97] looked at the impacts of **Barcelona**'s Bicing scheme and estimated that it resulted in an annual reduction in CO_2 emissions of 9,062t (around 1% of Barcelona's emissions from all road vehicles).

Other impacts

The reduction in emissions from BSS and the physical activity involved generate health benefits for users and city dwellers in general. For instance, the implementation of BSS led to an increase in bike ridership of 44% in Lyon in the first year[98] and 41% in Paris.

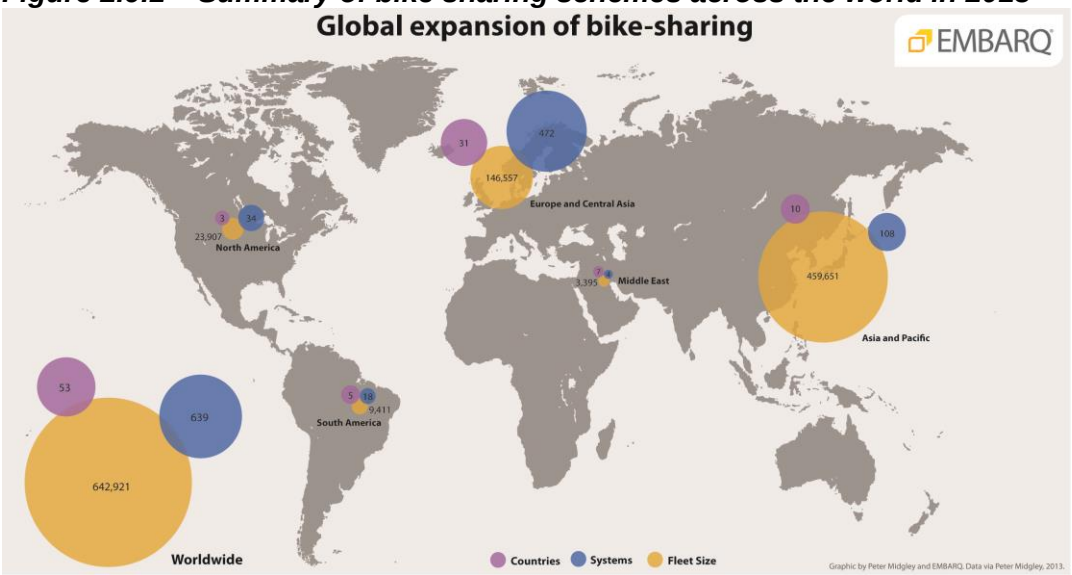
The British Medical Journal's study on **Barcelona**'s Bicing estimated that 12.46 deaths were avoided each year because of the scheme compared to car use, taking into account all mortality causes. These findings corroborated those of two other published assessments of multiple risks and benefits of active transportation. One study found that the health benefits of cycling would be larger (3-14 months gained) than the risks of road traffic incidents (5-9 days lost) and exposure to air pollutants (0.8-40 days lost) if car journeys were substituted by cycling trips. The other study found that if urban trips in private motor vehicles were replaced by active travel this would result not only in important health gains but also in reductions in carbon dioxide emissions.

Finally, by contributing to lower car use, they benefit car users and the wider city population through road congestion avoided and making the city more attractive to tourists and more pleasant to live in, although this is difficult to quantify.

2.9.2 Current development stage

As shown in the map below, today there are an estimated 639 bicycle-sharing schemes operating in 53 countries located in almost every region of the world, boasting a total of about 643,000 bicycles[99].

Figure 2.9.1 – Summary of bike sharing schemes across the world in 2013



Source: EMBARQ, http://thecityfix.com/blog/on-the-move-swift-global-expansion-bicycle-sharing-schemes-peter-midgley/

Detailed mapping of BSS across the world is available[100].

[97] BMJ (2011) The health risks and benefits of cycling in urban environments compared with car use: health impact assessment study

[98] http://www.treehugger.com/bikes/bike-sharing-programs-hit-streets-over-500-cities-worldwide.html

[99] http://thecityfix.com/blog/on-the-move-swift-global-expansion-bicycle-sharing-schemes-peter-midgley/

[100] https://maps.google.com/maps/ms?ie=UTF8&hl=en&om=1&msa=0&msid=104227318304000014160.00043d80f9456b3416ced&ll=43.580391,-42.890625&spn=143.80149,154.6875&z=1&source=embed&dg=feature

While the concept is now well-established, improvements are constantly sought and 'fourth generation' schemes are expected which will include design innovations such as movable and solar powered docking stations, electric bicycles, mobile phone real time availability, bicycles equipped with a GPS, electronic components which allow the station to recognize the bicycle and check its condition (lights, brakes, etc.), one card for all (public transport and BSS). Of these features, the introduction of electric bicycles is particularly significant in terms of enabling bicycle sharing in cities with steep terrain, as well as attracting older users.

However, while the upward trend in the development of BSS has been positive, the schemes do not always work: 59 systems have closed in the past year alone, many of which were located in countries like Spain that were particularly hard hit by the global financial crisis. The risks associated with BSS are considered further on.

2.9.3 Elaboration of the model

2.9.3.1 *Organisational aspects*

Actors involved, their role and interests

The main categories of actors which get involved in the implementation and delivery of BSS are: local / city authorities; scheme operators; equipment manufacturers; finance providers and citizens.

Local / city authorities usually initiate the schemes. Having approved of the concept, they then tend to be involved in all the stages of the project: consulting with stakeholders and individuals; commissioning feasibility studies from consultants to evaluate costs and technical requirements; contracting an operator or procuring the bikes and stations themselves, depending on the business model chosen.

Scheme operators can be divided into five main categories[101]:

- Advertising companies, street furniture providers or other public services (e.g. JCDecaux, Clear Channel, Cemusa);
- Publicly or privately owned transport companies (e.g. Call a Bike – DB Rent, EFFIA, Veolia);
- Bike sharing businesses (e.g. nextbike, Bicincittà, C'entro in bici);
- Municipal operators (e.g. Vitoria Spain);
- Associations, cooperatives (e.g. Greenstreet in Gothenburg, Chemnitzer Stadtfahrrad).

Among these, the first two are most pertinent to large-scale systems, while the latter two tend to apply to small-scale systems. Operators design, implement and deliver and maintain bike-sharing services. The OBIS study stresses that they should be involved as early as possible in the process in order to make use of their know-how on the latest technical developments and on the operational aspects of BSS. Operators' know-how is useful for tenders and feasibility studies. However, the view of an unbiased expert is necessary to assess operators' information.

Set-up of the model

The European Cyclists Federation[102] has categorised the main types of business-models for BSS as follows:

- Advertising-based schemes: operators finance the scheme in exchange for advertising rights on the bikes and stations e.g. Paris, Rome
- Local authority-ledschemes: city authorities contract a provider to install and operate the system for a fee (**Barcelona**) or designs, owns and operates the system themselves (Aarhus)

[101] OBIS (2011) Optimising Bike Sharing in European Cities – A handbook
[102] http://www.ecf.com/advocary/mobility/bike-sharing-scheme/

- Schemes run by public transport operators which provide and operate the system to enhance public transport services (La Rochelle, Germany, Netherlands).
- For-profit schemes which provide and operate schemes with minimal government involvement (Hamburg)
- Not-for-profit schemes, usually led by local associations and operating with the support of local authorities (Copenhagen)

In most cases, a contract between the municipality and the operator of a BSS is agreed. Contracts differ in terms of infrastructure ownership and length of the value-chain for each contracting party.

2.9.3.2 *Economic aspects*

The implementation costs of BSS vary depending on the scheme size and design. Table 1-1 presents cost estimates found in literature (although some of these estimates are quite dated).

Table 2.9.1 Capital costs of BSS (EUR)

	Paris	Lyon	Europe
Programme	Vélib	Vélo'V	
Capital cost / bicycle	3,200	3,260	2,500-3,000
Data year	2009	2009	2013

Sources: UN[103], OBIS[104]

A scheme without stations or a scheme with stations which do not need any groundwork (e.g. solar or battery powered stations) can be implemented at a fraction of the costs of conventional station-based schemes. In **Barcelona**, implementation costs were broken down as follows: 70% for station implementation (terminals, docking points, locking technology, ground work); 17% for bikes; 6% for set-up operations (workshop, logistics); 5% for communication and 2% for administration[105].

Running costs in large-scale systems are stated as EUR1,500 - EUR2,500 per bike and year in most large schemes. In **Barcelona**, they are structured as follows: 30% for the redistribution of bikes; 22% for bike maintenance; 20% for station maintenance; 14% for back-end system; 13% for administration; 1% for replacements of bikes and stations[106]. The Velib experience in Paris also showed that there can be unexpectedly high costs linked to theft and vandalism.

There are different financing models for BSS. The main financing sources from an operational point of view are registration charges and usage charges paid by the customer. As many systems offer a 30-minute-period free of charge for each ride, registration charges are most likely to be the most important income source rather than the usage charges. However, revenues from the scheme hardly ever cover the operational and investment costs and additional sources of funding are usually needed. Depending on the type of business model adopted, the schemes can be co-financed by direct subsidies, various advertising contracts, sponsorships (whole scheme, single components, stations or bikes), parking enforcement incomes or congestion charges. Generally, local authorities should explore the possibility of blending different sources of income to help support the long-term viability of the scheme.

No data has been found on the return on investment from BSS. When the scheme is contracted to private operators, this is likely to be confidential information and therefore difficult to obtain.

[103] UN (2011) Bicycle-sharing schemes: enhancing sustainable mobility in urban areas
[104] OBIS (2011) Optimising Bike Sharing in European Cities – A handbook
[105] OBIS (2011) Optimising Bike Sharing in European Cities – A handbook
[106] OBIS (2011) Optimising Bike Sharing in European Cities – A handbook

2.9.3.3 *Legal and regulatory aspects*

A review of available literature and research on BSS does not highlight any specific legal or regulatory requirements for BSS.

BSS would most likely be included in local authorities' transport strategies and as such be submitted to the local policy-making processes in place in each country. For instance, in most cases, the implementation of such initiatives require stakeholder involvement and consultation with residents. At national level, the Government may create a context which supports such schemes through knowledge-sharing, partnership work and setting up grants and other funding instruments.

However, legal requirements specific to BSS have not been identified. The only possible area of contention relates to helmet wearing. It is compulsory for cyclists in some countries, and experience in Australia has shown that compelling BSS users to wear a helmet can significantly hinder the success of the scheme.

2.9.3.4 *Technical aspects*

The key technical aspects of BSS are summarised by OBIS[107] as follows:

- Bikes. The bikes in BSSs differ in design and quality. Nevertheless they share the following general characteristics: robust parts to minimise vandalism damage and to facilitate maintenance; unique design to avoid theft and to make the bikes more visible in public spaces; advertising space; bike locking system at stations, only few schemes provide bike locks.
- Stations. They are a feature of most BSSs. They differ mainly in the technology involved. At low-tech stations the bike is locked to the docking point mechanically either with a lock on the docking point or a lock on the bike itself. Information columns give static information on the station, the rental process and the surrounding stations. High-tech stations with docking points are the most common type of bike sharing station. The bike is locked to the electronically controlled docking point. The rental process takes place at the rental unit (terminal or at the docking point itself), which can include touch screen display, card reader, RFID-Reader printer and keyboard. BSS stations also offer space for additional advertising and information measures.
- Access technologies. There is a range of access technologies from Smart card (the most common) through codes and keys to dealing with a person on site.
- Software. Software is needed to operate the system at the back-end and at the front-end. The scope of operation depends on the hardware design and necessary interfaces.
- Scheme Size and Density. The scheme size and density is determined by the size of the city or region itself, target groups, financial strength and goals of the BSS. Most urban schemes cover only central, dense areas of the city and provide a station every 300 meters or so. A successful BSS requires a well-developed network of stations. The location and density of the stations therefore needs to be carefully considered in order to ensure that they are easily accessible; integrated with other transport modes; available at all strategic locations with high footfalls such as commercial areas, cultural venues et hospitals as well as stations. Redistributing bikes across the stations is an important element of a successful scheme.

2.9.3.5 *Social or cultural aspects*

Climate and cycling modal share are the main factors that determine the appropriate scale and set-up of a BSS. Generally usage rates are higher in countries without a cycling tradition. Cities with a modal share for cycling less than 2.5% had almost tripled the amount of rentals per bike compared with cities with a cycling share between 2.5-5% and about 14 times more

[107] OBIS (2011) Optimising Bike Sharing in European Cities – A handbook

than cities with a cycling share above 5% (OBIS handbook). The main users of BSS tend to be those who cannot or do not want to own a bike.

BSS should also be flexible and adapt to travel patterns and consumer profiles in their cities. For instance, in 2011, Velib' introduced a new subscription formula called Velib' Passion for commuters to the suburbs whose trips often exceed the first free 30 min. For a higher subscription fee (EUR39 instead of EUR29) they have 45 min free for each trip. Together with new reductions for youngsters, this new offer has generated a 45% increase in the number of subscribers in just one year. Such an understanding of travel patterns can also be used to inform the location of stations, including through crowd-sourcing.

Finally, the role of information is essential to ensure that the scheme's usage is maximised. Indeed, customer utility can be increased and network used optimised by providing real-time information on availability of bikes or empty stations e.g. through smartphone apps like AllBikesNow by JC Decaux or SpotCycle in Barcelona and London

2.9.3.6 *Risks*

The main risk to BSS is their financial viability, or lack thereof. They rely on a mix of funding sources, all of which are vulnerable: revenues from users may drop if demand for bikes is weak; commercial interest through advertising varies depending on the economic context and the perception of the scheme. Failed schemes tend to have a sparse network which offers low visibility and limited service to potential users. A critical mass is needed to make bike-sharing an attractive option.

The financial viability of the scheme may also be impacted if replacement costs for bikes are higher than expected as a result of theft or vandalism. A deposit is usually required of users in order to avoid this risk.

Finally, there can also be risks associated with the safety of users if the city is not safe for cyclists.

2.9.3.7 *Key enablers*

The most important aspects for the survival and success of BSSs are:

- Cycling infrastructure in the city, including the construction and maintenance of cycle lanes or paths, direction signs for longer cycle routes, different safety measures at places of interaction with cars (such as junctions) and pedestrians (such as zebra crossings and where cyclists pass bus stops), safe cycle parking places, especially at PT stations and bus stops, etc.
- User accessibility. This covers all measures taken to make the system easy to access, both in space and time. It covers the ease of the registration process to make it simple to use the first time; the density of stations, or in the case of systems without stations, density of bikes at demand nodes; the dynamic access to both functioning bikes at the stations, as well as empty slots at the destination; the rapid repair of malfunctioning stations and bikes; and the hourly and yearly opening times.
- Safety.
- Bike and station design.
- Financing model (ownership and operation).
- Integration with other modes of transport – technical and practical.
- Redistribution traffic.

2.9.4 Current barriers and potential solutions for up-scaling

2.9.4.1 *Barriers*

Although BSS are a comparatively low cost transport investment, in times of restricted public sector budget, the upfront investment can remain a barrier, especially for smaller cities.

Once they are implemented, there can be a number of barriers to the uptake of the scheme: topography of the city; perception of safety for cyclists and general infrastructure for cycling

(e.g. lanes); lack of integration with other transport modes. Also, in places with a high existing level of bike use amongst the population, BSS can fail to compete.

There are other potential constraints to the implementation and growth of the schemes: space limitations to accommodate the stations; capacity to keep up with demand and to ensure that there are enough bikes at the right time and in the right places.

2.9.4.2 *Potential solutions*

Given the number of schemes currently in place, new cities considering the implementation of BSS can learn from their experience and address some barriers from the planning stage and through the integration of BSS in wider, coherent, transport strategies.

BSSs should always be combined with other cycling measures. A cycling strategy should therefore comprise infrastructure (such as cycle paths, safe cycle parking stands), choices on infrastructure use (like bike access to one-way streets, car-parking policy), support for initiatives that encourage cycling (led by user-groups, schools or employers) and communication measures that encourage cycling and other sustainable mobility options. A BSS can serve as an initial boost for cycling as a daily transport option (like it has in Paris, Lyon, Barcelona and London) which creates a demand for additional cycling infrastructure investments requiring decisions on provision and spending.

With regards to redistribution, it is important to analyse traffic flows before and after implementation and after that to optimise station planning, not only in terms of mobility needs, but also in terms of the redistribution capacity of the system. Smart algorithms for redistribution planning help optimise redistribution by assigning priorities to the respective stations. Not every empty station needs to be filled (e.g. when it is not usually used during the night). Additionally the use of zero-emission vehicles helps reduce the negative impact that redistribution has on the climate.

Technology also continues to help optimise the use of the network. For instance, Copenhagen 4th Generation BSS involves complete GPS integration which allows real time localization of the bicycle, routes calculation, and shares information between operators and the bicycle. It also relies heavily on the use of internet connections and mobile device use: users can book a bicycle with their phone and also book a place to leave their bicycle. Mobile phones are also used as a smart card to rent the bike. Screens display at stations provide live information (safe routes, docks available, bicycle basic information -lights, charge in the case of pedelecs, brakes …). The system also includes e-bikes and movable docks and stations and is largely powered by renewable energy sources[108].

Finally, local authorities have an important role to play in facilitating the allocation of space for docking stations in a simplified manner in order to avoid delays. As mentioned before, this has been one of the reasons for the slow expansion of the network in Stockholm.

2.9.5 Future potential

2.9.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

While the number of BSS has increased steadily over the last 10 years, there is potential for further growth as the policy agenda at European level encourages the development of low carbon transport solutions. The EU's Transport White Paper[109] aims to halve the use of conventionally-fuelled cars in urban transport by 2030 and to phase them out completely in cities by 2050, and states that walking and cycling should become an integral part of urban mobility and infrastructure design.

[108] http://www.ecf.com/advocary/mobility/bike-sharing-scheme/#sthash.xlA9OVWP.dpuf
[109] EU (2011) White Paper: Roadmap to a Single European Transport Area: towards a competitive and resource efficient transport system

BSS are highly adaptable to different types and sizes of cities and could in theory be implemented in many cities across Europe. Indeed, BSS have been developed in large metropolitan areas as well as medium-to-small towns with systems of only about 50 bicycles.

Basic calculations estimate that there are currently around 400-425 schemes in Europe. The Urban Audit records 630 cities with more than 100,000 inhabitants and 900 with more than 50,000 inhabitants[110]. Assuming all these cities eventually implement BSS, an additional 200 to 475 schemes could still be started across Europe.

Focusing on the lower end of this range (200 new BSS), high level job estimates have been produced:

- The latest data on BSS presented in Figure 2.9.1 shows an average fleet size of 311 per scheme
- Assuming implementation costs of EUR3,000 per scheme and an average annual wage of EUR35,800 in construction, and a standard ratio of 10 job years to one job in construction, an additional 200 BSS could generate around 520 jobs during their construction / installation period.
- Assuming operational costs of EUR1,500 per bike per year per scheme and an average annual wage of EUR40,000 , an additional 200 BSS could support around 2,300 permanent jobs.
- Both the installation and operational activity would then have further indirect effects on the supply chain.

In terms of environmental impacts, if these 200 new BSS each saved on average 10% of the annual savings estimated for the Bicing scheme in Barlecona (see Section 2.9.1.2), then these would save a total of 180,000 t CO_2 each year.

There may be further developments in the density and extent of current and new schemes through integration with other modes of public transport, and the introduction of pedelecs to encourage the replacement of longer journeys from the suburbs to city centres. The latter may also require development of an appropriate safe infrastructure of cycle routes. These are both at early stages and it is early to estimate upscaling potential.

2.9.5.2 *Replicability*

The approach developed by BSS is now being applied to car-sharing schemes as well to address the occasional needs of urban dwellers who do not want or need to own a car: short rental periods; renting and leaving the cars at different stations across a network; use of IT to inform customers of availability of cars and parking space.

[110] Note: Urban Audit data is not comprehensive and not always reliable as it combines a wide range of national sources

2.10 Used Cooking Oils

2.10.1 Background

2.10.1.1 *Description of the model*

Where it comes from

The use of biofuels in transportation has a long history, indeed they were the original fuel intended for cars: the first internal combustion engine to be patented in the US in 1826 was designed to run on a blend of ethanol and turpentine (derived from pine trees); Henry Ford designed his original 1908 Model T to run on ethanol; and Rudolph Diesel intended to power his engine with vegetable oil. In 1893, Rudolf Diesel showed considerable foresight when he stated: "The use of vegetable oils for engine fuels may seem insignificant today but such oils may become, in the course of time, as important as petroleum and the coal-tar products of the present time." However, in the 1920s as petro-diesel was cheaper to produce and more profitable, a decline in biofuels occurred. In the 1970s, in part as a result of the oil crises, interest in biofuels resurfaced in Brazil and the US. In the 1990s, local production facilities were set up in Europe and, more recently, legal requirements have been implemented to include a minimum proportion of biodiesel in fossil diesel.

Used cooking oils (UCOs) are one of several possible feedstocks for biofuels. UCO collection was initially set up to service the animal feed market[111] but UCO collectors were forced to find an alternative market following the EU-wide ban on using UCO for animal feed in 2004. The biofuel industry began to develop at this time providing UCO collectors with a convenient alternative market. Since then the industry has undergone significant expansion with several new entrants to the UCO collection business, many of which are also involved in processing UCO into biofuel. At this time biodiesel production represents by far the largest market for UCO in the UK and across the EU.

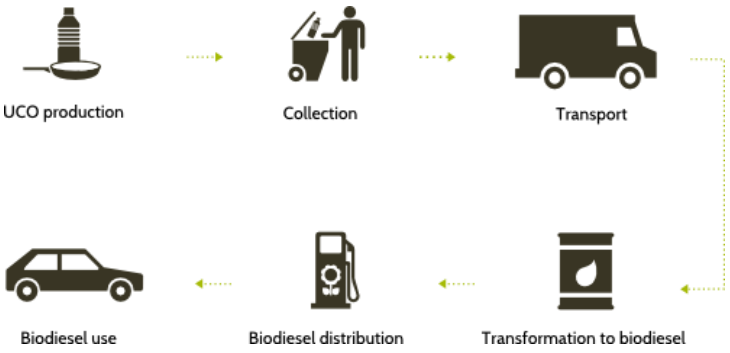
What is it and how does it work?

The Department for Transport defines UCOs as "purified oils and fats of plant and animal origin. These have been used by restaurants, catering facilities and kitchens to cook food for human consumption. They are wastes as they are no longer fit for that purpose and are subsequently used as either feedstock for the production of biodiesel as fuel for automotive vehicles and heating or as a direct fuel."

UCOs have to be collected, processed into biodiesel and distributed for use by individuals. The process is highly localised and offers opportunities for community-level action. The fuel produced can be used by local residents, community organisations, or more commonly in local public fleets.

[111] Ecofys (2013) Trends in the UCO market

Figure 2.10.1 Used Cooking Oils transformation process



Source: http://www.recoilproject.eu/index.php/en/ucos

UCOs are refined into biodiesel by a process called trans-esterification – which changes the molecular structure so that it behaves like mineral diesel refined from hydrocarbon oils. As a result, biodiesel can be used without engine conversion in most diesel cars, boats, trains, trucks, diggers, generators, ships. It can also be used in central heating oil boilers with a simple burner nozzle change.

Aims

The use of UCOs has several aims:

- To minimize direct carbon emissions. Biodiesel, especially recycled biodiesel is an excellent way to wean fossil fuel vehicle users onto sustainable carbon neutral fuel, without changing their vehicles or modifying their engines. So until truly ecological vehicles become mainstream biodiesel is an excellent place to start CO_2 reduction.
- To reduce emissions of air pollutants.
- To increase recycling and reduce landfill waste.
- To reduce imports of fossil fuel, develop local production and consumption patterns and thereby reduce the carbon footprint of road users.

Examples

UCOs are collected and used in many communities across Europe, especially in the UK:

- Sundance Renewables, in Wales[112], has been recycling UCOs since 2004 at the first community-based biodiesel production plant in the UK. This not-for-profit workers co-operative and social enterprise collects the oil from a wide variety of local outlets, converting it into a quality low-emissions alternative to diesel. Over 400 businesses and individuals purchase fuel through the Friends of Sundance scheme, either locally or delivered free across South and West Wales. This contributes to community recycling and bolsters the local economy.
- Richmond Council run the majority of their fleet on 100% biodiesel made exclusively from Waste Cooking Oil. Another UK area looking into the potential for UCOs to be used in public fleet is Devon County Council.
- In September 2012 South Norfolk Council opened collection points for UCO and fats at their local recycling centres. Nearly 2,000 litres of oils and fats were collected in the first months from five recycling centre collection banks and recycled into biofuel[113]. Three further collection banks were opened in July 2013 and more are planned.

[112] http://www.theecologist.org/campaigning/transport/370794/recycling_used_cooking_oil_to_power_diesel_cars.html

[113] http://www.south-norfolk.gov.uk/environment/6150.asp

2.10.1.2 *Key impacts*

Environmental impacts (GHG emissions avoided, renewable energy generated)

The conversion of UCOs to biodiesel can generate multiple environmental benefits:

- The re-use of UCOs supports the development of a circular economy, by finding an innovative secondary use for a waste material that is under strict disposal controls and can be extremely problematic when disposed of illegally through the sewerage system. Biodiesel is biodegradable and non-toxic. According to US Department of Energy findings, it is less toxic than table salt and biodegrades as quickly as sugar.
- It can help achieve significant reductions in CO_2 emissions compared to fossil fuels but also to other biofuels. The UK Government estimates that biodiesel from UCO represents a saving of 83% in greenhouse gas compared to fossil fuels[114].
- Biodiesel produced from UCOs avoid the potentially negative impacts from crop-based biofuels related to the displacement of food crops and the destruction of habitat as land is cleared for production.
- Biodiesel produces less (up to 60%) of the noxious emissions of particulates from the tailpipe when compared to fossil diesel. This is mainly due to the presence of oxygen in biodiesel which allows for complete combustion.

Other impacts

The use of UCOs has other impacts, mostly economic, as it basically creates value from an almost valueless material.

A new, commercially valuable product is generated from the process: a fuel similar to diesel which, when produced to the appropriate standards, can be introduced to existing diesel engines without any need for engine modification although there can be limitations depending on blend and vehicle type. In a context of rising oil prices, this is becoming an increasingly appealing option.

The process will generate local jobs for the collection of UCOs and production of biodiesel as well as new skills. As UCO for biodiesel production is essentially a local process, job and skills creation will occur in the EU as opposed to leaking overseas.

Finally, improving the collection of UCOs before it is disposed of down drains will reduce the cost of damages caused to the sewage infrastructure. In 2011, Defra estimated that in the UK 150,000 blockages per year are caused by fat, oil and grease being poured into the drains, at a cost to utility companies of EUR18 million per year[115].

2.10.2 Current development stage

The technology to transform UCOs into biodiesel is well established and the market is growing. There are schemes all over Europe and the world. However, the potential of UCOs remains under-used, in part because of limited collection processes. There is however growing interest in this field as a useful part of the portfolio of low carbon fuels.

There is a lack of statistics on UCOs currently collected or used in any EU Member State (with the exception of the UK RTFO statistics of biofuel use) and hardly any data on UCOs traded globally. A recent report by Ecofys[116] provides some data on the UK market. It found that in 2012, 5,317 million litres biodiesel from UCO had been reported to DfT. Most UCO originated from European sources (67% of UCO biodiesel, including UK) and the USA (25%), with the largest individual country source being the UK (40%, 128 million litres biodiesel). UCO sourced from the UK has increased each year and this trend looks set to continue. This trend is indicative of the fact that a number of the larger scale biodiesel plants in the UK moved away from using vegetable oils towards using waste oils (primarily UCO).

[114] Greenergy (2011) Making biodiesel from by-products
[115] Ecofys (2013) Trends in the UCO market
[116] Ecofys (2013) Trends in the UCO market

Restaurants are the major source for UCOs followed by food processors and households. In the EU-27 the gastronomy sector is well covered by UCO collectors. Recovery rates are expected to increase in areas not yet covered by UCO collection, especially for example in Eastern Europe, as long as economic incentives like double-counting justify the logistical effort.

Major food processors also tend to sell their UCO already or use it in their own anaerobic digesters at the production site. The strong and fierce competition in getting access to the sources of UCO in the UK is clear evidence that many of the large UCO generating entities are already covered. In addition, an increasing number of UCO thefts are reported in the EU which provides some indication of the potential latent demand at European level.

Further UCO potential supply is available from households. At the moment, UCO from households is only structurally collected in a few Member States (Austria, Spain and the Netherlands) whereas other Member States currently lack an appropriate infrastructure. The Intelligent Energy Europe funded RecOil project aims to increase sustainable biodiesel production and its local market intake by enhancing household UCO in the EU. Participating countries are Denmark, Greece, Italy, Portugal and Spain.

2.10.3 Elaboration of the model

2.10.3.1 *Organisational aspects*

Actors involved, their role and interests

UCO community schemes need to rely on strong collaboration between local authorities, community organisations, feedstock suppliers, residents, and the oil collectors and processors.

Local authorities generally need to be involved in the collection process in order to set up publicly accessible collection sites. They also often initiate such schemes, manage their implementation and use the biodiesel produced from UCOs to power their fleet.

Community organisations or cooperatives may also be set up to manage the scheme and organise oil collection.

UCO can be sourced from a variety of sectors and sources so *feedstock suppliers* can include food manufacturers, restaurants and hotels, and other organisations with large catering facilities such as hospitals or schools. Depending on the collection model chosen, feedstock may also be obtained from local *residents*.

In most cases, professional *oil collectors and processors* are likely to be involved. Consultancy company LRS[117] indicates that there are four main types of UCO collection companies operating in the UK and this is likely to apply to Europe as well:

- Suppliers and collectors: companies that both supply virgin cooking oil and collect it again when it is used.
- Waste collectors: waste companies that will collect UCO as part of their commercial waste collection service.
- Specialist commercial collectors: companies that operate UCO collection as a commercially viable business. Collectors may also be processors, refiners and blenders.
- Closed-loop collectors: some larger companies, such as McDonalds, have contracted collectors for all premises they operate across the UK and then use the UCO biodiesel in their transport fleets or for energy production.
- Other: smaller companies that collect oil at no cost and generally use it for personal consumption.

[117] LRS (2013) The market for biodiesel production from used cooking oils and fats, oils and greases in London

There are now numerous companies collecting UCOs across Europe as the market has developed. In the UK, over a certain volume, a Waste Management Licence is required and this may applied in other MS as well.

Set-up of the model

A UCO for biodiesel scheme can be initiated by a local authority or a community association or cooperative, although the RecOil Project's survey[118] found that in almost all cases local authorities or local agencies (i.e. waste or energy management companies) are the main promoters of such initiatives.

The project promoter will then need to determine the process through which UCOs will be collected, processed and ultimately re-used. The most typical collection method is by far the establishment of public collection points in gathering places such as schools, supermarkets, parking lots, municipal buildings etc. In the majority of cases reviewed by the RecOil Project, UCO is delivered by citizens in bottles or containers provided by the implementing organizations as the collection and delivery of the product must be as simple as possible.

The project promoter will likely need to enter into a contract with a facility which will process the UCOs. Sometimes UCO collectors will send UCO directly for biodiesel production, but often there are several stages involved in the collection and aggregation of UCO. There may simply be larger feedstock collectors and aggregators or there may also be some basic filtering and pre-processing to remove impurities such as water and pieces of food before the UCO is sold on for biodiesel production.

Once the UCO has been converted into biodiesel, there are four broad options for its use:

- Re-sale as a liquid fuel through retailers.
- Use for a community transport scheme or public fleet, leading to cost savings on fuel expenditure.
- Electricity for transport & local heat: use of biodiesel to generate electricity & heat from combined heat & power (CHP). The electricity would be used to power local electric transport options, whilst the heat would be used to meet local heat demand.
- Electricity for local transport: biodiesel is used only to generate electricity to power electric transport options.

2.10.3.2 *Economic aspects*

UCOs are increasingly becoming a viable element of the biodiesel supply chain although this depends on various key factors, namely the cost of raw materials and production, the retail price of biodiesel, the level of Government incentives available and the price of fossil fuel.

According to Ecofys[119], and using the UK as a benchmark example, prices paid for UCOs vary widely according to quality, location of the UCO sources and time of year. In 2008 the Environment Agency stated "some collectors charge to collect UCO, some collect for free and some pay the premises to receive their UCO". Competition in the UCO market is reported to have increased dramatically. Today collectors would generally not charge to collect UCO, although a few are reported to still charge a very minimal amount. Prices paid for UCO are dependent on its quality and also on the location of the UCO source. For example, UCO generators in city centres will generally be paid more than those in more rural areas as the cost of collection in more remote areas might negate the price for the feedstock. The time of year is also reported to be a factor as UCO is used less in biodiesel, or in lower blends, in winter months due to fears over the cold flow ability. LRS[120] for example indicate that UCO is sold by collectors to biodiesel processors for around £400 to £500 per tonne in winter months and £600 to £700 per tonne in summer months in the UK. Overall, biodiesel still costs approximately one and a half times that of petrodiesel depending on feedstock oils.

[118] http://www.recoilproject.eu/index.php/en/
[119] Ecofys (2013) Trends in the UCO market
[120] LRS (2013) The market for biodiesel production from used cooking oils and fats, oils and greases in London

The price of UCO naturally increases along the supply chain from the generating source to final UCOME (biodiesel), as the UCO is continuously processed to improve its quality. The estimations provided here are based on stakeholder interviews which were conducted by Ecofys in 2013. Whereas restaurants sell UCO for a maximum of 30 (€)ct/kg, small UCO collectors could charge up to 55 (€)ct/kg for filtered UCO. Larger UCO collectors and melting plants sell purified UCO ready for biodiesel production for 80-88 (€)ct/kg. The final product, UCOME, is currently sold for around 1€/litre.

However, the price at which biodiesel is sold varies across Member States, in part as a result of the Government incentives in place for biofuels vs petrol. Indeed, given that the production cost of biodiesel is higher than the production cost of diesel, biodiesel would not be competitive unless some support measure would be applied. This is reviewed in the next section.

2.10.3.3 *Legal and regulatory aspects*

Regulatory framework: does it support / hamper the concept?

The legal framework has an important role to play in the development of UCOs for biodiesel. It sets the rules for disposal and use, the standards, and the financial incentives to support UCOs.

The most relevant regulations for UCO and biodiesel at European level are:

- The Waste framework Directive 2008/98/EC identifies UCO as a bio-waste and according to this directive MSs shall take measures to encourage the separate collection and the treatment of bio-waste in a way that fulfils a high level of environmental protection.
- Directive 99/31/EC diverts liquid wastes (UCO included) from landfills, while Directive 2000/76/EC allows UCO to be incinerated, setting stringent criteria for plants which intend to burn UCO**.**
- According to the Animal By-Products Legislation 1774/2002**,** UCO cannot be used as an ingredient in animal feed anymore. They can only be used to produce biodiesel and oleochemical products.
- The EU Implementing Regulation 142/2011 defines the conditions under which UCO is a suitable starting material for biodiesel production and the process to be followed, case by case. Biodiesel plants are subjected to some requirements for transport, documentation and record-keeping.
- The Renewable Energy Directive (RED) 2009/28/EC sets a 10% renewable energy target for the transport sector, to be achieved by 2020, which has a big influence on the biofuel sector. The RED recognises biofuels based on waste resources as more environment friendly than biofuels produced out of agricultural commodities. RED Art.22 encourages EU Member states to create support schemes giving additional benefits to renewable energy applications such as wastes, residues, non-food cellulosic material and cellulosic material. More specifically, Article 21(2) allows Member States to count biofuels produced from wastes twice towards their 10% renewable energy in transport target for 2020. Member States currently have the responsibility to decide which feedstocks should count twice towards the target.
- The Fuel Quality Directive (FQD) sets a 6% GHG reduction target for nonrenewable fuels, compared to the average emission values of 2010, until 2020.

European directives and regulations are binding for all EU Member States, and they must be transposed into national laws and regulations. EU MS will have adopted various approaches – set out in their National Renewable Energy Action Plans - and will be at various levels of advancement in their support for biofuels generally and UCOs specifically. A range of tools are at their disposal, from regulatory ones (e.g. standards and mandatory incorporation targets) to market-based ones such as tax relief or subsidies. It is worth highlighting that in nine MS certain biofuels considered more sustainable (including UCOs) are receiving double

Renewable Transport Fuel Certificates. The use of double counting is limited but growing, in particular for biofuels produced from waste fats.

2.10.3.4 *Technical aspects*

As mentioned in previous sections, processing UCOs to produce biodiesel is a well-established technology, which needs to expand and mature in order to achieve economies of scale.

Several UK companies are also exploring new sources of waste oils and fats, for example retrieval of oils from food waste or of waste fats from the sewerage system, but these sources require investment in research and development and modifications to plant which remains difficult in the current investment climate.

With regards to the fuel produced, biodiesel has different properties to conventional diesel. Nevertheless, in principle, biodiesels conforming to EN14214 can be used at B100 in diesel engines as the diesel engine was designed to run on vegetable oil. However, engine attachments, namely the fuel injection equipment, may not be engineered to run on high or pure blends of biodiesel and therefore restrict such blends being used in certain vehicles. Low temperature operability of biodiesel fuel is also a commonly cited technical issue and varies depending on its blend level and feedstock.

Finally, setting up a UCO scheme does not raise any particular technical difficulties, more organisational issues especially with regards to collection.

There are no significant health or safety issues.

2.10.3.5 *Social and cultural aspects*

The EU's Recoil project has looked at the social and cultural aspects which influence the development of UCOs as biodiesel.

It found that householders' behaviour is a crucial factor in the UCO collection chain. Thus it is important to identify the most appropriate method and to identify the psychosocial factors that can function as barriers or facilitators to this collection.

RecOil undertook a survey in Greece, Italy, Portugal and Spain and interviewed the cookers of 877 households with the aim to build a behaviour profile regarding used oil disposal. Interviewees were mainly women (83.6%) between 38-54 years old (95%). Only a fifth of respondents have a Used Cooking Oil (UCO) Recycling System operating at the place they live.

Households use on average 2.5 litres of oil per month. Nearly half of them store the oil for reuse (58%) and most of these people eliminate residues of the oil (48%).

People prefer a UCO collection system with disposal facilities in public places, and are more prone to participate if the system is easy and practical (38.4%). Facilities should be well managed and clean, and a common identity for UCO collection system across the country should be developed. Domestic users demand information about where disposal facilities are located and practical description about how to dispose of UCOs, as well as information on UCO uses and environmental benefits. Social media such as TV, radio or newspapers are preferred for spreading the messages.

2.10.3.6 *Risks*

There are few limited risks attached to UCOs' use for biodiesel in community schemes.

The Ecofys report found that stakeholders in the UK have expressed concerns about the risks of unintended consequences if the UCO supply chain is not appropriately verified. Specific concerns include the risk of fraud if virgin vegetable oil would be sold as UCO or the risk that UCO is "used" less before being discarded. As a result, there is a need to ensure full traceability and chain of custody checks through the UCO supply chain back to the origin of the used oil. In the case of a community-based scheme, these risks are likely to be lower than for companies operating on a national or European scale.

There is also a risk that one litre of double counting UCO biodiesel could be double counted in more than one Member State, although this is a more general implementation risk with double counting and not a specific concern for UCO.

A growing risk as UCOs become more popular appears to be theft. Several companies interviewd by Ecofys indicated that UCO theft is a big issue currently in the UCO industry, and the biggest issue facing collectors.

2.10.3.7 *Key enablers*

The key enablers for the development of UCOs as biodiesel are: regulation on the use of UCOs and management of waste; the standards and quality protocols for biodiesel; the economic case for UCOs based on financial incentives, the price of biodiesel and the price of fossil fuel; the involvement of vehicle manufacturers to produce vehicles which can use high blends and are warranted for such use.

2.10.4 Current barriers and potential solutions for up-scaling

2.10.4.1 *Barriers*

The main barriers to implementing local UCO schemes relate to the collection process. UCO collectors interviewed in the UK indicated that it was hard to make kerbside collection of UCO economical because of the low volumes used by most people. With regards to collection in public places, the main barriers identified by Recoil are: inaccessible disposal facilities; lack of knowledge of where and how to dispose of UCOs; lack of recycling habit.

At a national level, there are economic and regulatory barriers to mainstreaming UCOs:

- As mentioned previously, biodiesel remains more expensive to produce than diesel and there is often a lack of certainty and clarity with regards to Government incentives.
- The legal framework also has weaknesses which hinder the uptake of UCOs. Despite EU level regulations, every EU country develops its own rules to manage UCO as a waste or as a by-product.This results in an extremely fragmented landscape. There is a lack of consistency and clarity at European level generally on how UCOs should be defined, collected, treated and recycled.
- As mentioned before, there are also issued with regards to traceability and the quality of the fuel produced.
- Finally, car manufacturers can also hinder the uptake of biofuels by placing limits on vehicle warranties depending on the biodiesel blend they use.

2.10.4.2 *Potential solutions*

In order to address the key barriers identified so far, local schemes must have a simple collection system, with easily accessible collection points in public places. People are more prone to recycle if they can fit it in with other activities (instead going out for recycling specifically, do it at the same time as you are going shopping or bringing the children to school) and such busy locations are seen as safer. Disposal facilities will have to be well managed (enough maintenance to keep it clean and below capacity limit, and solve any problem really fast).

Recoil also found that when starting a system, neighbourhoods with families should be prioritised.

The Recoil project's survey identified other areas of best practice:

- Try to provide a Common Image for oil disposal facilities within the country
- Containers. Facilities where a container with the oil is thrown inside are preferred to those where the oil has to be poured in.
- Provide information at the facility about WHAT to deliver (used cooking oil may be mixed with butter or oils from cans food) and HOW to deliver; preferably using images

- Inform people about location of the system (how it looks like) and its surroundings (where it is placed, using references around it). Prefer images to words and Prefer photos to maps
- Information on environmental benefits should focus on 'please, do not throw it to sewage
- Emphasise how oil will be used, by whom and the benefits of it (focus on what is the benefit for the community – e.g. emphasise donation of reprocessed oil to municipalities and its use for running municipalities' buses)
- Be careful on providing benefits to people. If you pay them (with money or other benefits you will need to keep it indefinitely, if you withdraw the benefit people will stop recycling).
- If you advertise savings on water treatment you should either tell people what you are doing with the money you are now saving, or decrease municipal taxes

At a national and European level, the main avenues to explore relate to the development and implementation of consistent rules for UCO collection, treatment and recycling. A UCO dedicated regulation should define responsibilities and obligations for waste producers as well as for all the other actors involved. At the same time, the legal framework should avoid any ambiguity and harmonize the EU context in order to create the proper conditions for marketing the UCO as an international commodity to be traded on global scale. Fraudulent activity of feedstock categorization should also be carefully controlled and eliminated. For this reason, certification and traceability are crucial topics.

2.10.5 Future potential

2.10.5.1 *Preliminary educated guess of up-scaling potential up to 2050*

The availability of used cooking oil is difficult to determine because supply is highly localised and quality often inconsistent. However, Ecofys[121] estimates a maximum *collectable* UCO potential in the *gastronomy sector* of 972,000t for the EU-27.

Although restaurants are the primary source of UCO the potential significantly increases if food processors and households are also taken into account. According to the BioDieNet project, of which Ecofys was project partner, the total UCO potential in the EU-27 is 3.55Mt, which is equivalent to 8 litres of UCO per capita. This estimate includes the gastronomy sector, food processors and households, and was based on an assessment of both collected and discarded UCO in ten EU Member States, which was then extrapolated to the whole EU. The contribution of the domestic sector is 1.748Mt per year, of which it is estimated that over 60% is disposed of improperly. The BioDieNet project was conducted within the Intelligent Energy for Europe Programme in 2009 facilitating the uptake of UCO to produce biodiesel.

However, the growth potential of UCOs will also depend on how Government incentives and the price of fossil fuels evolve over time.

For illustrative purposes, assuming this full potential of 3.55Mt is achieved and replaces diesel in cars, an estimated 9.1Mt of CO_2e could be saved. This is based on the 2013 conversion rates for diesel published by the Carbon Trust and assuming that UCO generate 83% fewer CO_2 emissions as mentioned in Section 2.10.1.2.

With regards to employment, anecdotal evidence from the US and the UK suggests that 200t UCO collected and biodiesel produced may support one direct job. This would equate to around 17,700 jobs for the full 3.55Mt potential mentioned above. This does not include the indirect jobs in the supply chain but it also does not include the potential loss of jobs in the diesel and oil refining industry. The difference is that jobs in UCOs will tend to be much more localised as the collection, distribution and processing activities will tend to occur at community or regional levels. It is important to bear in mind that these figures are very high

[121] Ecofys (2013) Trends in the UCO market

level estimates based on anecdotal evidence and much more detailed analysis would be needed in order to produce robust figures.

2.10.5.2 *Replicability*

UCO collection schemes are currently more common in some EU countries than others but can in principle be replicated across different countries and areas, especially those with a high density population.

2.11 Energy Performance Contracts

2.11.1 Background

2.11.1.1 *Description of the model*

Where does it come from

Energy Performance Contracts (EPCs) are a contractual arrangement between the end energy user and an energy services company (ESCO). An EPC is a form of 'creative financing' for the installation, often retrofit, of energy efficiency and renewable energy measures.

The initial financial requirements and risk of installation are carried by the ESCO, with the energy and carbon savings achieved, and the corresponding financial savings, benefiting either the ESCO solely, or split between the organisations involved, as dictated by the original EPC agreement. Such arrangements also usually ensure that the whole estate, potentially multiple buildings and grounds, is compliant with current legislation in terms of energy efficiency. Essentially the ESCO will not receive its payment unless the project delivers energy savings as expected. Energy Performance Contracting may also be known as Energy Savings Performance Contracting (EPSC), which is more descriptive term to potential customers and is more common in the US.

This approach to financing the investment in cost effective energy efficiency measures for buildings was initially developed in the USA, with the US Congress enabling Federal agencies to make use of private sector financing through the Energy Policy Act of 1992 which came into effect in 1995.

The Federal Government is the largest energy consumer in the USA and the approach adopted, the development of EPC, was to enable Government Agencies and sites to realise the opportunity and responsibility to demonstrate leadership on reducing emissions and meeting energy targets.

How it works

Energy Performance Contracts (EPCs) are an alternative financing mechanism designed to accelerate investment in cost effective energy saving or renewable energy measures in either public or private sector non-domestic property portfolios. Many of the known recipient clients of such arrangements are public sector instructions, but this could simply represent those whose information on such arrangements is in the public domain.

An EPC provider, the ESCO, typically conducts a comprehensive energy audit for the owner/operator of a building/estate, then designs and constructs a project that meets the client's needs and arranges the necessary financing.

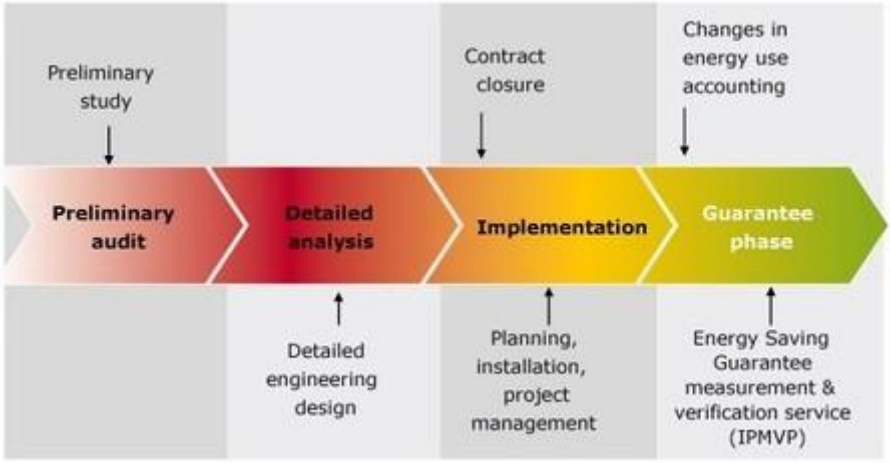
ESCO arrangements, i.e. simply providing energy services to a customer, are a long standing business model. The services provided by ESCOs can cover a wide range of provisions, as shown below.

- Energy analysis and audit
- Energy management of the estate
- Project design and implementation
- Maintenance and operation of the estate
- Monitoring and evaluation of energy/water/emissions savings
- Property/facility management
- Energy and/or equipment supply
- Provision of service (space heating, lighting, etc.)

The innovation with energy performance contracting (also EPC) is that the ESCO is also able to provide financing, or a route to financing, for the capital costs of the renovations / installation of new energy system / renewable energy technology systems that have been identified and agreed upon. Correspondingly the ESCO takes on some of the risk of the initial capital costs and the risks of achieving the increased energy efficiency / energy generation.

EPCs are marketed as without risk to the end customer, as the energy savings can be guaranteed, so all risk is transferred to the ESCO.

Figure 2.11.1 The EPC process as described by eu.bac[122]



Aims

The aim of the company owning/operating the building/estate is that the energy efficiency of the building(s) and / or the installation of renewable energy measures within the estate is achieved with little or no immediate up front capital investments from them. The upfront capital is provided by, and hence the risk is taken by, the ESCO, either alone or in conjunction with the provider of the finance.

There is the benefit that the ESCO will bring valuable technical knowledge and skill, understanding how best to achieve and maximise any such savings, ensuring that both partners achieve the maximum benefit, and overcoming any potential lack of in-house knowledge by the owner/operator.

Examples

In the USA there are many examples of the use of EPC by Federal Agencies, with the first one awarded in 1987 by the US Postal Services for a lighting retrofit in San Diego.

Specific examples include:[123]

[122] About EPC, eu.bac: European Association of Energy Service Companies, www.euesco.org, About EPC.

- Bureau of Land Management has an EPC arrangement with Johnson Controls Inc, 3.6 million USD project covering a number of small sites, installing updated lighting and associated controls, HVAC controls (heating, ventilation and air conditioning), new boilers, ground source heat pumps and advanced meter installations.
- FDA (Food and Drug Administration) White Oak Campus, installation of combined heat and power plant, 20MW of cogeneration, costing 71 million USD for installation, and anticipated to save 5.8 million USD in annual energy costs and 6.5 million USD in annual reduced operation and maintenance costs.
- Harold Washington Social Security Administration Centre, Chicago, Illinois, installed energy efficient lighting and controls, energy management control system upgrades, HVAC improvements, waterless urinals to name only some. The centre's annual energy consumption has been reduced by more than 20%, more than 4 million kWh, and 2 million gallons of water saved each year.
- The Statue of Liberty National Monument installed energy efficient lighting, variable speed drives and energy management control systems which are anticipated to produce savings of 4 billion Btu each year.

In Europe the use of EPC is less widespread, as adoption has only slowly become a reality in some countries, and hardly at all in others, despite the fact that ESCOs have existed and been in business on a significant scale since the late 1980s.

Examples of EPCs underway in Europe include:[124][125]

Honeywell

- Transport for London (TFL) (UK)

The aim was a 25% carbon reduction target, across 22 buildings that had not been taken forward previously due to a lack of capital funding. Through an EPC arrangement with Honeywell the lighting and controls were upgraded, as were the energy management controls, the building fabric was improved, a CHP (combined heat and power) integrated energy system was installed and solar thermal hot water was installed. TFL's gas consumption was reduced by 20%, and electricity by 25%. The guaranteed energy savings were about EUR900,000 per annum and TFL witnessed a CO_2 reduction of 3,650t per year.

- Gwent NHS Trust (now Aneurin Bevan Health Board) (UK)
- Lievensberg Hospitals (Netherlands)
- Atrium Hospital Complex, Heerlen (Netherlands)
- St Elisabeth Hospital, Herten (Germany)
- Klinikum Landshut, Landshut (Germany)
- Hapimap Resort (Germany)
  In Winterberg Germany 190 holiday apartments that were built in 1994 were taken under an EPC arrangement. The measures adopted were the installation of CHP and modernisation and optimisation of the ventilation and control equipment in the swimming pool complex. A reduction of 110 tonnes of CO2 emissions each year has been achieved.

Siemens

- Brigittenau Swimming Pool, Vienna (Austria)

The challenge was a 25 year old swimming pool in Vienna that faced raising energy costs to heat the water, run the ventilation systems and dehumidify the interior. The water was heated with an inefficient district heating system. Through the EPC agreement solar collectors for heating pool water were installed, heat was recovered from the pool water, improved control of water flow and chlorine management was achieved, water treatment

[123] Case Studies from the Office of Energy Efficiency and Renewable Energy, http://energy.gov/eere/femp/energy-savings-performance-contract-case-studies
[124] Energy Solutions 2011, European building automation controls association: http://www.euesco.org/fileadmin/euesco_daten/pdfs/euESCO_response_concerning_EPC.pdf
[125] EPC Success Stories, www.euesco.org

systems were refurbished with water saving fittings, a condensing boiler was installed and a new building management system was installed. Collectively this reduced the energy used to heat the pool by 66%, and water consumption was reduced by 45%. The savings achieved were EUR200,000 annually.

- UniCredit Group, Milano (Italy)
- University of Art, Berlin (Germany)
- City of Berlin (Germany) (see below, Future Potential)
- Municipality of Amstetten (Austria)

Covering 27 buildings this EPC arrangement included a boiler upgrade, solar collectors for hot water, a rebuild of the hydraulic system, and energy management. Guaranteed energy cost savings of EUR75,000 per year, and a reduction of CO2 emissions of 25% per year were achieved from an initial investment of EUR735,000.

Schneider Electric

- Municipality of Nyköping, Sweden

The Municipality of Nyköping wanted to gain better control and tracking of facilities. The EPC agreed encompassed 123 properties (public buildings, schools and care centres), covering approximately 257,000m^2. The facilities had a savings potential identified as 17%, with a payback period of 11 years. Third party financing was used to implement a number of actions over two years, including the installation of a comprehensive building management system, with optimisation of operations, reduced operating hours and temperatures, pressure controlled circulating pumps, balancing of the heating system as well as knowledge transfer to facilities staff. Savings achieved were 25%, equivalent to EUR1.2 million per year.

- City of Örebro, Sweden
- Swedish University of Agricultural Sciences (SLU)
- Municipality of Hollola, Finland
- Municipality of Middelfart, Denmark
- University of Sheffield, UK
- Hoeje-Taastrup Municipality (Denmark)

The EPC arrangement covered 260 buildings that were a mix of old and new, and the measures undertaken include renovation of the ventilation system, eradicating the backlog of maintenance measures and the largest PV installation in Denmark (800m^2). This achieved a reduction of approximately 15% of energy consumption each year and 15% reduction in CO_2 emissions each year.

Johnson Controls

- Oranienstein Army Base (Germany)

An Army base in Germany, 37,000m^2 and with a range of buildings including a 17th Century Castle as part of the estate, undertook a range of measures including replacement of the boiler system with a new wood chip boiler, installation of two gas mini-CHP systems, changes of warm water supply for several buildings, replacement lighting system, etc. The savings achieved were 49% in terms of annual energy costs and a 55% reduction of CO_2 emissions.

- Community of Hude (Germany)

This EPC arrangement covers 9 buildings including four schools and the town hall, and runs for 12 years. The measures undertaken included a new heating and building control system in one of the schools, new metering for gas and electricity, new hot water boilers and improvements to the lighting systems. Annual energy costs were cut from EUR213,000 to EUR182,000, through the EUR250,000 investment and CO_2 emissions were reduced by 128t/year. There is also some budget relief for the due to the share on savings.

2.11.1.2 *Key impacts*

Environmental impacts (GHG emissions avoided, renewable energy generated)

The driving force behind the development and adoption of EPC is the desire to save energy and reduce emissions, providing both the benefit of achieving these aims and of achieving costs savings for the avoided energy consumption and potentially avoided charges for the emissions released.

Bringing technology to market

The EPC model uses the approach of life time costs to enable the installation of energy efficiency measures and renewable energy technology. Consequently this approach may help to bring to market relatively new technology that will pay for itself over its lifetime, but where the initial investment needed for the capital costs can appear prohibitive. This may be especially relevant to the public sector, with large estates and limited budgets especially since the 2008 financial crisis.

2.11.2 Current development stage

The use of EPC is well advanced particularly in the USA, where it originated, estimated to be worth 6.2 billion USD in 2013. In the UK and Germany such arrangements have been adopted by some large estate public sector organisations, including the National Health Service estate and hospitals (in the UK), and adoption in numerous countries throughout Europe is underway although it is still very early in the market development.

However Europe-wide the use of EPC is less widespread; adoption has only slowly become a reality in some countries, and hardly at all in others. The business model of EPC is still considered to be a relatively new and untested approach.

A review of the Energy Service Companies Market in Europe, 2010 (the last date for which results were published)[126] has a number of highly relevant observations about this market, and although the report is largely focused on the existence of ESCOs and the full range of services they provide, there is significant detail on the provision of EPC across Europe.

The information in Table below has been gathered from this report.

[126] Energy Service Companies Market in Europe, Status Report 2010, A. Marino, P. Bertoldi, S. Rezessy, B. Boza-Kiss, JRC-IE.

Table 2.11.1 Summary of the basic data on the energy service companies from a number of example countries, with EPC specific information gathered, 2010[127]

	Number ESCOs	Type of ESCOs	Sector ESCO Projects & main EE measures	EPC specific detail
Austria	5-14 Most offer EPC	Private and public. Mainly Energy service & supply companies and consulting/engineering firms	Supply side projects, complex building projects involving more energy services, and street or indoor lighting	Municipalities and, most importantly, the federal state created a steady demand for EPC through energy performance contracting tenders for their own building stock and for street lighting. This has created a significant market push. Yet, so far, no "spin-off" effect to the private building sector can be observed. In the public sector, the Federal Contracting Initiative accounts for 30% of the annual EPC investments. The energy agencies are involved in marketing, providing advice on how to use the EPC approach (including information and advice activity for utilities), and acting as impartial advisors. Most EPCs use the guaranteed savings model.
Belgium	1 public, 7 large, and 5-7 small	Larger international manufacturers of building automation & control systems	Public buildings, HVAC and control and cogeneration	The large international companies offer EPC contracts with guaranteed savings and account for 70-80% of the EPC market value. Fedesco (public ECSO) is organising stakeholders and facilitating EPCs in the public sector, for example by an initiative to retrofit federal public buildings, partially using EPC.
Czech Republic	8-10, all offer EPC	Manufacturers of building automation & control systems and energy services and supply companies	Public buildings involving HVAC-control system installation, boiler houses, lighting and pipes insulation.	EPC was introduced in 1994-1995, with a €3 million investment to improve the energy efficiency of public healthcare, and further progressed in 2001 with the obligation for large energy consumers to perform energy audits. A template contract has been developed for EPCs, which is used in most public tenders and is based on a financial guarantee of savings, where the financing is provided by the ESCO. The market potential for EPC projects (excluding residential projects and projects with payback time exceeding 10 years) is estimated at about €20 million annually. About 1/3 of this potential lies in the public sector (including schools, healthcare, administration, etc).
Germany	250-500 ESCOs Around 50 have more than one EPC reference	Energy suppliers and manufacturers of building automation & control systems	Public and private non-residential building projects and Cogeneration, district heating and renewables through CEM	The value of EPC projects accounts for a small part of the market, estimated to €250 million to €350 million /year. There are a number of SMEs with EPC as their main activity.
Latvia	5	Engineering consulting firms and energy services and supply companies	Co-generation & other supply side projects industrial sector involving more energy services	The most common contracts offered are EPCs with guaranteed or with shared savings. Projects are financed through loans from local commercial banks and subsidiaries of foreign commercial banks and state subsidies.
Poland	3-10	Energy services and supply companies	Street and indoor lighting and co-generation in the public sector	No mention of EPC activity. Highlighted that potential customers are not willing to pay to outsource the risk of energy efficiency measure performance due to in-house expertise in the municipal and industrial sites and most Polish ESCOs do not have the capital base to finance projects themselves or through commercial banks.
Sweden	5-10 EPC providers, with up to 70	International medium sized manufacturers of building	Mainly modernization and refurbishment of public	The domestic EPC market is reported to have developed significantly 2007-9.

[127] Data taken from reference Status report 2012 – Se reference 120.

	Number ESCOs	Type of ESCOs	Sector ESCO Projects & main EE measures	EPC specific detail
	employees in the relevant divisions.	automation & control systems and facility & operation companies with EPC as a side business.	buildings involving lighting, HVAC, complex refurbishments and fuel switch	Provision of EPC is mainly from a small number of international companies, where EPC is offered as supplementary to their core business and smaller companies with energy service as their core business. The significant political impetus behind energy efficiency measures has spurred this area to develop, and the Swedish Energy Agency works to help the adoption through providing information and guidance on procurement processes.
UK	15-20 ESCO 5-6 offering EPC	Subsidiaries of large international manufacturers of building automation & control systems and energy service & supply companies	Public sector complex building projects and co-generation, district heating and supply side projects	EPC are to date adopted by industrial sites, hospitals, universities and for some district heating schemes.

2.11.3 Elaboration of the model

2.11.3.1 *Organisational aspects*

Actors involved, their role and interests

There are two principal actors: the owner/operator of a large building or estate; and the ESCO specialising in achieving energy saving measures through the use of EPC.

The owner/operators are the customers, often managing large and complex estates, with a desire to reduce their energy consumption, their emissions and the corresponding costs of these. Industrial entities and private entities may have both the technical expertise and the capital available to them to invest themselves, and not need to explore the EPC route. Consequently EPC are often found in the public sector.

The ESCOs are for the most part large multinational companies, although SME (small and medium enterprises) based activities do exist, all usually specialising in areas that relate to large scale building management such as facilities management or building controls. Generally EPC is offered as a supplementary part of the services offered by the company as a whole. These companies will bring highly specialised knowledge of energy efficiency technologies and building controls that the customer organisation may lack.

The third key player is the financial lender, which may be the ESCO itself, or may be a third party whose involvement is the provision of capital.

Different countries have differing financing and accounting requirements that must be adhered to.

Set-up of the model

As described by the JRC-IET, an EPC project may include one or many of the following elements:[128]

- Site survey and preliminary evaluation;
- Investment grade energy audit;
- Identification of possible energy saving and efficiency improving actions;
- Financial presentation and client decision;
- Guarantee of the results by proper contract clauses;
- Project financing;
- Comprehensive engineering and project design and specifications;
- Procurement and installation of equipment; final design and construction;
- Project management, commissioning and acceptance;
- Facility and equipment operation & maintenance for the contract period;
- Purchase of fuel & electricity (to provide heat, comfort, light, etc.);
- Measurement and verifications of the savings results;
- Operation and maintenance.

The key features that makes the arrangement an EPC one are the provision of financing for the installation of energy efficiency or renewable energy measures by the ESCO (or through the ESCO), and that the ESCO takes on a measure of, or all of, the risk in delivering the energy savings. The ESCO derives their financial benefit from the energy savings achieved over the duration of the contract.

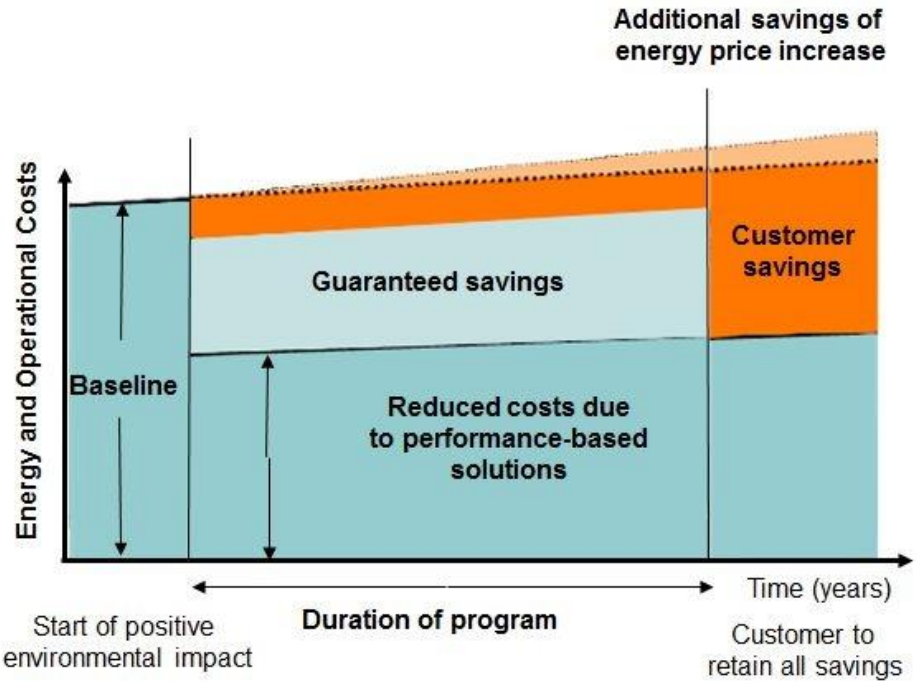
2.11.3.2 *Economic aspects*

The potential economic advantages are the key driving force and key advantage of the EPC model. The initial up front capital costs are provided from (or through) the ESCO, and may not otherwise be available to the customer. The financial benefit is then derived by the ESCO

[128] Energy Service Companies, Joint Research Centre, Institute for Energy and Transport, 2014, http://iet.jrc.ec.europa.eu/energyefficiency/esco

over the duration of the contract by the ESCO gaining the benefit from the difference of the original energy costs, to those reduced through its installation of energy efficiency or renewable energy technologies.

Figure 2.11.2 Energy Performance Contract approach, according to eu.bac[129]



The main characteristics of an EPC arrangement are defined by the JRC-IET as:[130]

1. ESCOs guarantee energy savings and/or provision of the same level of energy service at lower cost. A performance guarantee can take several forms. It can revolve around the actual flow of energy savings from a project, can stipulate that the energy savings will be sufficient to repay monthly debt service costs, or that the same level of energy service is provided for less money;
2. The remuneration of ESCOs is directly tied to the energy savings achieved;
3. ESCOs can finance, or assist in arranging financing for the operation of an energy system by providing a savings guarantee.

There are two standard approaches to EPCs are:

- Those that deliver guaranteed savings
- Those that deliver shared savings.

An important difference between guaranteed and shared savings models is that in the former case the performance guarantee is the level of energy saved, while in the latter the cost savings are split at the agreed percentage for an agreed length of time. This represents a difference in the level of risk accepted by the parties involved. Most ESCOs prefer to use the guaranteed savings model, according to the report produced by eu.bac,[131] assuming all of the design, installation and savings performance risks. However the ESCO is unlikely to assume the credit risk of repayment of the programme costs by the customer, which are retained by the customer.

[129] About EPC, eu.bac: European Association of Energy Service Companies, www.euesco.org,
[130] Energy Service Companies, Joint Research Centre, Institute for Energy and Transport, 2014, http://iet.jrc.ec.europa.eu/energyefficiency/esco
[131] Energy Performance Contracting in the European Union, 2011, eu.bac, eu.bac ESCO.

According to the eu.bac report:

"The ESCO does this under a guaranteed savings contract by assuming the entire design, installation and savings performance risk. However the ESCO does not assume the credit risk of repayment of the programme costs by the customer. A key advantage of this model is that it provides the lowest financing cost because it limits the risks of the financing institutions to their area of expertise, which is assessing and handling the customer's credit risk. The customer repays the loan assumes the investment repayment risk. However, due to the guarantee, if the energy consumption savings are not enough to cover debt service, then the ESCO has to cover the difference. If savings exceed the guaranteed level, generally the customer keeps these".

An alternative approach to this area is the use of an Energy Service Provider Company (ESPC). Such companies offer an alternative service to final energy users that may encompass installation of more energy efficient equipment, the supply of energy, facilities management, etc. The difference between these arrangements and those of EPC, is that considerably less risk is taken on within an ESPC arrangement, than within EPC for the ESCO. Generally a fixed fee, of the added value of the equipment, is the financial arrangement, so the risk is carried by the end energy user. It has been identified that often the full costs of the energy services are recovered in the fee, so the ESPC does not assume any risk in case of underperformance.
The table below summarises the main performance based energy services contractual arrangements:

Table 2.11.2 Comparison Table for Energy Contract Types, source eu.bac[132]

	ENERGY PERFORMANCE CONTRACTING (EPC)	SHARED SAVINGS	ENERGY SUPPLY CONTRACTING (ESC)
Agent	• ESCO	• ESCO	• Energy Supply Service Company
Key characteristics	• Implementation of technical measures (ECM's) with ongoing M&V services to provide guaranteed energy savings (kWh)	• Implementation of technical improvements to provide cost savings associated with the overall energy bill	• Supply a set of energy services via the *outsourcing* of the central energy plant (primary energy conversion equipment) providing heating and/or cooling to the end-use equipment
Energy savings potential	• High. Comprehensive and detailed approach via Investment Grade Audits-IGA covering both on-site energy conversion and demand side	• High. ESCO's primary focus and incentive is for energy cost savings with technical operation requirements as secondary	• Low. Limited to the central energy plant (boilers, chillers, etc.) without regard to demand-side equipment (AHUs, building envelope, space htg, lighting, ...)
Energy efficiency guarantee	• The ESCO guarantees the performance related to the level of energy saved throughout the contract life	• The ESCO guarantees the performance related to cost of energy saved throughout the contract life	• The ESC may have incentives related to energy use reduction, but without assuming any risk in case the expected efficiency is not reached
Payment	• Directly related to the energy savings achieved	• Value of payments is linked to energy prices	• Payment is at a fixed rate/tariff without any energy performance (efficiency) requirements
Contractor's risk	• Assumes technical design, implementation and performance guarantee risks	• Assumes performance and customer credit risk	• Usually does not assume tech risk (energy efficiency) neither financial risk
Energy efficiency improvement transparency	• High. The energy efficiency is measured before and after (throughout the contract life) of ECMs implementation typically following IPMVP "*International Performance Measurement and Verification Protocol*" (www.evoworld.org)	• Low. The goal is purely cost savings related to energy. Scope of work and services are not clearly defined and at the descretion of the ESCO	• Low. An specific energy bill reduction is stablished (in euros, not in kWh). Usually the contract does not take into account the measurement of the energy efficiency

[132] Energy Performance Contracting in the European Union, 2011, eu.bac, eu.bac ESCO.

2.11.3.3 *Legal and regulatory aspects*

The EU Directive 2006/32/EC on Energy End-use Efficiency and Energy Services, the Energy Services Directive, is a key piece of legislation that established much of the language around energy service companies within Europe. The purpose of the Directive was to drive improvements in the end use of energy, establishing the institutional, financial and legal frameworks needed to eliminate market barriers and imperfections which prevent the efficient end use of energy. The Directive creates the conditions for the development and promotion of a market for energy services and for the delivery of energy-saving programmes and other measures aimed at improving end-use energy efficiency, i.e. EPC as one such solution.

The adoption of EPC by public institutions may be hampered by national legislation and procurement rules that prevent such contracts, see below Barriers and Solutions.

To facilitate the uptake of EPCs the Berlin Energy Agency developed two standard contracts for EPC.[133] These standard contracts obviously refer to German Industry Standard terms and conditions for construction and public tendering as well as other German standards, but perhaps offer a good start point for standardisation, and represent the efforts that have been achieved in Germany in terms of standardisation.

2.11.3.4 *Technical aspects*

The technical aspects of EPC relate to the contractual arrangements between the two main actors – the customer/end energy user and the ESCO providing the service.

There are two different contracting models: shared savings and guaranteed savings. Within a shared savings arrangement the savings achieved through reduced consumption of energy, water, reduced emission, etc, are split between the customer/end energy user and the ESCO. The particular details of this split depend on the contractual arrangements agreed, but common aspects that will vary between contracts include the length of time the split exists over and the percentage arrangements of the spilt. Here the performance guarantee is the level of energy saved. Within a guaranteed savings contract the ESCO themselves guarantees a particular level of energy savings. This serves to shield the customer from any performance risk, with the ESCO accepting this risk. The performance guarantee here is the cost of energy saved.

2.11.3.5 *Social and cultural aspects*

Energy Performance Contracts (EPCs) are usually contractual arrangements between an ESCO and public sector institutions. The financial benefit is derived by the ESCO from the difference of the original energy costs and those achieved through the installation of energy efficiency or renewable energy technologies. Hence the ESCO makes its profit directly from the saving of energy, and this situation some organisations, or individuals within organisations, may not support and may fund unsatisfactory.

The successful undertaking of EPCs will likely require a close working relationship between the public estate facilities management and the ESCO team and the equivalent of board level ‘buy in’ within the public estate to drive the changes. The public estate must also be able and willing to adapt their behaviour, work space and facilities potentially to enable the improvements to be made. Again this will require support and ‘buy in’ throughout the organisation.

2.11.3.6 *Risks*

The main risk to EPC is their financial viability with respect to the guaranteed savings that need to be delivered for the ESCO to realise their financial payback.

[133] Berliner Energie Agentur, Energy Performance Contracting, http://www.berliner-e-agentur.de/en/topics/energy-performance-contracting

Energy prices may fall, or not increase as quickly as anticipated, in which case the payback period of any projects utilising an EPC arrangement will be undermined.

The contracts formed under EPC are likely to be relatively long lived contracts. This means that the customer will be unable to have the full flexibility to change contracts as regularly as perhaps had been undertaken previously, and the level of interaction between the customer and the EPC company may need to be greater to ensure that maximum benefits are achieved.

2.11.3.7 *Key enablers*

In order for EPC arrangements to become more wide spread and more widely adopted there are a number of enablers that are necessary.

Two obvious requirements are that companies capable of offering EPC need to exist in the area concerned, and these will likely need to have access to credit to enable the contract to be developed.

National procurement laws must enable this type of long term contract to be taken out by public authorities, and this requirement has necessitated development of the regulatory framework in a number of countries to facilitate this.

2.11.4 Current barriers and potential solutions for up-scaling

2.11.4.1 *Barriers*

EPC may be relatively unknown and untrusted by the groups that are actually best placed to take advantage of it. Hence a significant barrier is both a lack of knowledge that the framework exists, and a reluctance to adopt a relatively new approach to managing one's energy requirements. This may stem from a lack of confidence in the concept, a lack of experience in implementing an EPC arrangement and that it is a challenge to commit to the duration of time required.

There is also the barrier that the number of ESCO companies who are able to offer EPC may be low or non-existent in particular countries or areas of Europe.

Public institutions may also identify a barrier within their own public procurement rules and within legislation that prevents them adopting such contractual arrangements, or makes it more challenging. A further barrier may be that many institutions, both public and private, are not willing to adopt a new approach to the provision of energy in this way, or indeed find the concept of profiteering from environmental benefits unacceptable.

A lack of good energy consumption data makes the establishment of baselines challenging, and reduces the will to drive energy savings. The matter of energy efficiency and how to drive improvements is often not high on a board's or corporate agenda, and may hinder the identification of this as a priority area. Alternatively, and commonly, companies and institutions may have good in house knowledge and do not see the need to outsource management of their energy requirements.

Relatively low energy prices will have the result of making EPC less attractive as the pay back times will increase proportionally. In addition the financial crisis of 2008 and its after effects have most likely not been advantageous for the roll out of EPC, as organisations simply retrenched financially, and may only now be beginning to look for more long terms solutions and approaches. Furthermore the crisis limited the supply of credit, which will have had an impact on new EPC arrangements. The longer term solutions now present an opportunity for EPC to become more widely accepted and adopted.

The European ESCO Status Report 2007 listed 10 major barriers in Europe, many of which will apply to EPC:[134]

[134] Energy Service Companies Market in Europe, Status Report 2010, A. Marino, P. Bertoldi, S. Rezessy, B. Boza-Kiss, JRC-IE.

- Low awareness of and lack of information about the ESCO concept;
- Mistrust from the clients;
- High perceived technical and business risks;
- Public procurement rules and accounting rules (including off balance sheet regulations);
- Lack of accepted standardized measurement and verification procedures;
- Administrative hurdles and consequently high transaction costs;
- Principal/agent dilemma with split incentives in the housing sector;
- Aversion to outsource energy;
- Lack of appropriate forms of finance (EPC is one potential solution to this barrier);
- Low priority of energy efficiency measures.

2.11.4.2 *Potential solutions*

There are solutions to overcome the barriers identified above. Increasing awareness of the existence of EPC, of the potential benefits and of successful examples will help to promote this approach. If the dissemination of such information and the provision of advice comes from public bodies then a greater degree of legitimacy is given to the business model itself, and to the EPC providers. The JRC-IET report in 2010 identified that there were limited policies and actions designed to specifically support the ESCO market and correspondingly EPC arrangements.

There are examples where local authorities are permitted to retain the financial savings generated from energy saving projects, which has a significant impact on both their ability and their willingness to enter into long term contractual arrangements such as EPC. Public authorities providing guidelines, model contract templates, guidance on calls for tender and other supporting material will also likely enable a wider audience to approach EPC for the first time.

Ensuring that public procurement approaches enable such a contractual arrangement is key and has been identified as the main barrier for the whole ESCO area[135]. Although many European countries have already taken steps in the right direction on this matter, public procurement remains a complicated area and there are a number of requirements that may hamper this approach. An example quoted in the JRC-IET report is that in Spain long term service contracts were not permitted, but in 2007 this was rectified and contracts up to 20 years are now allowed, while in France the legally regulated contractual agreements for project development are identified as a major barrier, and in Croatia VAT needs to be paid on the equipment at the point of installation by the ESCO and this is often prohibitive.

Requiring life cycle costs, including maintenance and energy costs, to be used as the basis for procurement decisions will also benefit the identification and adoption of measures that have long pay off periods, and EPC may benefit from this change of approach.

The JRC-IET Report provides evidence of increased awareness of the EPC contract arrangement, and a greater degree of trust is awarded to providers than previously. The environmental agenda and the business case for energy efficiency have moved on and energy efficiency and renewable energy provision have risen up the agenda of institutions and organisations. Potentially even the commercial agenda has moved on, whereby bringing in a commercial enterprise to work with an organisation to reduce their energy needs, and potentially to make a profit from such an arrangement, is seen as more acceptable than it was a few years before.

The recently agreed Energy Efficiency Directive, (entered into force in 2012, with provisions to be implemented by June 2014) requires member states to renovate public buildings, introduce energy efficiency obligations and establish financing facilities for such measures,

[135] Same as reference 133

and thus strengthens the climate for the use of EPC.[136] Recognising this, DG Energy, Energy Efficiency area, is working with a number of organisations including the EIB's PPP expertise centre (European Investment Bank, Public-Private Partnership) (EPEC), ManagEnergy Initiative and the Covenant of Mayors, to launch an EU-Energy Performance Contracting Campaign intended to support Member States and the market actors in this area. The aim is country specific awareness raising, building confidence and establishing a legal and financial framework for the market of energy services, to be achieved through capacity building seminars, running in 2014 and 2015.

2.11.5 Future potential

2.11.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

EPC is expanding across Europe, and there is the potential for this funding model to be widely adopted in the public, industrial and potentially in the residential sector. An increasing demand for energy management services should translate to some degree into increased demand for EPC, especially within the public estate, where following the financial crisis of 2008, access to large sums of initial capital for investment is exceedingly rare.

An interesting example to focus on is the case of Berlin. The Senate of Berlin has been using EPC since 1996, with the Berlin Energy Agency an early and holistic adopter of EPC. The Berlin EPC agreements encompass over 500 sites, with over 1,300 public buildings including public swimming pools, schools, correctional facilities, Universities and the town hall. Berlin has successfully achieved average energy savings of 26% across the 25 different energy partnerships within the scheme.

Part of the agreement is with Siemens, covering 164 sites, under a 12 year contract. Measures undertaken include renewal of air conditioning systems, replacement of lighting systems, installation of water technology and improvement controlling, monitoring and maintenance measures. There is an immediate budget reduction for Berlin of EUR1.14 million, and EUR5.3 million energy costs saved annually. The guaranteed savings for Berlin over the duration of the contract are EUR47.7 – 63.6 million, and 29,000 tonnes per year reduction in CO_2 emissions (25%). In total ESCOs have invested EUR40 million in energy efficient equipment in Berlin, in over 1,400 buildings, and produced more than EUR10 million in savings as well as savings of 60,000t CO_2 per year (26%).[137]

Berlin has a population of 3.5 million[138], and only London is larger in Europe. If the assumption is made that the largest 10 cities in Europe could achieve similar savings with a holistic approach to their public estate then the following results are generated:

[136] Energy Efficiency, Energy Performance Contracting Campaign (ECPP), http://ec.europa.eu/energy/efficiency/financing/campaign_en.htm
[137] Policy: Energy Performance Contracting, Future Policy.org, http://www.futurepolicy.org/2723.html
[138] Note: Urban Audit data is not comprehensive and not always reliable as it combines a wide range of national sources

Table 2.11.3 Potential carbon savings and financial savings in European cities

City	Population (million)	t CO_2 saving per year	EUR saving per year
Berlin	3.5	60,000	10,000,000
London	8.3	142,286	23,714,286
Madrid	3.3	56,571	9,428,571
Rome	2.6	44,571	7,428,571
Paris	2.2	37,714	6,285,714
Bucharest	1.9	32,571	5,428,571
Vienna	1.6	27,429	4,571,429
Hamburg	1.7	29,143	4,857,143
Budapest	1.7	29,143	4,857,143
Warsaw	1.7	29,143	4,857,143
Barcelona	1.6	27,429	4,571,429
Munich	1.2	20,571	3,428,571
SUM		**476,571**	**79,428,571**

If it is assumed such an approach would have relevance and could be applied to 20% of Europe (75% of Europeans live in urban areas):[139]

Table 2.11.4 Potential carbon savings and financial savings across Europe

	Population (million)	t CO_2 saving per year for 20% of population	EUR saving per year for 20% of population
Europe	739.2	2,500,000	420,000,000
28 European MS	505.7	1,700,000	290,000,000

Each of these figures is a per year value, taking these numbers forward to 2050 is simply a matter of scaling up by 36 years, so for 10 European cities 2.8 billion EUR would be saved, and for 20% of Europe 10 billion EUR would be saved.

It is reported by a number of ESCOs that throughout the lifetime of an EPC arrangement closer contact between the customer organisation and the ESCO is needed than many customers initially anticipate. This potentially represents an increase in the number of jobs surrounding each EPC arrangement. This, together with the additional people employed at energy service companies, to carry out the EPCs, is further job creation.

Furthermore the potential to save EUR80 million from public municipality budgets each year means that this money can be re-invested elsewhere, with the potential to create further employment opportunities. Spending EUR80 million on infrastructure projects for example would potentially create 2,400 jobs per year or 86,400 jobs to 2050.[140]

[139] Urban Environment, European Environmental Agency, http://www.eea.europa.eu/themes/urban
[140] An Economic Analysis of the Sector: UK Construction, Department for Business Innovation and Skills, July 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210060/bis-13-958-uk-construction-an-economic-analysis-of-sector.pdf. 90 billion GBP, 110 billion EUR, 2.93 million jobs. Fiscal Spending Jobs Multipliers: Evidence from the 2009 American Recovery and Reinvestment Act" (San Francisco, CA: Federal Reserve Bank of San Francisco, 2011), Daniel J. Wilson, p. 33, http://www.frbsf.org/publications/economics/papers/2010/wp10-17bk.pdf. 48.3 billion USD, 35.5 billion EUR, 1.1 million jobs. Both yield approximately 1 million EUR produces 30 jobs.

2.11.5.2 ***Replicability***

EPC is highly replicable, as the concept itself is relatively simple, and each specific contract is specific to the situation it covers. Initially the focus was energy efficiency, whereas more recent developments are also embracing renewable energy installations.

Such an agreement could potentially be rolled out to encompass the provision of: CHP technology; water efficiency and water harvesting; refrigeration; and of energy procurement. There is even the possibility that EPC could be applied to behaviour change, although in this case it can be challenging to identify accurate statistics to demonstrate the savings. All of these could potentially be provided under the one EPC type arrangement as a suite of measures.

2.12 Municipal Bonds

2.12.1 Background

2.12.1.1 *Description of the model*

Where does it come from

Municipal bonds are debt securities issued by local authorities, generally to raise funding for their daily operations or for specific projects, such as the development of roads, bridges, hospitals or schools.[141]

Issuers of municipal bonds may be states, cities, counties, development agencies, publically owned infrastructure such as airports and sea ports.

There is a long history of municipal bonds being issued to fund the building of infrastructure projects internationally, with the first officially recorded municipality bond issued by New York City for the building of a canal in 1812 in the USA.

How it works

Municipal bonds pay interest to holders on a regular basis over a predetermined period. At the end of that period, the bond reaches its maturity date and the full amount of the original investment is returned to the bond holder. Municipal bonds come in all maturity ranges, from very short-term instruments to 30-year bonds. Depending on the specifications of the bond, it may be tax-exempt, as is often the case in the USA.

The two most common types of municipal bonds are general obligation (GO) bonds and revenue bonds.

- *General obligation bonds:* GOs are unsecured bonds backed by the full faith and credit of the issuing authority. These are generally paid off with funds from taxes or fees, and are considered the safest of municipal issues. For that reason, they offer lower yields.
- *Revenue bonds:* Revenue bonds are issued to fund projects that will eventually generate revenue (e.g. a toll road), and that revenue is used to pay off the bonds. Because they are considered somewhat riskier than GO bonds, revenue bonds typically offer higher yields.

Aims

Municipal bonds offer investors the opportunity to support projects that can directly benefit their local community. They offer a local alternative to limited, sometimes uncertain, funding sources from central Governments.

[141] http://www.investopedia.com/articles/bonds/05/022805.asp

In addition, municipal bonds have a range of other financial benefits which contribute to their appeal to investors:

- They offer investors a reliable source of income and a high degree of safety relative to many other types of fixed income assets. Generally speaking, municipal bonds are considered safer than corporate bonds, for the simple fact that governments are less likely than companies to fail and default on their obligations.
- They can accommodate longer maturities than bank loans.
- The costs of borrowed funds are usually lower than the cost of a long-term loan.
- They can benefit from tax exemptions, as is often the case in the US.

Examples

Kommuninvest is the Swedish local government debt office, a Cooperative Society, which began in Sweden 28 years ago as a plan to realise credit for one county council and ten municipalities through pooling their borrowing needs. The organisation now provides not only finance, but finance advice skills development and cooperation. In 2013 the organisation lent SEK208.6 billion (just over EUR23 billion). Kommuninvest has 279 members: 271 municipalities and 8 county councils (there are 310 municipalities in Sweden). This organisation is rated as AAA/Aaa by the credit rating institutions Moody's and Standard and Poor's, and has had this rating even since it was first rated.[142] The range of options it offers are described as follows:

- Maturity – from one month to 30 years.
- Exposure – from standard to structured.
- Currency – any currency subject to agreement.
- Size – minimum USD 5M, EUR 5M, JPY 50M.

During the financial crisis Kommuninvest was one of the few sources of credit available to municipalities. Its success also promotes local government as a sound investment. Its funding has been used to finance road networks, sea ports and renewable energy. Municipal housing companies accounted for 30% of total lending in 2013.[143] Kommuninvest had 66 employees in 2012.

Municipality Finance, MuniFin, was launched in Finland in 1990, and is owned by the government, councils and Keva (the body responsible for public sector pensions).[144] The intention is to ensure that the provision of affordable financial services for the local government sector under all market conditions and in 2013 it had a total lending portfolio of EUR17.8 billion. It raises funds from international and domestic investors through issuing various types of bonds, which are in high demand internationally. The company is rated as Aaa by Moody's and AAA by Standard and Poor's. The company also provides financing for central government subsidised housing production. The 2013 Annual Report states that:

"Municipality Finance maintained its position as by far the largest lender for its customer base like in recent years. At the same time banks' interest in local government long-term financing remained weak. The company continued to be essentially the sole financier for the central government subsidized housing funding."

MuniFin has 83 employees, and in 2013 lent 41% to housing corporations. In the Annual Report it also highlights activities of financing new replacement street lighting, energy efficiency technology and the installation of wind farms.

France launched a local government bond agency in October 2013, the **Agence France Locale.** The funds raised will be spent on local infrastructure developments and further

[142] Kommuninvest, Swedish Local Government Debt Office, 15th May 2014, http://www.kommuninvest.org/en-gb/investor-relations/financial-information/onepager.php
[143] Kommuninvest Annual Report 2013.
[144] Municipality Finance Plc, Annual Report 2013, http://www.kuntarahoitus.fi/en/financial-reports.html

projects. At the point of launch 11 member authorities signed up, including Bordeaux, Lille and Lyon, with the French government backing the scheme. By February 2014 a further 15 further members had joined, giving a total membership of 26 communities.[145] The organisation is made up of two companies: a cooperative society that sets the strategy and a financial firm that will issue the bonds and monitor the investments. The total spend represented here is 53 million EUR, or 17.7 million per year until 2016.

2.12.1.2 *Key impacts*

Provision of Funding

The primary function of municipal bonds is to provide financing for local government institutions. Having the funds available to invest in projects ensures that the benefits to be delivered by the project, whatever they are, are able to be delivered. Without such funds available it is highly likely that many projects would not be undertaken. The funds raised by municipal bonds enable projects to happen, possibly with an earlier start date for the benefits as the date of completion of a project has been facilitated by the available funds. It may also be that without this funding mechanism the project would not progress at all.

Environmental impacts (GHG emissions avoided, renewable energy generated)

Where the project to be funded delivers environmental benefits, all or part of such benefits can be attributed to the funding mechanism itself as the enabling factor, in this case the municipal bond. If the project is the installation of a renewable energy technology, the generation of clean energy and the corresponding reduction of GHG emissions is an impact. If the project is the renovation or building of social housing, with lower energy use then existing housing, then the reduction in energy use is the impact.

Social Impacts

Several examples of municipal bonds issued above address the matter of the provision of social housing. Providing improved social housing brings obvious social benefits to communities, improved conditions to live with potentially better access to suitable water, transport, education, support networks and the better outcomes associated with a beneficial place to live.

Economic Impacts

Many, if not all, projects have a beneficial economic impact, and where the project is enabled through the provision of funds from the municipal bond, this is a direct impact. For example the provision of social housing has significant economic benefits, as does the creation of transport links such as roads and sea ports.

2.12.2 Current development stage

Municipal bonds are well understood instruments and are widely used in the US. However, in Europe their use is less widespread, although the market is growing rapidly.

In Europe, the sub-sovereign (i.e. sub-national) market is primarily dominated by agencies and supranational institutions such as the World Bank, KfW[146] and the European Investment Bank (EIB). As European countries have increasingly become one market, the growth of the sub-sovereign bond market has been significant as well.[147] This is in part because effective government needs to finance day to day operations of public services and capital

[145] First Capital Increase of Local Agency France, Agence France Locale, http://translate.google.co.uk/translate?hl=en&sl=fr&u=http://www.agence-france-locale.fr/&prev=/search%3Fq%3DAgence%2BFrance%2BLocal%26rlz%3D1C1EODB_enGB573GB573%26es_sm%3D93

[146] KfW is a German government owned development bank, set up in 1948 as part of the Marshall Plan. Bonds issued are guaranteed by the federal government. 90% of lending is within Germany (with a small amount within other European countries), with the remaining 10%lent internationally. https://www.kfw.de/KfW-Group/About-KfW/Identit%C3%A4t/Geschichte-der-KfW/

[147] Types of Bonds, http://investinginbonds.eu/pages/learnaboutbonds.aspx?folder_id=472

infrastructure investments in roads, hospitals, bridges, reservoirs, etc. at the same time as sovereign governments have debt ceiling limits.

As mentioned earlier, the market is developing in Europe. Some examples of relevant developments in Europe include:

- Denmark, Sweden (Kommuninvest), Finland (MuniFin), Norway, the Netherlands and France already have Municipal Bonds Agencies.[148]
- In Leeds, UK, the successful close of a £101.8 million wrapped bond issued by the "Sustainable Communities for Leeds (sc4l)" consortium was recently announced.[149] It will finance the redevelopment of the Little London, Beeston Hill and Holbeck areas of the city through the refurbishment of 1,245 homes plus external works to 51 leaseholders and construction of 388 new homes. This will create an improved community estate with predominately family housing, together with new parks and play areas, reinvigorating a community and economic hub close to the centre of Leeds. The bond was issued for 19 years.
- In response to a reduction in the budget provided to local authorities by central UK Government and an increase in rates from the Public Works Loan Boards (where public borrowing normally comes from) some local authorities have explored the possibility of using municipal bonds. More specifically, via the Local Government Association, they are considering the possibility of creating a capitalised local authority-owned collective agency which could raise funds from bonds markets, and lend it onto local authorities at competitive rates. In December 2013, the Local Government Association announced plans to proceed to a more detailed phase of setting up the agency, now backed by 18 councils, and based on similar bodies in other European countries.[150]
- Croatian authorities have often relied on municipal bonds over the last ten years.[151]
- In 2005, a Eurobond of €500m was issued by Bucharest to finance a range of transport projects. This was the largest Eurobond offering by a local or regional authority in Europe at the time.[152]
- In Germany, 2013, Nuremberg and Wuerzburg Municipal Bond was launched by these two cities, and was oversubscribed by 4.5 times.[153] This is the first time that a joint bond has been issued in Germany.

2.12.3 Elaboration of the model

2.12.3.1 *Organisational aspects*

Actors involved, their role and interests

Municipal bonds involve a range of actors:

- Local authorities, who may be the issuer of the bond
- A municipal bond agency if there is one in place, who will supersede the local authority as the bond issuer
- Central government / central tax authorities on issues of tax exemptions or changes to tax rules
- Individuals and businesses as investors
- Financial services professionals, brokers and banks used to advise the other actors
- The national Stock Exchange if the bonds are to be listed

[148] http://newstartmag.co.uk/features/learning-from-europe-municipal-bonds/
[149] http://assuredguaranty.newshq.businesswire.com/press-release/transactions/assured-guaranty-successfully-closes-first-wrapped-bond-uk-ppp-transactio
[150] http://opinion.publicfinance.co.uk/2013/12/the-name-is-municipal-bond/#sthash.i5H0kQ0t.dpuf
[151] Municipal Bonds, http://www.nalas.eu/borrowing/3_3.html
[152] Municipal Bonds, http://www.nalas.eu/borrowing/3_3.html
[153] Municipal Finance Agency, http://www.kofin.de/index_en.htm

- Insurance companies, if the bonds are to be insured
- The investors.

The market for sub-sovereign bonds in Europe has less individual participation than in the USA; individual investors in the US municipal bond market also enjoy significant tax advantages for their investments.

Set-up of the model

Issuers of municipal bonds may be states, cities, counties, development agencies, and publically owned infrastructure such as airports and sea ports. The issuer (the municipality) sells the bond to the bond holder (the investor). The bond holder then lends the issuer a set amount of money for a set period of time and in exchange receives agreed regular scheduled interest payments.

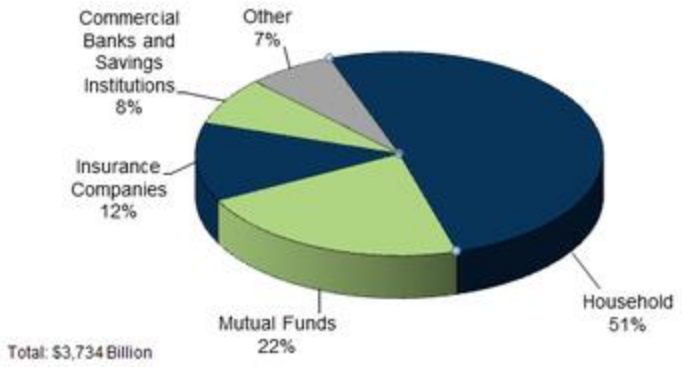
In the USA almost half of all bonds are insured,[154] meaning that an insurance company buys the bonds themselves and resells them to investors. Hence such bonds carry the guarantee that even if the original bond issuer defaults the insurance company will provide the interest payments for the duration of the agreement and the principal at the maturity date. Insured bonds generally carry a lower interest rate, because of the lower risk to the investor.

2.12.3.2 *Economic aspects*

A successful and extensive bond market exists in the USA, and there are several examples of successful organisations and markets existing in Europe, especially in Scandinavia. Hence development of a successful municipal bond market is achievable.

Achieving such a market that operates Europe-wide is likely to be challenging given the variety of regulation and legislation in the different European Countries, as well as the variation of fiscal practices, market structures, market liquidity, etc. Market growth is occurring, and there is significant interest, but the structure of European financial markets and national regulation may limit the market to nationally based systems rather than European-wide arrangements.

Figure 2.12.1 Holders of Municipal Securities Outstanding in the US as of September 2011.



Source: Federal Reserve Flow of Funds, December 2011.

As shown in Figure 2.12.1 above, households own over half of US municipal bonds, half of USD3.7 trillion. Bond ownership is very stable, with most investors buying and holding bonds until they reach maturity.[155] US banks hold less than 10% of such bonds, because the tax exemption does not apply to such investors. Bond ownership is also likely to be stable by state, as it is common for the ownership of municipality bonds to be tax exempt in the issuing state.

[154] How Municipal Bonds Work, http://money.howstuffworks.com/personal-finance/financial-planning/municipal-bond1.htm
[155] The Municipal Bond Market and the EU, Reuters, 2011, Cate Long, http://blogs.reuters.com/muniland/2011/12/23/the-municipal-bond-market-and-the-eu/

Meanwhile in Europe, most sovereign (country level) bonds are held by European banks, and there is deep connectivity between banks and sovereign bonds across Europe. Sub-sovereign bonds from Europe can be targeted at a diverse range of investors, both domestic and international, with MuniFin releasing a bond in 2013 targeted specifically at investors in the US.

2.12.3.3 *Legal and regulatory aspects*

Regulatory framework: does it support/hamper the concept? (e.g. related policies, permits, state aid issues, etc.)

The legal and regulatory aspect is likely to be having an impact on the growth rate of municipal bonds in Europe, in that compared to the US model, Europe as a whole has considerably more variation in the legal and regulatory framework that applies within each country.

Consequently investors need to consider each country in its own right. While this may be slowing down development, the fact that many of the recent municipal bonds issued in Europe have been oversubscribed indicates that this is not an insurmountable issue.

2.12.3.4 *Technical aspects*

Municipal bonds are sub-sovereign bonds, i.e. they are issued by a (any) level of government below the national or central government.

The rate of interest paid on municipal bonds, particularly in the US, tends to be relatively low compared to other types of investment. This makes the bonds look less attractive in times of a strong economy when other instruments may be paying a higher rate of interest, but more attractive in times of financial downturn.

Investors may opt to purchase individual municipal bonds directly from the issuer or through a broker. Investors may also choose to diversify their portfolio by investing in a professionally managed municipal bonds mutual fund. The minimum investments are usually much lower and fund shares are easily exchanged or liquidated. Municipal bond funds typically have no maturity date, but they pay income monthly or quarterly, whereas the bonds themselves generally make distributions semiannually. Investing in a municipal bond mutual fund offers advantages such as: monthly or quarterly income; professional portfolio management; diversified mix of investments; liquidity; low initial investment amount; ability to exchange fund shares within the same family of mutual funds.

Most investors hold municipal bonds to maturity, when their original investment is returned to them, and collect the regular income they generate in the interim. If an investor opts to sell a municipal bond prior to maturity, he or she receives the current market price for the bond, which may be more or less than the purchase price.

2.12.3.5 *Social and cultural aspects*

There needs to exist a market for the municipal bonds that is willing to accept a lower rate of return than that perhaps traditionally received from investments. Indeed there needs to exist a market for the bonds themselves, so a public that has sufficient capital that is available to be invested.

Municipal bonds are largely used for the support of basic activities of municipalities. However there are examples of their use to fund the creation of stadiums, or of museums, which would have obvious cultural implications.

2.12.3.6 *Risks*

The main risk of municipal bonds is the variability inherent in the financial markets themselves, although such bonds are recognised as one of the safest types of long terms

investments so the risk is generally perceived as lower than with many other financial instruments. The risks within the financial model include:[156]

- Call risk – the bond issuer retires the bond before its maturity date.
- Credit risk – the bond issuer may experience financial problems and so find it challenging, or impossible, to make the interest payments.
- Inflation risk – raising inflation reduces purchasing power, a risk for fixed rate of interest investments.
- Interest rate risk – bonds have a fixed face value, and at maturity the investor receives the face value back. A variation in interest rates will affect the rate gained by the investor.
- Liquidity risk – potentially investors may not have a suitable market available to them if they want to buy or sell the bonds at a time of their choosing.

Establishing a municipal bond market as a Europe-wide market will likely be hampered by the variation of regulation and financial institutions across the different European States, and even the creation of national level markets introduces considerable variation between states as to the rules and requirements. This may be seen as a risk and a barrier by investors, although the establishment of national or even regional bond arrangements may also be seen as a positive thing by local investors and by household investors.

2.12.3.7 *Key enablers*

Issuing a bond is more complicated than taking a loan and hence requires a more developed financial market.

A significant enabler of the US municipal bond market is that they are generally tax free in the state of issue, and are consequently an attractive investment. Municipal bonds are generally considered to be very stable and safe long term investments, with a very low rate of default. Insured bonds are considered to be even safer.

Municipal bonds exist where the investor can withdraw their money before maturity with no penalty ("put bonds"), and bonds commonly pay interest twice a year (in the US), so can form a predictable supply of income, for example, for retirees.

A factor in the successful Nordic model of municipal bonds is that Nordic (Swedish, Danish or Finnish) municipalities cannot go bankrupt; it is a legal impossibility. Hence bonds issued within the municipal bonds system have a high degree of stability. In contract, in the US 5.5% of US municipal bonds defaulted in 2010 and 2011. This has never happened in the Danish, Finnish and Swedish municipalities in their 100 year history.[157] This is not to say that financial difficulties have never been experienced, simply that they are addressed in a way that does not default on the bond.

2.12.4 Current barriers and potential solutions for up-scaling

2.12.4.1 *Barriers*

As said above, the US municipal bond market enjoys considerable tax incentives, investors in many states are not required to pay tax on parts of their bond coupon. Furthermore the structures of bond markets in the US have significant similarities between states, and this facilitates the market.

Neither of these situations occurs in Europe. Europe has a wide range of tax regimes and policies, hence the creation of a framework across Europe would be challenging to achieve. Europe also has significant variation of procurement rules and regulations, which add further variation in the market.

[156] Investor Bulletin: Focus on Municipal Bonds, US Securities and Exchange Commission, http://www.sec.gov/investor/alerts/municipal.htm
[157] The Nordic Model – Local Government, Global Competitiveness in Denmark, Finland and Sweden, 2012.

The rate of interest paid on municipal bonds, particularly in the US, tends to be relatively low compared to other types of investment. This makes the bonds look less attractive in time of a strong economy when interest rates from other investments may be significantly higher. But in times of economic downturn municipal bonds become more attractive, as all investments have low return rates, and at this point the tax free status becomes more relevant.

2.12.4.2 *Potential solutions*

The potential to harmonise the financial systems across Europe, or any small steps that could be taken towards this end point could be considered, although such developments are likely to be hugely challenging and take a significant amount of time to achieve.

A more practical approach would be to follow the examples already well-established in Europe, those of Sweden, Denmark and Finland, and more recently of France. To date the successful and enduring schemes appear to have a number of municipality members who come together for a long term arrangement, covering a sovereign area.

2.12.5 Future potential

2.12.5.1 *Preliminary educated guess of up-scaling potential through to 2050*

The potential to roll out further municipality scale bonds in many European countries is significant, and there appears to be considerable interest in doing so. How much of this interest will translate into actual bond issues is not yet clear, but many municipalities report considering it. With the challenge to public finances across Europe unlikely to be solved in the near future, and continuing cuts to public funds announced, it is highly likely that municipalities will be searching for alternative funding mechanisms for a significant period to come. Municipal bonds seem likely to fill at least part of this gap.

Scaling from France, which has begun only recently, or from Sweden representing the most advanced example, and applying to the ten most populated countries in Europe with similar economies would give the following benefit in terms of money available to invest in municipal activities.

Table 2.12.1 Potential funds that could be made available through municipal schemes, using 2013 values.

Country	Population (million)	EUR available Agence France Locale (million)	EUR available Kommuninvest (billion)
France	65.7	17.7	
Sweden	9.6		23
Germany	80.6	21.7	193.1
UK	64	17.2	153.3
Italy	60	16.2	143.8
Spain	46.6	12.6	111.6
Poland	38.5	10.4	92.2
Romania	19.9	5.4	47.7
Netherlands	16.8	4.5	40.3
Belgium	11.1	3.0	26.6
Greece	10.8	2.9	25.9
Portugal	10.6	2.9	25.5
SUM		**97 million per year**	**860billion per year**

It could be assumed that 5% of spend goes into activities that directly benefit the environment, such as renewable energy installations and energy efficiency (we assumed

2.5% for each sector), while a further 35% (mid-point of Kommuninvest and MuniFin) goes towards social housing developments of which 10% is assumed to be used for energy efficiency improvements (social housing investment often includes substantial energy efficiency related work as policies such as the Decent Homes Programme in the UK illustrate).

Using the far more conservative figure of the French scheme, this gives a potential annual spend of EUR4.7 million on environmental projects and EUR33 million on social housing. The resultant estimated saving in greenhouse gases is about 4,300t of CO2 per year, and an estimate of jobs created is about 370.

In terms of job creation there will be a small increase due to the founding of new financial institutions. The bulk of the job creation will come from the construction and engineering jobs created by the infrastructure projects undertaken, the homes refurbished and built, the renewable technologies installed.

There are three distinct types of jobs that will be supported as a result of municipal bonds:

- **Direct jobs**: persons employed directly by solid wall insulation companies (including contractor staff) who receive wages and salaries;
- **Indirect jobs**: persons employed in businesses which supply the goods and services used in the process of installing solid wall insulation; and
- **Induced jobs**: further income and employment generated as incomes created directly and indirectly are spent within the economy.

In order to estimate the number of jobs supported by municipal bonds we make use of input-output tables. Input-output tables show the flows of expenditure which take place between sectors of the economy and allow the impact of a given level of expenditure on income and employment to be calculated.

These 'ripple effects' of capital expenditure can be estimated using multipliers. Multipliers are measures of the way in which an increase in activity by one firm will lead to an increase in activity by other related firms. For example, the contractor for a new building buys concrete, the concrete subcontractor buys new tires for its trucks, all the firms' workers spend their wages on food or consumer goods, and so forth. Multipliers are estimated by indirect means, using input-output tables. They are calculated by using the estimates for direct, indirect and induced effects, which are also estimated from I-O tables.

The main assumptions used for the employment calculations are based on authoritative sources on employment effects covering energy efficiency[158] [159], renewable energy[160], and induced effects[161]. Based on those sources we estimated the employment effect per million € invested.

However, the results are indicative only not taking into account any leverage effects (where municipal bonds result in larger investments than covered by the bonds alone), and assuming that the energy efficiency related investments take place in the building sector only. It is also important to point out that once municipal bonds are reduced or withdrawn many of the previously supported jobs will be lost. Furthermore, investments in one type of activity are likely to displace at least some alternative investments and in an ideal world those opportunities would be evaluated on a like-for-like basis. We also based our analysis

[158] Janssen, R. and Staniaszek, D. (2012): How Many Jobs? A Survey of the Employment Effects of Investment in Energy Efficiency of Buildings. Brussels: The Energy Efficiency Industrial Forum
[159] DECC (2012): Final Stage Impact Assessment for the Green Deal and Energy Company Obligation. London: DECC
[160] Pollin, R., Heintz, J., and Garrett-Peltier, H. (2009): The Economic Benefits of Investing in Clean Energy How the economic stimulus program and new legislation can boost U.S. economic growth and employment. Amherst, Massachusetts: Department of Economics and Political Economy Research Institute (PERI) University of Massachusetts, Amherst
[161] Scottish Government (2013) Input-Output Tables 1998–2009 – Latest Year (2009). Online: http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/Downloads/IO1998-2009latest [accessed 21/04/2014]

on the presumption that no substitution and/ or deadweight losses of jobs take place. Substitution effects are defined as jobs attributed to the programme being taken up by workers who would otherwise have worked in other parts of the economy. Deadweight losses encapsulate the phenomenon of some workers being hired even in absence of the subsidy scheme which are still classified as new jobs created as a result of the programme.

Taking those caveats into account, the table below presents the indicative employment effects municipal bonds could have.

Table 2.12.2: Estimate of potential employment impact of municipal bonds in selected countries

			Number of direct jobs [#]			Number of indirect jobs [#]			Number of induced jobs [#]			Total number of jobs [#]		
Country	**Assumed bond volume**	**Volume of bonds [million]**	**SH[162]**	**RES**	**EE**	**SH**	**RES**	**EE**	**SH**	**RES**	**EE**	**SH**	**RES**	**EE**
Germany	based on Swedish figures	193,104	128,414	37,292	91,724	53,393	31,383	38,138	177,752	114,057	91,724	359,560	182,732	221,587
	based on French figures	22	14	4	10	6	4	4	20	13	10	40	21	25
UK	based on Swedish figures	153,333	101,967	29,612	72,833	42,397	24,920	30,283	141,143	90,566	72,833	285,507	145,097	175,950
	based on French figures	17	11	3	8	5	3	3	16	10	8	32	16	20
Italy	based on Swedish figures	143,750	95,594	27,761	68,281	39,747	23,362	28,391	132,322	84,906	68,281	267,663	136,029	164,953
	based on French figures	16	11	3	8	4	3	3	15	10	8	30	15	19
Spain	based on Swedish figures	111,646	74,244	21,561	53,032	30,870	18,145	22,050	102,770	65,943	53,032	207,885	105,649	128,114
	based on French figures	13	8	2	6	3	2	2	12	7	6	23	12	14
Poland	based on Swedish figures	92,240	61,339	17,813	43,814	25,504	14,991	18,217	84,907	54,481	43,814	171,750	87,285	105,845
	based on French figures	10	7	2	5	3	2	2	10	6	5	19	10	12
Romania	based on Swedish figures	47,677	31,705	9,207	22,647	13,183	7,748	9,416	43,887	28,160	22,647	88,775	45,116	54,709
	based on French figures	5	4	1	3	1	1	1	5	3	3	10	5	6
Netherlands	based on Swedish figures	40,250	26,766	7,773	19,119	11,129	6,541	7,949	37,050	23,774	19,119	74,946	38,088	46,187
	based on French figures	5	3	1	2	1	1	1	4	3	2	8	4	5
Belgium	based on Swedish figures	26,594	17,685	5,136	12,632	7,353	4,322	5,252	24,480	15,708	12,632	49,518	25,165	30,516
	based on French figures	3	2	1	1	1	0	1	3	2	1	6	3	3
Greece	based on Swedish figures	25,875	17,207	4,997	12,291	7,154	4,205	5,110	23,818	15,283	12,291	48,179	24,485	29,692
	based on French figures	3	2	1	1	1	0	1	3	2	1	5	3	3
Portugal	based on Swedish figures	25,396	16,888	4,904	12,063	7,022	4,127	5,016	23,377	15,000	12,063	47,287	24,032	29,142
	based on French figures	3	2	1	1	1	0	1	3	2	1	5	3	3
TOTAL	based on Swedish figures	834,469	554,922	161,153	396,373	230,731	135,618	164,808	768,128	492,877	396,373	1,553,781	789,648	957,553
	based on French figures	94	62	18	45	26	15	19	86	55	45	175	89	108

[162] Where: SH = social housing; RES = renewable energy schemes; EE = energy efficiency.

In order to estimate the potential GHG savings resulting from municipal bonds we have reviewed the evidence on investment cost compared to carbon savings from a selected number of sources covering energy efficiency in buildings in Europe[163], loan programmes for energy efficiency retrofits in Germany[164], renewable energy loans in Germany[165], energy efficiency investments in the UK[166][167], and global renewable energy investments[168]. Based on those sources we assumed a mid-point figure for GHG savings per million EUR invested.

Table 2.12.3: Estimate of potential GHG savings of municipal bonds in selected countries

			GHG emissions saved (in t of CO2 per annum)			
Country	**Assumed bond volume**	**Volume of bonds [million]**	**SH**	**RES**	**EE**	**Total**
Germany	based on Swedish figures	193,104	3,379,323	3,020,838	2,413,802	8,813,963
	based on French figures	22	380	340	271	991
UK	based on Swedish figures	153,333	2,683,333	2,398,680	1,916,667	6,998,680
	based on French figures	17	302	270	216	787
Italy	based on Swedish figures	143,750	2,515,625	2,248,762	1,796,875	6,561,262
	based on French figures	16	283	253	202	738
Spain	based on Swedish figures	111,646	1,953,802	1,746,539	1,395,573	5,095,914
	based on French figures	13	220	196	157	573
Poland	based on Swedish figures	92,240	1,614,193	1,442,956	1,152,995	4,210,143
	based on French figures	10	182	162	130	473
Romania	based on Swedish figures	47,677	834,349	745,840	595,964	2,176,152
	based on French figures	5	94	84	67	245
Netherlands	based on Swedish figures	40,250	704,375	629,653	503,125	1,837,153
	based on French figures	5	79	71	57	207
Belgium	based on Swedish figures	26,594	465,391	416,021	332,422	1,213,834
	based on French figures	3	52	47	37	136
Greece	based on Swedish figures	25,875	452,813	404,777	323,438	1,181,027
	based on French figures	3	51	46	36	133
Portugal	based on Swedish figures	25,396	444,427	397,281	317,448	1,159,156
	based on French figures	3	50	45	36	130
TOTAL	based on Swedish figures	834,469	14,603,203	13,054,066	10,430,859	38,088,129
	based on French figures	94	1,642	1,468	1,173	4,283

2.12.5.2 *Replicability*

The range of situations and projects that municipality bonds can facilitate is widespread, encompassing infrastructure projects, social housing, renewable energy, etc. The potential exists to widen the scope still further to include the funding of non-profit colleges and hospitals for example. Furthermore there is the potential for bonds to be issued for specific activities and investments that are not necessarily within the remit of the municipality, for example the development of a public transport infrastructure project such as a new railway line, the fund for which could be raised directly by the transport authority.

[163] http://www.bpie.eu/uploads/lib/document/attachment/21/LR_EU_B_under_microscope_study.pdf
[164] http://www.ieep.eu/assets/1267/Energy_Savings_2030_IEEP_Review_of_Cost_and_Benefits_of_Energy_Savings_2013_published.pdf
165 https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-alle-Evaluationen/Evaluierung_EE_2012.pdf
[166] http://s3.amazonaws.com/zanran_storage/www.defra.gov.uk/ContentPages/4234041.pdf
[167] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42984/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf
[168] http://www.unep.org/pdf/Green_energy_2013-Key_findings.pdf

3 Potential impacts of case study concepts

For each of the case studies in Section 2, the future potential has been estimated through:

- Preliminary educated guess of the up-scaling potential through to 2050
  - Reduction in greenhouse gas emissions
  - Creation of jobs
- Potential for replicability.

3.1 Up-scaling potential, greenhouse gas emission savings and jobs created

As this is a limited study, these are preliminary assessments and not full assessments of the potential impacts for the case study concepts for cooperative production, financing or use of low carbon technologies. Results are summarised in Table 3.1.

Table 3.1 Preliminary estimate of potential impacts of low carbon cooperative concepts through to 2050[169]

Concept	Up-scaling potential	Possible reduction in emissions (t CO_2)	Possible jobs created	Replicability
Low carbon hub	Currently difficult to assess	Not estimated	Not estimated	Could be extended to other technologies, locations. Availability of incentives may be a limitation
Solar schools	Assume taken up by 5% of schools with PV potential	23,000/ year	400 (installation only)	Possibly extendable to wind turbines, heat pumps, as well as in other countries
Euronet 50/50	Potentially high to schools across EU	34,000/year	Not estimated, as it's related to different types of technologies	Already covers a range of technologies. Potential for replicability in other countries is high.
Local energy cooperatives	In UK and Germany, annual installed capacities of 600-1,800MW per year by 2050	Up to 34 500 000 per year in 2050	Not estimated	Currently mainly in North and West Europe. Potential for replicability in other countries is high.
Nudge initiatives	In NL, could be community of 75,000 to 140,000 by 2050	Not estimated, as the savings depend on the type of initiative	Not estimated, as the job creation depend type of initiative	Could be replicated in other countries, possibly most

[169] Further detail on the background to these assessments is given in the relevant sub-section of Section 2 of this report.

Concept	Up-scaling potential	Possible reduction in emissions (t CO_2)	Possible jobs created	Replicability
				easily where balance of individualism and wish to collaborate is appropriate
Online house renovation community	Not clear beyond 2015	Not estimated	Not estimated	Potentially replicable in other EU members states
Crowd funding for RES / district heating etc	Potentially can be scaled up significantly. For instance, one UK site has a target to raise EUR1.2B over next 10 years	Not estimated	Not estimated	The crowdfunding concept can be applied to a wide range of technologies in a wide range of EU member states
PV purchase collectives	No fundamental barrier to uptake across the EU. Potentially 50M households could be interested	Roughly 2 000 000 per year	40,000	Could be extended to other technologies such as small-scale wind and heat pumps
Bike sharing	Currently 400-425 schemes in EU28. Potential for 200-475 more. Further significant extension possible if pedelecs are introduced	180,000	520 (installation), 2,300 (operation)	Principles can be applied to car sharing
Use of cooking oil	Estimates of potential range from 1Mt to 3.5Mt per year	9,100,000 (assuming full potential of 3.5Mt cooking oil per year is accessed)	17,700	Can potentially be extended across Europe particularly where there is a high population density.
Energy performance contracting	Considered extending rate of savings in Berlin to 10 European cities, 20% of EU28	500,000 (10 cities) to 1,700,000 (20% of EU28)	2,400 (solely from re-use of savings in energy costs by 10 cities)	Highly replicable – could encompass CHP, water efficiency and water harvesting, refrigeration …
Municipal bonds	If scaled from current position in France or Sweden, annual funds could be EUR 100M to EUR 900B	4,300 (scaling from France) 380,000 to 3,800,000 (scaling from 1% to 10% of Swedish levels)	370 (scaling from France) 33,00 to 330,000 (scaling from 1% to 10% of Swedish levels)	Potentially replicable to a wide range of situations and projects.

3.2 Competitiveness

A first order assessment of the potential effect of the low carbon concepts on competiveness of EU technology and service providers is given below.

Table 3.2 First order assessment of potential impact of the concepts assessed

Concept	Sectors involved	Market size, inside/outside EU	Resource supply	Export potential	Added value	Substitution options	Market entry barriers	Resilience[170]	Potential impact on competitiveness
Low carbon hub	Competitiveness assessment is not directly relevant in this case as the funding is not specific to a particular technology.								Could be moderate if this is widely replicated
Solar schools	PV panels PV installation	Maybe 5% of schools with PV potential	Needs finance support. Panels largely from outside EU	Low	High Mainly for installation	Could also be supported through municipal bonds	Low. Barrier is experience in installation	Currently depends on feed in tariffs	Low (less than for PV purchase collectives as the market size is lower)
Euronet 50/50	Competitiveness assessment is not directly relevant in this case as the funding is not specific to a particular technology								Low (small market size)
Local energy cooperatives	Competitiveness assessment is not directly relevant in this case as the funding is not specific to a particular technology								Potentially high if volume of support for EU technologies and installation is high
Nudge initiatives	Competitiveness assessment is not directly relevant in this case as the funding is not specific to a particular technology								Current examples have low impact, but could be significant
Online house renovation community	House renovation	Difficult to assess	Resources are materials and installation	Low	High – mainly for installation	The online community could be substituted through EU/Members State advice services, but this may be much more expensive	Low. Barrier to providing renovation services is experience	Community itself currently depends on financial support	Currently low. Could be moderate, if community is replicated widely and encourages significant renovation.

[170] This refers to the extent to which the concept is currently or potentially dependent on financial support in order to be viable in the long term.

Concept	Sectors involved	Market size, inside/outside EU	Resource supply	Export potential	Added value	Substitution options	Market entry barriers	Resilience[170]	Potential impact on competitiveness
Crowd funding for RES / district heating etc	Competitiveness assessment is not directly relevant in this case as the funding is not specific to a particular technology								Potentially high if volume of support for EU technologies and installation is high
PV purchase collectives	PV panels PV installation	Maybe 5% of EU households	Needs finance support. Panels largely from outside EU	Low	High Mainly for installation	No direct substitution for this concept	Low. Barrier is experience in installation	Currently depends on feed in tariffs	Moderate
Bike sharing	Bike supply Bike and infrastructure manufacture, installation and operation IT systems Advertising	Further 200-475 schemes in Europe	Bikes, infrastructure and IT systems can be from Europe	Moderate for infrastructure and systems expertise	Moderate Mainly for installation and operation of the scheme	No direct substitute for this concept	Moderate Need significant experience in installation and operation Upfront costs are not insignificant	Bike-sharing schemes are rarely commercially viable and therefore depend on the provision of subsidies from public authorities	Low as number of potential additional schemes in Europe is relatively low. Some potential for export. Indirect impacts on the competitiveness of cities as places to live and do business.

Concept	Sectors involved	Market size, inside/outside EU	Resource supply	Export potential	Added value	Substitution options	Market entry barriers	Resilience[170]	Potential impact on competitiveness
Use of cooking oil	UCO collection and transport Biodiesel transformation and distribution	Potential in EU is estimated as 1Mt to 3.5Mt per year	Resource is waste, which tends to be a local product. Needs refining capacity	Moderate for refining solutions	High –as this makes use of a waste product	No direct substitute for this concept. The conversion of UCOs to biodiesel is the most effective use of UCOs. On the other hand, biodiesel production can also be generated from other sources e.g. corn, soybeans etc.	Needs sufficient supply of appropriate quality Needs refining infrastructure	UCO can be operated as a commercial operation and does not necessarily need to rely on public support	Potentially high if a higher proportion of available UCO can be used UCOs can contribute to higher energy security by offering a substitute to imported fossil fuels.
Energy performance contracting	Competitiveness assessment is not directly relevant in this case as the funding is not specific to a particular technology Potential for the countries involved in successful schemes to export their knowledge to developing schemes. Regulatory market must enable EPC arrangements, not all countries in Europe currently do.								Potentially high
Municipal bonds	Competitiveness assessment is not directly relevant in this case as the funding is not specific to a particular technology Potential for the countries involved in successful schemes to export their knowledge to developing schemes.								Potentially high if volume of support for EU technologies and installation is high

4 Recommendations

Recommendations are given in four sections below:

- The potential contribution of cooperative financing, production and use of low carbon technologies to the EU's climate action and competitiveness targets
- The most promising concepts
- Recommendations for promoting cooperative concepts generally
- Recommendations for the most promising options individually.

4.1 Contribution to EU targets

4.1.1 Climate targets

Total CO2 emissions in the EU are around 4.7 Gt CO2eq/year[171]. Achieving the European Commission's climate targets of 2020 and 2030 requires annual savings in the order of several hundred megatons CO2 equivalent. The saving potentials identified in this study range from 0.02-34.5 Mt CO2eq/yr. The combined potential savings of the concepts under study which could be quantified (8 out of 12) add up to more than 60 Mt CO2eq/yr.

The table below indicates how this savings potential relates to the potential of other policy areas.

Table 4.1 Annual mission saving potential by 2020

EC policy	Annual emission reduction potential (2020)
Cars Efficiency Regulation	50 MtCO2 /year
Fuel Quality Directive	62.5 MtCO2 -e/year
Directive on the Energy Performance of Buildings	160-210 MtCO2 -e/year
Ecodesign and labelling	411 MtCO2 -e/year

Source: CAN, 2012

The combined emission savings potential of the concepts under study seems in the same order of magnitude as the policy areas listed in the table above. Innovative low carbon concepts can thus potentially contribute significantly to the European Commission's climate targets.

4.1.2 Competitiveness and job creation

Impacts on competitiveness are summarised in section 3.2 above. These have not been quantified but are considered to be potentially significant in some cases.

The potential job creation typically ranges from 400-40,000 jobs per concept. An exception could be municipal bonds with a potential of up to 330,000 jobs. According to estimates, implementation of energy efficiency measures could lead to 2 million jobs being created or retained by 2020 and the development of renewable energy sources could lead to 3 million jobs by 2020[172]. The impact of the concepts under study on employment in the EU thus

[171] CAN, 2012, Closing the ambition gap, What Europe can do

[172] EC, 2012, Green jobs: Employment potential and challenges. http://ec.europa.eu/europe2020/pdf/themes/19_green_jobs.pdf .

appears to be modest. The combined potential of those concepts we were able to quantify (6/12) is over 60 000 jobs, without taking into account municipal bonds.

4.2 Most promising concepts

The concepts considered vary widely in their applicability, state of development and in potential impacts. Based on this initial assessment, a tentative ranking in terms of relative impact can be given as below.

Table 4.2. Tentative ranking of concepts considered in terms of impacts

Concept	Up-scaling potential	Possible reduction in emissions	Possible jobs created	Replicability	Total
Low carbon hub	Not assessed	Not assessed	Not assessed	Medium (1)	**1**
Solar schools	Low (0)	0	0	High (2)	**2**
Euronet 50/50	Medium (1)	0	Not assessed	High (2)	**3**
Local energy cooperatives	High (2)	2	Not assessed	High (2)	**6**
Nudge initiatives	Medium (1)	Not assessed	Not assessed	Medium 1	**2**
Online house renovation community	Not assessed	Not assessed	Not assessed	Medium 1	**1**
Crowd funding for RES / district heating etc	High (2)	Not assessed	Not assessed	High (2)	**4**
PV purchase collectives	Not assessed	2	2	Medium 1	**5**
Bike sharing	Not assessed	1	1	Low (0)	**2**
Use of cooking oil	High (2)	2	2	Medium 1	**7**
Energy performance contracting	Medium (1)	1	1	High (2)	**5**
Municipal bonds	High (2)	1 or 2	1 or 2	High (2)	**6 - 8**

On this basis:

- Concepts with highest potential impacts
  - Local energy cooperatives
  - PV purchase collective
  - Use of cooking oils
  - Energy performance contracting
  - Municipal bonds
- Concepts with lower potential impact
  - Low carbon hub
  - Solar schools

[173] Based on the information provided in table 3.1 we have made an assessment in order to identify the most promising concepts based on up-scaling potential, replicability, emissions reduction and job creation. The score assignment is as follows:

	Up-scaling	Emission reduction	Job creation	Replicability
0	Low	< 100 000 t CO2	< 1 000 jobs	Low
1	Medium	< 1 000 000 t CO2	< 10 000 jobs	Medium
2	High	> 1 000 000 t CO2	> 10 000 jobs	High

Where there was not enough information available to make an estimate we have mentioned that it has not been assessed (and given no score).

  - Euronet 50/50
  - Nudge initiatives
  - Online house renovation community
  - Crowd funding for RES / district heating etc
  - Bike sharing schemes

Several of the concepts assessed provide (creative/alternative) financing for different types of initiatives and even for other concepts. These include:

- **Crowd funding -** Crowd funding is the mechanism by which a project or venture is funded by raising small amounts of money from a large number of people.
- **Municipal bonds -** Municipal bonds offer investors the opportunity to support projects that can directly benefit their local community.
- **Nudge initiatives** - The core business of Nudge is to connect, amplify and accelerate sustainability initiatives which evolve and are led by (local) communities. Knowledge and hands-on experience is shared and facilitated via the Nudge platform.
- **Energy performance contracting** - An EPC is a form of 'creative financing' for the installation, often retrofit, of energy efficiency and renewable energy measures.

Certain initiatives discussed could be (or already are) implemented in tandem. For example, the Solar Schools concept can be combined with the Crowd Funding concept (such as in Solar Schools UK) or with the Local Energy Cooperatives concept (Such as in Solar Schools NL).

Energy Performance Contracts are also very flexible and can be used e.g. with Solar Schools and Euronet 50/50.

4.3 Recommendations for promoting cooperative concepts in general

From assessing twelve cooperative concepts for cooperative production, financing and use of low carbon technologies and discussing these with stakeholders at and after a workshop in June 2014, a number of areas for recommendations emerged. These are:

- Awareness raising
- Exchange of information and skills
- Access to support
  - Point of entry
  - Dedicated financial instrument or action
  - Fostering cooperative production, financing and use of low carbon technologies

There is already support within European Union programmes that addresses some aspects of these areas and this is noted in section 4.3.1. Then sections 4.3.2 to 4.3.6 address each area for recommendation, noting where these are already, to some extent, addressed within current programmes, and making recommendations for support by some European Union programmes for cooperative concepts for low carbon technologies.

4.3.1 Current EU programmes reviewed

A select number of European Union programmes and initiatives have been reviewed for this and the following section. The aim is to illustrate both where the areas for recommendation are already being addressed and where specific recommendations may be developed. The programmes and documents considered are:

- Horizon 2020

    - Council decison of 3 Decemebr 2013 establishing the specific programme implementing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)
    - Work programmes for 2014-2015 for
        - Secure, clean and efficient energy
        - Climate action, environment, resource efficiency and raw materials
        - Smart, green and integrated transport
- LIFE
    - Regulation 1293/2013 of 11 Deceember 2013 on the establishment of a Programme for the Environment and Climate Action (LIFE)
    - Commission implementing decision of 19 March 2014 on the adoption of the LIFE multiannual work programme for 2014-17
- Climate- KIC
    - Review of website at http://eit.europa.eu/eit-community/climate-kic

Support for cooperative concepts appears to be allowed by the objectives of the LIFE programme sub programme for Climate Action. The objectives under the priority on Climate Change Mitigation include:

- To contribute to the development and demonstration of innovative climate change mitigation technologies, systems, methods and instruments that are suitable for being replicated, transferred or mainstreamed.

In addition the objectives for the priority area on Climate Governance and Information include:

- To support communication, management, and dissemination of information in the field of the climate and to facilitate knowledge sharing on successful climate solutions and practice, including by developing cooperation platforms among stakeholders and training.

Within the LIFE work programme for 2014-2015, applications are suggested in a number of areas including:

- Support for pioneering a post carbon society. Pioneers and role-models are important to guide the transitory process to low carbon economies and societies. Many technologies, life styles or governance models are piloted in social groups, small communities and by innovators before they become mainstreamed. Support to the deployment of new approaches (model cities or regions) for producing, consuming and governing with a transformational impact, should reflect fully the objectives of the EU climate and energy package or the Roadmap 2050 targets. To succeed, existing low carbon technology should also be examined with regards to non-technology barriers which prevent market penetration.

The decision on the Horizon 2020 programme notes under section 3.7 on Market uptake of energy innovation - building on Intelligent Energy Europe (IEE):

“Research and analysis repeatedly confirm the crucial role of the human factor in the success and failure of sustainable energy policies. Innovative organisational structures, the dissemination and exchange of good practices and specific training and capacity-building actions will be encouraged.”

A number of the topics covered by the calls for the 2014-2015 work programme on secure clean and efficient energy may be relevant to cooperative concepts[174].

[174] These include:

- EE10 – 2014-2015: Consumer engagement for sustainable energy. Coordination and Support actions

The Climate-KIC also includes a strategic challenge on “Making transitions happen“ that may be relevant to cooperative concepts. This challenge is “to create a low carbon culture that engages companies, communities and citizens to reduce their impact and connect globally on the climate change challenge“.

4.3.2 Awareness raising

One perception is that there is a lot of activity on cooperative concepts for low carbon technologies but that it is not widely known.

Area for recommendation 1. That additional mechanisms be developed for raising the awareness of cooperative concepts for low carbon technologies at European, national and local levels and in the academic and business communities.

The calls for coordination and support actions noted in section 4.3.1 may be relevant to cooperative concepts for low carbon technologies.

The EU can play a prominent role in disseminating the promising concepts and highlighting their benefits. As explained in the case studies, communication in these cooperative concepts is key. For example, crowd funding has been heavily accelerated through social media and online communication.

In some cases increasing awareness can help boost the use of some of these concepts. For example, bike sharing initiatives would profit from increased awareness on sustainable mobility options. The same is true for energy performance contracting (EPC): Increasing awareness of the existence of EPC, of the potential benefits and of successful examples will help to promote this approach.

The EU could play a supporting role promoting the concepts and specific best practices. The EU already has in place a number of communication and dissemination platforms through which promotion of successful concepts could be done. If the dissemination of such information and the provision of advice comes from public bodies then a greater degree of legitimacy is given to the concepts.

Recommendation 1: That the European Union raises awareness of cooperative concepts for low carbon technologies, for instance by supporting work to bundle information to disseminate results and good practice.

One element of this is to review and make visible information on work that has already been funded and is being funded by the European Union, for instance under programmes for Research and innovation.

This could also include identification and dissemination of good practices, through publications and dedicated events which would be a platform for discussion. For instance an approach currently used for renewable energy cooperatives[175] could be used as an example that might be replicated or expanded for other concepts. There is also a role for other stakeholders in considering how to make more visible information on cooperative production, financing and use of low carbon technologies.

- EE19 – 2014-2015: Improving the financeability and attractiveness of sustainable energy investments. Coordination and Support actions
- EE20 – 2014-2015: Project development assistance for innovative bankable and aggregated sustainable energy investment schemes and projects. Coordination and Support Actions
- LCE4 – 2014-2015: Market uptake of existing and emerging renewable electricity, heating and cooling technologies. Coordination and Support Actions.

[175] See for instance RESCoop (http://www.rescoop.eu/)

Note that this recommendation complements Recommendations 3 and 4 on Access to support - point of entry.

4.3.3 Exchange of information and skills

Cooperative delivery of low carbon concepts can be led by municipalities, by business or by communities. Community groups may have the legal form of cooperatives and are often staffed by volunteers in their spare time. For all groups, and particularly for the latter group, there is a potential need to be able to develop skills in particular by exchange with other groups delivering low carbon technologies cooperatively. For instance:

- Visits by pioneers in cooperative concepts to prospective cooperatives – can "inspire“ and lead to the foundation of cooperatives
- Visits by prospective or new cooperatives to established cooperatives assist in sharing both practical learning on how the cooperatives operate but also the values underlying the development of the cooperative.

One analogy for this area might be the ERASMUS+ programme that provides opportunities to study, train, gain work experience and volunteer abroad.

Area for recommendation 2. That additional mechanisms be developed for exchange of information and skills on cooperative concepts for low carbon technologies.

This area is currently being addressed under existing Coordination and Support Actions under the Secure, Clean and Efficient Energy work programme for 2014-2015 (section 4.3.1 above) and topics of this type could be considered for future work programmes. One particularly positive area is the topics that involve interaction between the finance community and energy efficiency initiatives. It should also be noted that cooperative concepts are often applied in combination, so an initiative can include both energy efficiency and low carbon energy. The split of Energy Efficiency and Competitive Low-Carbon Energy in the current Horizon 2020 energy programme may not be what is happening in practice.

As an example of another current initiative an EU**-Energy Performance Contracting Campaign** will be launched with support from DG Energy, Energy Efficiency area, The European Investment Bank’s public private partnership expertise centre (EPEC), ManagEnergy Initiative and the Covenant of Mayors. The aim of the campaign is to enable country specific discussions and capacity building of core stakeholders. This will also contribute to awareness raising.

Acknowledging the activities that are already in place, it is considered that there is a potential extended role for exchange of information and skills between those involved in cooperative production, financing and use of low carbon technologies and those that are interested in developing cooperative concepts.

Topics should include specific mention that cooperatives are eligible and welcome as active partners. Topics could for instance: support links between the finance community and cooperative concepts; be open to cooperative concepts that address both energy efficiency and competitive low-carbon energy (and possibly also other areas such as low carbon transport).

A second area of building of skills is at a much deeper level, and might, for instance involve extended study by those who are interested in developing a cooperative concept at an established cooperative action. Although the analogy is not perfect, this might be thought of as an ERASMUS+ programme for active citizens who are members of or interested in developing cooperative concepts.

Recommendation 2: That the European Union provides more training and support for those involved in cooperative concepts for low carbon technologies by:

2A: Continuing to provide funding for Coordination and Support Actions under the Climate Action sub-programme of the LIFE programme, and by developing

topics under the Horizon 2020 programme, for instance in the Secure, Clean and Efficient Energy work programme (and other relevant work programmes such as Smart, Green and Integrated Transport)
2B: Developing a topic or action (or in the long term programme) to provide training through exchange of skills for active citizens in cooperatives, for instance through the ERASMUS+ programme.

4.3.4 Access to support – point of entry

It has been noted that there is no dedicated access point to the European Union programmes for cooperatives or active citizens. This makes it difficult to identify what programmes may be relevant to cooperative concepts.

Area for recommendation 3. That an access point and route be developed for European Union funding programmes for cooperatives/ active citizens.

At the moment, there is no straightforward point of entry for cooperatives or active citizens.

An overview of EU funding is at http://europa.eu/about-eu/funding-grants/index_en.htm

Under a heading of "Applying for funding" there are links for small businesses, young people, researchers, and for farmers and rural businesses. There is a link for non-governmental and civil society organisations, which may be relevant, though this link leads to a general page on European Commission Grants, which does not appear to be tailored to the specific requirements of NGOs and civil society organisations.

A similar situation holds on the Climate-KIC website[176] where the major navigation options are: For students; For entrepreneurs; For businesses; and For public bodies.

There are two aspects here: that it would be beneficial to have a point of entry to EU funding programmes for cooperatives; and that it would be beneficial to provide a pointer to all funding programmes, calls and topics that are specifically relevant to cooperative concepts for introduction of low carbon technologies.

Recommendation 3: There should be an entry point from the overview page on European Union funding for cooperatives and citizen groups. This should link to a page that points to funding programmes, and preferably calls and topics that are particularly relevant to cooperatives.

There are a number of ways of meeting this recommendation. If it is considered that the only area for pointing is in cooperative concepts for low carbon technologies, then the link from the overview page could be to a page on the Climate Action website. If there are other programmes to which cooperatives should be pointed, then a more complex structure is needed, though there would probably still be a need for a page on the Climate Action website pointing to programmes, calls and topics relevant to cooperative concepts for low carbon technologies, so a related recommendation is:

Recommendation 4: That DG Climate Action should introduce a webpage that points to programmes, calls and topics that are particularly relevant to cooperative concepts for low carbon technologies.

This in turn could be pointed to from the communications platforms mentioned under Recommendation 1.

This point of considering whether there is an appropriate point of entry for cooperatives or active citizens could also be considered by other stakeholders providing information on European Commission programmes and more generally on low carbon technologies.

A further point raised is the cost of applying for European Union funds, this being a barrier for cooperatives, where those involved are frequently volunteers supporting the cooperative in

[176] See http://www.climate-kic.org/

their spare time. One possible way forward would be to recommend support for preparing applications. It is preferred instead to suggest an instrument specifically for cooperatives as in the next section.

4.3.5 Access to support - Dedicated financial instrument or action

One mechanism for encouraging the growth and spread of cooperative concepts would be to have a financial instrument or action that is specifically for such activities.

Area for recommendation 4. That a financial instrument or action be developed specifically for cooperative concepts for low carbon technologies.

Some current activities are addressing this area. Within the LIFE programme there are two new financial instruments managed by the European Investment Bank. One of these- the Private Financing for Energy Efficiency instrument (PF4EE) is only in the climate action sub-programme. The instrument has two objectives summarised as: to make energy efficiency (EE) lending a more sustainable activity across European financial institutions; and to increase the availability of debt financing to projects supporting the energy efficiency priorities of Member States. The PF4EE instrument provides a risk participation mechanism (Risk Sharing Facility) for private sector financial institutions and expert support for financial intermediaries (Expert Support Facility) combined with EIB long-term funding (EIB Loan for Energy Efficiency).

Loans are envisaged to vary typically from EUR 40,000 to EUR 5 million and could be to private individuals, home-owner associations, SMEs, larger businesses and/ or public institutions of bodies making energy efficiency investments in line with the member state National energy efficiency action plan.

At present there does not appear to be an action that is specific to cooperative concepts or to cooperatives[177], though there is of course an action for SMEs and this might be used by SMEs if they are leading cooperative concepts.

A new instrument for SMEs has been introduced in the Horizon 2020 programme. This provides staged support for highly innovative SMEs with high growth potential with stages of feasibility assessment, initially for feasibility assessment, then for innovation development and demonstration, and finally (with no funding) access to innovation support services and facilitated access to risk finance.

It could be argued that cooperative delivery of production, financing and use of low carbon concepts could provide an engine for delivery of a low carbon future and that an instrument dedicated to this type of activity is appropriate. This could, for instance be under the energy programme of Horizon2020, or under the Climate Action sub-programme of the LIFE programme.

Recommendation 5: That the European Union develops or widens an instrument/action specifically to support cooperative concepts for production, financing and use of low carbon technologies, perhaps on access to seed finance at cooperative project start-up.

Preferably this should have a staged approach with separate support for feasibility assessment and for demonstration.

This could for instance address the start-up phase of a cooperative project through providing access to seed finance.

[177] The reference to cooperatives could also cover a number of community entities such as home-owner associations

4.3.6 Access to support - Fostering cooperative production, financing and use of low carbon technologies

The focus in this section is on specification of topics under existing programmes, rather than new instruments or actions.

It is noted (see Section 4.3.1 above) that several of the European Union programmes for 2014-2020 have objectives that encompass cooperative and other means of delivering low carbon technologies. Whilst some priority themes under the specific multi annual work programmes are relevant to cooperative concepts for low carbon technologies, few, if any seem relevant solely to cooperative delivery.

Area for recommendation 5. That areas be developed under relevant European Union multi annual work programmes for cooperative production, financing and use of low carbon technologies.

Some of the initiatives that we have reviewed are already being co-funded through EU programmes and initiatives:

- The Oxfordshire Low Carbon hub is co-funded by IEE
- The ZEMedS project (Zero Energy MEDiterranean Schools) , discussed in the Solar Schools concept, is co-funded within the Intelligent Energy Europe Programme (IEE).
- The Euronet 50/50 project was established with the support of the Covenant of Mayors and funded by Intelligent Energy Europe. Due to the results of the first stage there is now a follow up project up to 2016.

The competitive application process for European Union funding is of course recognised. However, one way forward is if support is won through the competitive application process to help upscale these initiatives. E.g. IEE could co-fund Low Carbon Hubs in other locations following similar principles to the Oxfordshire LCH. However, this should be done only after an initial assessment of the emissions reductions and jobs creation potentials which at the moment are difficult to assess. For other projects such as Euronet 50/50 which have already proved their success, support could be extended even longer or alternatives such as local support could be sought. Targeting of such support to support cooperative concepts may be enhanced if a dedicated instrument or action were developed as in Recommendation 6.

It has also been noted that a number of topics under the current Secure, Clean and Efficient Energy work programme for 2014-2015 are relevant to cooperatives. This is welcome and the development of topics relevant to cooperative concepts would be welcome for future programmes. (See Recommendation 2A)

Current topics that are most relevant are for Coordination and Support Actions, rather than for demonstration of the cooperative concepts.

The Climate Action sub-programme of the LIFE programme currently publishes annual lists of policy priorities for which submissions are invited[178]. This list of priorities is not exhaustive. A future policy priority could cover the role of cooperative concepts

Recommendation 6: That the European Union considers a topic under Horizon 2020 or a policy priority under the LIFE programme sub-programme on Climate Action, that supports demonstration of cooperative concepts for low carbon technologies.

A further route to encourage applications from cooperatives and for cooperative concepts is to raise awareness with National Contact Points that such applications would be welcome under the LIFE or Horizon 2002 programmes.

Recommendation 7: That the European Union raises awareness with relevant National Contact Points for the Horizon 2020 and LIFE programmes of topics and calls for

[178] See e.g. LIFE Climate Action Guidelines for applicants 2014.
http://ec.europa.eu/environment/life/toolkit/pmtools/life2014_2020/documents/2014climate_sub_programme_app_guide.pdf

which applications from cooperatives and for cooperative concepts would be welcome.

A further means of providing support for cooperative concepts for low carbon technologies is under the Cohesion Policy for 2014-2020[179]. One of the priority areas for investment is supporting the shift towards a low-carbon economy. Investments can be in areas, such as increasing the use of renewable energy and decreasing energy use, that are relevant to cooperative concepts for low carbon technologies. Support can be from the European Regional Development Fund (ERDF), the Cohesion Fund and from the European Social Fund (for development of skills). Activities here could be in part awareness raising to ensure that Member State governments are aware of the possibilities of cooperative concepts, and in part development of programmes that include cooperative approaches.

Recommendation 8. That the European Union encourages the development of programmes, and that programmes are developed under the European Regional Development Fund and the Cohesion Fund, that include support for cooperative concepts as part of supporting a shift to a low carbon economy.

Finally the power of prizes is noted in terms of both encouraging pioneers and in raising awareness of technologies or concepts. Witness the success of the “Dragon’s Den” approach that started in the UK in encouraging entrepreneurship. It is noted that a Prize action has been introduced in Horizon 2020, and a prize for pioneers in cooperative concepts for low carbon technologies could be considered.

Recommendation 9. That the European Union considers an inducement prize for successful pioneers in cooperative production, financing and use of low carbon technologies. This could be under Horizon 2020, or possibly under the Climate Action sub-programme of LIFE.

4.4 Recommendations for the most promising concepts

Recommendations for promoting the most promising concepts individually are given in this section.

4.4.1 Used Cooking Oils

The transformation of UCOs to biodiesel is a growing market with as yet untapped potential for further growth. If realised, this continued expansion of the sector can generate significant environmental and economic benefits in terms of CO_2 and air pollutant emissions, waste reduction, income and local job creation, and reduced exposure to increases in the price of fossil fuels. These impacts can all make significant contributions to EU competitiveness.

However, support is needed to accelerate the development of this concept and the EC has a role to play. In particular, based on the barriers and risks identified in the case study, the following areas of intervention need to be considered:

- **Recommendation UCO 1**: **Access to support**. Continuing to facilitate and expand the collection process, in particular to include households. This is a priority area for the Intelligent Energy Europe-funded RecOil project and should continue to be supported. It has already produced useful findings on best practice which can be built on and disseminated to local authorities and organisations interested in setting up UCO schemes.
- **Recommendation UCO 2:** Developing a consistent regulatory framework at EU level. While a range of policies and standards are already in place, the situation across Europe remains fragmented and further standardisation is needed with regards to: the use of UCOs and management of waste; the standards and quality protocols for biodiesel; and financial incentives such as double-counting Renewable

[179] See for instance http://ec.europa.eu/regional_policy/sources/docgener/informat/2014/fiche_low_carbon_en.pdf

Transport Fuel Certificates. Such a consistent framework is paramount in order to develop a single EU-market.

- **Recommendation UCO 3:** Linked to the above is the need to develop more robust procedures to track and certify UCOs and to monitor their deployment and use in EU Member State.
- **Recommendation UCO 4:** Finally, the EC should seek to engage with vehicle manufacturers to tackle any barriers to the use of high blend biofuels in vehicles.

4.4.2 Energy Performance Contracts

Energy Performance Contracts is a mature and well-developed model, used commonly in the USA, and to some extent in European countries, such as the UK, Germany, and Italy. However there is significant opportunity for this approach to grow within the EC, likely across all member countries. The driving force behind the adoption of EPC is the desire to save energy and reduce emissions, providing both the benefit of achieving these aims and of achieving costs savings for the avoided energy consumption and potentially avoided charges for the emissions released. Potentially this approach can be applied to CHP technology, water efficiency and water harvesting, refrigeration; and energy procurement.

The business model of EPC is still considered to be a relatively new and untested approach. Support is needed to accelerate the development of this concept and the EC has a role to play. In particular, based on the barriers and risks identified in the case study, the following areas of intervention need to be considered:

- **Recommendation EPC1:** The adoption of EPC by public institutions may be hampered by national legislation and procurement rules that prevent such contracts, and there is a role for the EC to work with national governments, and potentially state and local governments, to ensure that EPC arrangements can be utilised; that procurement legislation does not prevent them. .
- **Recommendation EPC 2:** Work to develop guidance and example contracts that local and state governments could use to facilitate the set-up of EPC arrangements within the buildings they own or operate. The development of such documents from the Berlin Energy Agency, and the success that Berlin has with these arrangements, are very likely linked.
- **Recommendation EPC 3: Awareness raising.** Work to publicise the successful examples of EPC within Europe. Many institutions, both public and private, are not willing to adopt a new approach to the provision of energy in this way, or indeed find the concept of profiteering from environmental benefits unacceptable. Such a barrier must be broken down to enable successful adoption of EPC.
- **Recommendation EPC 4:**Encourage energy monitoring as a requirements within buildings, as monitoring energy is the first step on a process of reducing energy consumption, and one method to achieve this is the use of EPC.

4.4.3 Municipal Bonds

Municipal Bonds are an extremely well established concept in some countries, such as Sweden and Kommuninvest, or Finland and MuniFin, while in many other countries there is no such system in existence.

Achieving a successful and extensive sub-sovereign bond market that operates Europe-wide is likely to be challenging given the variety of regulation and legislation in the different European Countries, as well as the variation of fiscal practices, market structures, market liquidity, procurement rules etc. Market growth is occurring, and there is significant interest, but the structure of European financial markets and national regulation may limit the market to nationally based systems rather than European-wide arrangements.

A more practical approach would be to follow the country level examples already well-established in Europe, those of Sweden, Denmark and Finland, and more recently of France.

To date the successful and enduring schemes appear to have a number of municipality members who come together for a long term arrangement, covering a sovereign area.

- **Recommendation Bonds 1: Awareness raising.** To accelerate the development of this concept the most relevant role for the EC to play is in promoting and publicising the success of such schemes already in existence. Encouraging members of existing schemes to share their experiences more widely in Europe could yield benefits and encourage adoption.
- **Recommendation Bonds 2: Exchange of information and skills**. Furthermore, developing a set of guidelines and case studies that municipalities could use as reference materials would help to share the concept and illustrate what is possible.
- **Recommendation Bonds 3: Awareness raising/ Exchange of information and skills.** Potentially a 'best practice' centre could be established, based on the experiences already in Europe, those in Swede, France, Finland, etc.

4.4.4 Local energy cooperatives

The cooperative model was first used to develop renewable energy projects in Denmark, and is well established by now in The Netherlands, Belgium, Germany and the UK.

Local energy cooperatives (LECs) could play a major role in the EU climate strategy, while providing huge social benefits, bringing people together and providing an opportunity for local ownership and investment. However, the sector remains a long way from fulfilling its potential. Support is needed to accelerate the development of this concept and the EC has a role to play. In particular, based on the barriers and risks identified in the case study, the following areas of intervention need to be considered:

- **Recommendation LEC 1:** In order to achieve their potential, improvements in the regulatory framework are needed to better accommodate LECs. The EU could have a leading role in harmonising the framework and thus facilitating operation across the EU.
- **Recommendation LEC 2: Access to support:** In addition, the EU and/or national governments could provide support with legal and administrative issues, as well as with identifying the right partners to realise renewable energy projects. For example, the EU could have an online platform with interested stakeholders, facilitating communication between relevant stakeholders.

4.4.5 PV Purchase collectives

PV purchase collectives offer a cheaper and easier alternative for consumers to buy a residential PV system. The experience with the concept in Europe, outside The Netherlands, is very limited. Yet, it has the potential to kick-start a PV market, as it seems to have done in The Netherlands. Key success factors include a certain level of 'green' awareness, a trusted initiator and some form of programme financing. Support is needed to accelerate the development of this concept and the EC has a role to play. In particular, based on the barriers and risks identified in the case study, the following areas of intervention need to be considered:

- **Recommendation PV purchase 1: Awareness raising:** Governments, including the EC, can also help to raise awareness regarding renewable energy in general, and PV and PV purchase collectives in particular. The success of the Dutch examples could be promoted in Europe, including success factors.
- **Recommendation PV purchase 2:** Trusted parties to initiate a PV purchase collective could also include governments, on a national, regional or local level.
- **Recommendation PV purchase 3: Access to support:** The ability of households to finance PV installations will vary strongly within the EU. Programme financing proved a success factor in The Netherlands but may be even more important in lower income countries. Programme financing can for instance include soft loans or subsidy

schemes. Both have been successful in PV purchase collectives. Programme financing could be funded from EU sources, for instance ERDF funds earmarked for investments in energy efficiency/renewable energy in the residential sector[180].

[180] See also Rademaekers et al., 2012, Local investments options in Energy Efficiency in the built environment, Identifying best practices in the EU, Client: DG Energy, Rotterdam, 7 November 2012

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