Cooperative production, financing and use of low carbon technologies

Case studies

Prepared by RICARDO-AEA Triple

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Foreword

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 brochure 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.

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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 [1].

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.

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 brochure has been prepared as part of a project [2] 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 summaries 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 mode of cooperation (that is, whether the cooperation is in production, financing or use of low carbon technologies as follows for the concepts in this brochure):

1 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)

2 Further information on the project including reports and presentations is available at www.lowcarbonconcepts.eu including (from October 2014) a report presenting assessments of the 12 concepts summarised in this brochure.

Concept	Production	Financing	Use
Low carbon hub	✓		✓
Solar schools		✓	
EURONET 50/50			✓
Local energy cooperatives	✓	✓	✓
Nudge initiatives			✓
Online house renovation community			✓
Crowdfunding for RES/district heating and so on		✓	
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.

Concepts can also be grouped by the energy sector to which they apply or by who is leading or financing the initiative.

Low Carbon Hubs

Background

A Low Carbon Hub (LCH) 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 a range of approaches among the different examples.

One example is the **Low Carbon Hub (LCH) Oxfordshire**. This is a social enterprise that develops local community-owned renewable projects under an innovative **community benefit impact model**[3]. The concept involves the grouping of renewable energy projects, using low cost loans to finance the build and then replacing this finance through equity. In short a community share offer replaces the construction finance and then local power is owned by local people. The LCH Oxfordshire has now been shortlisted for two prestigious awards for innovation in the community energy sector.[4]

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

- **Powering down communities (energy efficiency 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.
- **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.

The vision of LCH Oxfordshire is for the waterways and rooftops of Oxfordshire to be the power stations of the future.

Aims

The aim of LCH is to lower carbon emissions by developing a community owned renewable energy infrastructure for Oxfordshire, and carrying out energy reduction projects for the benefit of local communities.

Examples

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, the Zero Carbon Hub has worked with government and industry with the focus on raising build standards and reducing the risk associated with implementing the Zero Carbon Homes policy.

3 **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.

4 2 Degrees Champions Award – Social Value Category and The Observer Ethical Award – Community Energy category

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 59,000kWh per year.
- Installed a 140kW solar PV scheme on the Oxford Bus Company roof in Cowley, the largest in Oxford. It generates 122,085kWh per year and will save 1,257t of CO_2 over the life of the project.
- Supported the first community-owned hydro scheme in Oxfordshire, which will generate 159,000kWh of renewable electricity in the heart of Oxford, enough to power 50 homes, and save 83t of CO_2 per year.
- Installed a 19kW solar PV scheme on Eynsham Village Hall and adjoining presbytery, which will generate 10,535kW of green electricity and save 5.8t of CO_2 per year.
- Installed external wall insulation to 16 of the most poorly insulated, pre-fabricated BISF properties trough 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, 206t of 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.

Future potential

Preliminary educated guess of up-scaling potential up to 2050

This concept is at a very early stage of development. LCH Oxfordshire only started its operations on December, 2011. Therefore, only a few projects have been implemented while additional ones are in the pipeline. LCH Oxfordshire expects to have all systems in place by next year (2015) such that it will be easier to scale-up its activities. For the moment, it is difficult to assess the up-scaling potential through to 2050.

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 payback 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.

Solar Schools

Background

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. Schools 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.

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

- Installation of solar pannels in 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.

Aims

Solar School schemes are implemented in different contexts. They aim to promote renewable energy by allowing schools to use their own roofs to generate clean energy by installing solar panels to reduce greenhouse gas (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 a bigger programme.
- Make the process easier for individual schools, as they do not have to navigate multiple bids and scenarios independently, and also have more leverage (for example, 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

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 sets a fundraising target for their very own solar roof, and then everyone chips in to help make it happen. Other examples include:

- Solar Schools (NL). Here links are made between solar installations in the Netherlands and in a developing country, with money generated from the Dutch solar installation being used to fund maintenance of the installation in the develoing country.
- Solar 4R Schools (USA). This scheme has installed solar panels on over 250 schools across the USA.
- Solarizate (a programme for solar schools in Spain (ES)
- Ohio Solar Schools (USA)

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 USA has installed 248 photovoltaic systems in schools which have generated over 12,000,000kWh of solar electricity to June 2014, avoiding about 7,600t of CO_2 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 105,000kWh and 1,364t of avoided CO_2 emissions.[5]

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

Future potential

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 EU27 has roughly 147,000 schools[6]. For practical reasons we assume only 70% of schools have potential PV capacity[7]. 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 = 51,500kW installed capacity. (Taking into account a conservative approach, where each school installs a small – medium solar system of 10kWp).

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

- Electricity generation[8] of 44GWh per year
- Annual reduction of 23,000t of CO_2 or 573,000t of CO_2 over the lifetime of the panels (25 years).
- One MW of installed capacity generates approximately 7.7 full-time equivalent jobs[9], so the 51.5MW of installed capacity may translate into roughly 400 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.

Replicability

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

[5] 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 GBP10,000 would buy a 4.2 kWp system, save 47t of CO_2 and produce 3 615kWh per year; while GBP15,000 would buy an 8.6kWp system, save 96t of CO_2 and produce 7,385kWh per year.

[6] 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').

[7] 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.

[8] 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).

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

EURONET 50/50

Background

The EURONET 50/50 project ran over three years (2009-2012) with support from the Intelligent Energy Europe programme. It engages schools in a 50/50 network in several European countries with aims to save energy, reduce CO_2 emissions and tackle climate change. It has been succeeded by the EURONET 50/50 MAX programme (2013-2016). In this model, schools and local authorities work together to implement a methodology for increasing awareness of energy use and how to reduce it, mainly through behavioural change. It 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 such as solar panels. Schools are free to choose where to invest this funding.

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 encourage more sustainable habits. Nevertheless, these buildings usually lack a specific energy policy. The EURONET 50/50 and subsequent EURONET 50/50 MAX programmes aim 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 projects 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. They also seek to promote co-responsibility among councils, pupils and teachers.

Examples

In Hamburg, the **Gymnasium Hummelsbüttel Gym** along with several other schools 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 EURONET 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 by monitoring of electricity consumption. During the first months of this project a 57% electricity savings of 57% and 41% were obtained in the cultural facility and the sports.

Key impacts

Environmental impacts (GHG emissions avoided, renewable energy generated)

The primary positive impact of the 50/50 programmes is a reduction in energy consumption by facilities and equipment within schools. This in turn helps reduce indirect GHG emissions caused by the production of electricity. There is also potential for decreasing direct GHG emissions through reduced vehicle travel to and from schools and also for reducing other forms of indirect emissions through more efficient use of materials within schools and water consumption.

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 on a wide range of context specific issues (location of school, type of panel, and so on), 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.

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 [10] 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 to 2012 [11]:

- 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 339t of greenhouse gases (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 CO_2 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.

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.

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.

Preliminary educated guess of up-scaling potential up 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.

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 [12].

The impact of the programme upon the wider economy, such as the creation of jobs or growth in particular industries has not been examined. 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.

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 implemented effectively in multiple European countries.

[10] Source: www.display-campaign.org/example477

[11] www.euronet50-50.eu/index.php/eng/contents/details/results

[12] www.euronet50-50.eu/app/webroot/files/contentsfilestranslation/main-data-results-of-50_50.pdf (Accessed 09/06/2014)

Local energy cooperatives

Background

A local energy cooperative (LEC) is 'a group of citizens that cooperates in the field of renewable energy, developing new production, selling renewable energy or providing services to new initiatives'[13].

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 an LEC 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.
- 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 and 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 (REScoop.EU) with the support of the Intelligent Energy Europe Programme (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.

[13] http://rescoop.eu/what-rescoop

Key impacts

Energy generated

The impact in terms of energy generated differs strongly from country to country. Capacity in the UK has grown from 4MW in 2003 to nearly 60MW 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 [14].

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 [15]. LECs typically also have a community value mission and focus on more than financial gain, such as revitalising the community, reducing pollution, and leaving a cleaner environment for the future [16].

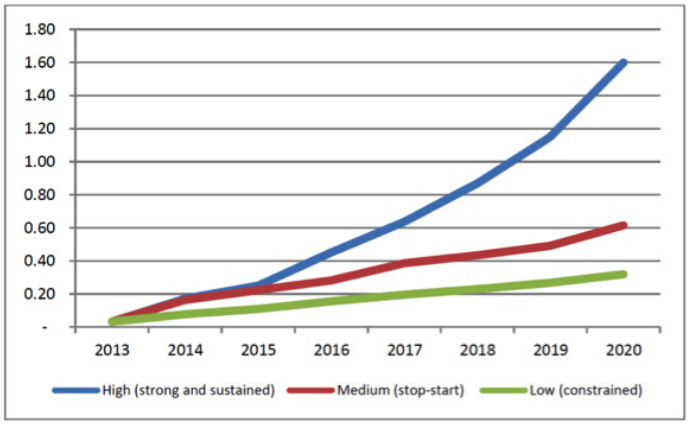
Future potential

Preliminary educated guess of up-scaling potential through 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 40MW of installed capacity [17]. 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 1).

Figure 1: Average annual installation rate per community energy organisation (MW/year)



Source: Capener, 2014 [18]

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.

Replicability

The number of LECs that have 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.

[14] The Guardian, 2013, Community energy: power to the people, Friday 13 September 2013

[15] 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

[16] Calderone, L., 2012, Are Green Energy Co-ops in Our Future?, eMagazine Issue Oct/Nov 2012

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

[18] 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

Nudge

Background

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 [19]. 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.

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

The company consists of a small core team (eight, full-time equivalent people) that, via their online platform [20], brings together consumers and 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 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.

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 "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".

Examples

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. To date, a total of 467 initiatives have been set up. Similar concepts, most of which 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.

[19] Shortened version of definition from www.inudgeyou.com/whats-a-nudge/

[20] See nudge.nl

- **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:

Project example: Love-to-load**:**

The company and friend-of-nudge 'The New Motion' (TNM) came in May 2012 to Nudge with a 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 of all the criteria that needed to be met) among its Nudgers. Within four weeks, 221 locations were found that met all criteria. Together with TNM this was checked and fed into the 'breeding place' section.

The Nudge community had to decide which of these location suggestions would be best by commenting and voting. 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.

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.

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 55,000kWh 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. Currently The New Motion's charge network with over 14,000 charge points is 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.

Future potential

Preliminary educated guess of up-scaling potential through to 2050

The question that needs to be addressed 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 organisations in a bottom-up manner is timeless[21]. Currently, the natural growth of the Nudging community is about 100 per month. A simple extrapolation using 100 and 250 new Nudgers per month shows us that the community can grow from 32,000 Nudgers now to somewhere between 75,000 and 140,000 Nudgers by 2050.

Replicability

Nudge can be replicated in other European Member States, although some countries provide a better (cultural) fit for the concept than others. 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. To date the website content is only available in the Dutch language. This language allows only for expansion into the Flemish market.

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

[21] This information is obtained through an interview with Tieneke Braamhaar (Operational Director, Nudge) and Geert van de Linden (Impact Analyst and Functional Designer, Nudge)

Online house renovation community

Background

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. Energy Leap, is an innovation programme created to achieve this target. As part of this, a frontrunners house renovation community called 'A house full of energy' was set up [22]. The platform brings together house owners who have the ambition to renovate their own home into an energy neutral residence. Via an online community, house owners are able to share their experiences with energy-neutral renovation or new construction projects with others.

Aims

Energy Leap, aims to accelerate innovative initiatives in the fields of construction and residential housing. 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 [23]. By identifying these owners Energy Leap 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. 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 and 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 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 Energy Performance of Buildings Directive (EPBD) and EPBD-recast in particular. Several European countries have enthusiastically set about the development of high ambition energy concepts for the built environment.

Links:

- House full of energy
- Office full of energy

[22] https://www.huisvolenergie.nl/

[23] In the Netherlands there are 4,000,000 privately owned homes

Key impacts

Energy generated/GHG emissions saved

Some 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 in the table below.

Table 1: Example statistics of a building that has been renovated [24]

	Before	After
Energy label	G	A++
Electricity (kWh/year)	3,500	-8,632
Natural gas (m^3/year)	3,800	0
Water (m^3/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 some of the buildings are not renovated but newly constructed, no before and after statistics could be submitted. Based on the 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 the book Freakonomics, Stephen J. Dubner, puts it "helping the planet is nice; but being seen helping the planet is really nice"[25].
- Attention of the media.
- Generation of jobs.
- Market development.
- Knowledge creation.

Future potential

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 quantitative and 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 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 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.

Replicability

Energy Leap is 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 examining whether there are opportunities for European funds to come with a similar programme in other European countries. From their visits and experience in countries, such as Germany and Belgium, they also learned that some of these regions have even more knowledge on energy efficient buildings.

[24] https://www.huisvolenergie.nl/woningen/renovatiewoning-energiecentrale/, Energy Neutral building of the year 2012 in the Netherlands.

[25] Dubner, S. J. (2012). 'Freakonomics radio: Show and Yell.' Freakonomics radio Retrieved 15-06-2012, 2012, from www.freakonomics.com/2012/03/15/show-and-yell-a-new-freakonomics-radio-podcast/.

Crowdfunding

Background

Crowdfunding 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.

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 crowdfunding has been a key part of the answer.[26] Accelerated through social media and online communication, crowdfunding is a financial power tool for energy cooperatives.

Aims

Crowdfunding 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. Crowdfunding could be the turbo-boost that renewable and community energy needs"[27].

Examples

Some examples of platforms that focus on crowdfunding 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 crowdfunding 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.
- 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 organisations 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.

[26] www.theguardian.com/sustainable-business/corwdfunding-renewables-straglehold-big-six-energy-companies

[27] www.respublica.org.uk/item/Community-Energy-Unlocking-Finance-and-Investment

- 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 [28].
- Mosaic 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. [29]
- Green Crowding
- Trillion Fund
- SunFunder
- De Windvogel
- Crowd Energy

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 crowdfunding platforms. For example, the crowdfunding platform for solar energy, Mosaic, has implemented projects that have so far (June 2014) generated over 13,000,000kWh.

Other impacts and benefits

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

- Crowdfunding can provide finance to small business and community organisations otherwise excluded from formal finance.
- Speed in mobilising funding is a another characteristic of crowdfunding– as neatly demonstrated in the recent new world record where EUR1.3 million was raised in just 13 hours by selling shares in a wind turbine to 1,700 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.

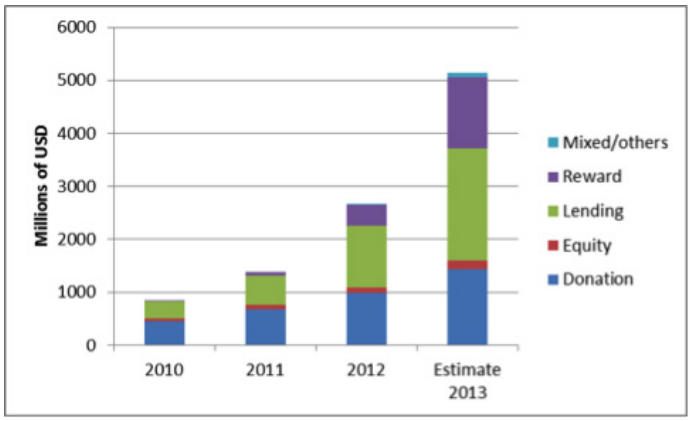
Future potential

Preliminary educated guess of up-scaling potential through to 2050

Crowdfunding 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 lend money to small businesses. The ambition is there, the British energy crowdfunding site Abundance for example, has set a target of raising EUR1.2 billion over the next 10 years.

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

Figure 2: Growth in funding volume by crowdfunding model (millions of USD)



Source: Crowdfunding Industry Reprot (Massolution, 2013)

Replicability

The potential list is endless. Small-scale wind turbines, energy efficiency retrofits, and solar arrays are all possibilities of crowdfunding projects.

[28] 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

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

PV purchase collectives

Background

Photovoltaic (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 purchasing power. In addition, 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 choose to install the panels themselves, whereas PV novices may choose to join a collective in which an installer is already contracted.

Several types of PV purchase collectives can be distinguished:

- initiated by the supplier of the solar panels.
- 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.
- for members of (interest) organisations or employees of companies. These are typically large scale bulk purchases.
- 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 participant owns their own system and has their own contract with the installer. Another approach is for a group to purchase 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

- Vereniging eigen huis The Vereniging Eigen Huis (VEH, Home Owners Association) is the largest home-owner organisation in The Netherlands with over 600,000 members. In 2012, VEH organised two collective purchases of residential PV systems for their members. To select the supplier of these systems, a reverse auction was organised during which potential suppliers could bid against each other for the exclusive right to offer and sell the participating VEH members a PV system. 11% to 33% reductions on the prices setby VEH were achieved through the reverse auction and installed capacity was 10MW.
- US Department of Energy community guidebook[30] to collectively purchase residential PV systems.

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

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 [31]. 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 such initiatives [32].

Other impacts:

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

Future potential

Preliminary educated guess of up-scaling potential through to 2050

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 [33]*0.05*2,000Wp = 5,000MW installed capacity. One MW of installed capacity generates approximately 7.7 full-time equivalent jobs [34], so the 5,000MW of installed capacity may translate into roughly 40,000 jobs.

Replicability

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.

[31] www.zonnestroomnl.nl/nieuws/performance-nederlandse-zonnestroomsystemen-gemiddeld-784-kwhkwp/

[32] SMZ, 2013, Grootschalige inkoopacties, Ervaringen en leerpunten. Onderzoeksrapport SMZ2013001 Utrecht, 22 februari 2013

[33] 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.

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

Bike sharing

Background

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 to optimise bike use.

Aim

BSSs 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 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, for examples:

- The Bicing scheme in Barcelona, which was introduced in 2007. 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.
- Stockholm City Bikes in Sweden.

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 of CO_2 and air pollutants.

A recent study by the University of California [35] 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 minutes.
- 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.

[35] Transportation Sustainability Research Centre, University of California Berkeley (2012) Bikesharing in North America: understanding the social & environmental impacts

The survey results also show that BSS seem to replace public transport use and generate more use (18% use public transport more, 39% use it less), highlighting the need to integrate cycling with the public transport network.

However, it is important not to over-state the benefits in terms of modal shift. An attempt at quantifying modal shift found that BSS replaced 2-10% of car trips. They mostly replaced trips made by public transport or walking [36].

The British Medical Journal [37] 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 [38] 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.

Future potential

Preliminary educated guess of up-scaling potential through to 2050

Basic calculations estimate that there are between 400 and 425 schemes in Europe. The Urban Audit records 630 cities with more than 100,000 inhabitants and 900 with more than 50,000 inhabitants [39]. Assuming all these cities eventually implement BSS, an additional 200 to 475 schemes could still be started across Europe. For 200 new BSS, the lower end of this range, it is estimated that 520 new jobs would be generated during construction and a further 2,300 permanent jobs supporting operations. If these schemes each saved on average 10% of the annual savings estimated for the Bicing scheme in Barcelona, then these would save a total of 180,000t of CO_2 each year.

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.

[36] United Nations Department of Economic and Social Affairs (2011) Bicycle-sharing schemes: enhancing sustainable mobility in urban areas

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

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

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

Used Cooking Oils

Background

The use of biofuels in transportation has a long history, indeed they were the original fuel intended for cars. Used cooking oils (UCO) are one of several possible feedstocks for biofuels.

The UK 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.

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 and ships. It can also be used in central heating oil boilers with a simple burner nozzle change.

Aim

The use of UCOs has several aims:

- To minimise 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:

- In Wales [40], Sundance Renewables 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 in the UK runs the majority of its fleet on 100% biodiesel made exclusively from UCO. Another UK area looking into the potential for UCOs to be used in public fleet is Devon County Council.

[40] www.theecologist.org/campaigning/transport/370794/recycling_used_cooking_oil_to_power_diesel_cars.html

- In September 2012 South Norfolk Council in UK opened collection points for UCO and fats at 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[41]. Three further collection banks were opened in July 2013 and more are planned.

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[42].
- Biodiesel produced from UCOs avoids 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, the UK Department for Environment, Food and Rural Affairs 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 GBP15 million per year[43].

Future potential

Preliminary educated guess of up-scaling potential through to 2050

The availability of used cooking oil is difficult to determine because supply is highly localised and quality often inconsistent. However, for the EU27 Ecofys estimates a maximum collectable UCO potential in the gastronomy sector of 972,000t.

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 EU27 is 3.55Mt, which is equivalent to 8 litres of UCO per person. This estimate, includes the gastronomy sector, food processors and households, and was based on an assessment of collected and discarded UCO in 10 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 UK Carbon Trust and assuming that UCO generate 83% fewer CO_2 emissions as compared to fossil fuels.

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.

[41] www.south-norfolk.gov.uk/environment/6150.asp

[42] Greenergy (2011) Making biodiesel from by-products

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

Energy performance contracts

Background

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.

An EPC provider, the Energy Services Company (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 (that is, simply providing energy services to a customer) are a long standing business model. 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.

Aims

The aim of the company owning/operating the building/estate is that the energy efficiency of the building(s) is improved and/ or the installation of renewable energy measures within the estate is achieved with little or no immediate upfront 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.

In Europe, the use of EPC is less widespread, as adoption has been slow 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:[44]

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 combined heat and power (CHP) integrated energy system was

[44] Energy Solutions 2011, European building automation controls association: www.euesco.org/fileadmin/euesco_daten/pdfs/euESCO_response_concerning_EPC.pdf

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 year and TFL witnessed a CO_2 reduction of 3,650t per year.

Brigittenau Swimming Pool, Vienna (AT)

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 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.

Municipality of Nyköping, Sweden

The Municipality of Nyköping wanted to gain better control and tracking of facilities. The EPC 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.

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 the benefit of achieving these aims, and 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.

Future potential

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 estate, in the industrial estate and potentially in the residential sector. An increasing demand for such 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 rare.

An interesting example 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. 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 and 60,000t of CO_2 per year[45]. If it is assumed that the 10 largest cities in Europe could achieve similar savings, the total would approach 500,000t of CO_2 per year.

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. The additional people employed at energy service companies, to carry out the EPCs, is further job creation.

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.

[45] Policy: Energy Performance Contracting, Future Policy.org, www.futurepolicy.org/2723.html

Municipal bonds

Background

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.[46]

Issuers of municipal bonds may be states, cities, counties, development agencies and 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 municipal bond issued by New York City for the building of a canal in 1812 in the USA.

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 US.

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.

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 and a Cooperative Society. In 2013, the organisation lent about EUR23 billion. Kommuninvest has 279 members: 271 municipalities and eight county councils (there are 310 municipalities in Sweden). 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.

- **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)[47].
- 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 projects. By February 2014, the membership was 26 communities[48]. 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.

[46] www.investopedia.com/articles/bonds/05/022805.asp

[47] Municipality Finance Plc, Annual Report 2013, www.kuntarahoitus.fi/en/financial-reports.html

[48] First Capital Increase of Local Agency France, Agence France Locale, www.agence-france-locale.fr/accueil.aspx

- In Leeds, UK, the successful close of a EUR120 million wrapped bond issued by the 'Sustainable Communities for Leeds (sc4l)' consortium was recently announced.[49] It will finance the redevelopment of three 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 2005, a Eurobond of EUR500 million 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.[50]

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 than 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.

Future potential

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 up figures from the recently started scheme in France to the 10 largest countries in Europe and assuming that 5% of spend goes to activities that directly benefit the environment such as renewable energy and energy efficiency and a further 35% to social housing, of which 10% is assumed to be used for energy efficiency improvements, 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 CO_2 per year, and an estimate of jobs created is about 370. Estimates can also be made starting from the example of Sweden. This is very strongly developed and it is unrealistic to expect this degree of development across Europe by 2050. Assuming that development might be to between 1% and 10% of the Swedish level gives estimates of CO_2 savings of between 380,000t and 3.8Mt per year and of jobs created between 33,000 and 330,000 per year.

Replicability

The range of situations and projects that municipal bonds can facilitate is widespread, encompassing infrastructure projects, social housing, renewable energy, and so on. 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.

[49] http://assuredguaranty.newshq.businesswire.com/press-release/transactions/assured-guaranty-successfully-closes-first-wrapped-bond-uk-ppp-transactio

[50] Municipal Bonds, www.nalas.eu/borrowing/3_3.html

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