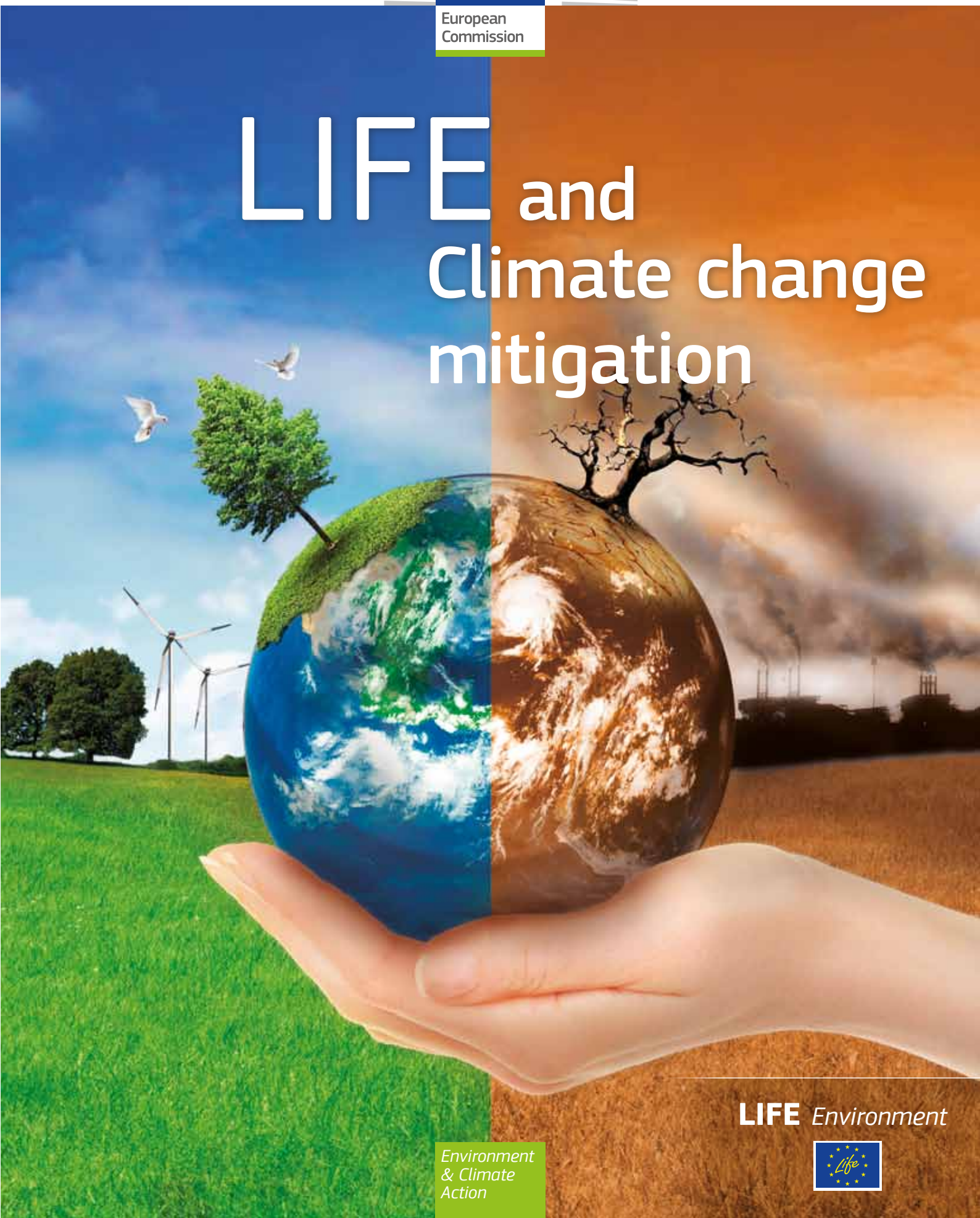
European Commission

LIFE and Climate change mitigation



LIFE *Environment*

Environment & Climate Action

EUROPEAN COMMISSION
ENVIRONMENT DIRECTORATE-GENERAL

LIFE ("*The Financial Instrument for the Environment*") is a programme launched by the European Commission and coordinated by the Environment Directorate-General (LIFE Units - E.3. and E.4.).

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Foreword

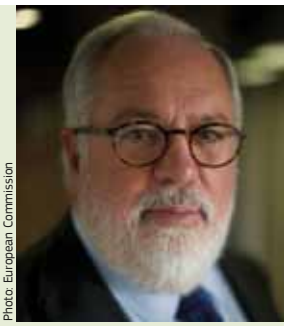

Photo: European Commission

Miguel Arias Cañete
EU Commissioner for Climate Action and Energy

Climate change is one of the major global challenges. Science has shown that recent climate changes have had widespread impacts on human and natural systems. The European Union is at the forefront of global efforts to address this challenge.

The transition to a low-carbon society is an essential underpinning of Europe 2020 – Europe's growth strategy. At the heart of the flagship initiative "resource-efficient Europe" is the 2050 Roadmap for moving to a competitive low-carbon economy. The EU is also contributing proactively to the conclusion of an ambitious global climate agreement in 2015.

Most recently, EU leaders agreed on a new integrated climate change and energy framework for 2030. This sets more stringent targets for reductions in greenhouse gas emissions, increased use of renewables and greater energy-efficiency. These will be combined with a revision of the EU Emissions Trading System and more reliable and transparent governance to ensure climate change mitigation targets are met.

With regards to funding, 20% of the EU budget for 2014-2020 is dedicated to climate action. This includes €864 million that the new LIFE sub-programme for Climate Action will make available over seven years for projects targeting both mitigation and adaptation efforts.

Such funding streams will be supported by new collaborative initiatives with the European Investment Bank, such as the Private Finance for Energy Efficiency (PF4EE), using public money to leverage significant private investment in favour of climate action.

Since 1992, the LIFE programme has mobilised more than €600 million in favour of climate change mitigation. As this publication shows, in so doing LIFE has already contributed to the shift towards a resource efficient, low-carbon and climate-resilient economy by demonstrating effective, cost effective and inclusive ways of mitigating the effects of climate change across a range of key sectors, including energy, agriculture, transport and enterprise.

One of LIFE's particular strengths is its ability to support practical and replicable solutions developed at local level, whether the individual municipality or the individual farm. The new LIFE Climate Action sub-programme seeks to build on this, increasing the public and private sector's capacity to integrate and mainstream climate objectives into everyday practice, as well as supporting better climate governance at all levels.

It is clear that the LIFE programme has been, and will continue to be, an important source of funding for actions that help us achieve the goal of creating a resilient and low-emission energy union with a forward-looking climate change policy.

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Mitigating climate change: **the EU's 2030 policy perspective**

Climate change, and action to address it, is a key priority for the EU, and in particular the Juncker Commission.

Photo: Theodore Scott

Renewable energy will play a key role in the transition towards a competitive, secure and sustainable energy system

President Juncker has stated that: "We owe it to future generations to limit the impact of climate change and to keep energy affordable – by using more energy from renewable sources and becoming more energy efficient."

Such commitments to EU citizens are to be delivered through a new integrated EU policy framework on climate action, which should lead to a low-emission and climate-resilient economy. This modernised policy perspective covers the period up to 2030 and is focused on ensuring a coordinated approach across Member States, as well as regulatory certainty for investors. It acknowledges that substantial progress has been made towards the attainment of the EU targets for greenhouse gas (GHG) emission reduction, renewable energy and energy-efficiency, which need to be met by 2020.

The 2020 package

The European Union's 2020 Climate and Energy Package[1] sets binding national targets for reducing GHG emissions by 20% (compared to 1990 levels), for raising the share of renewable energy used by 20%, and for a 20% improvement in energy-efficiency. The 20-20-20 targets aim to combat climate change, increase the EU's energy security and strengthen its competitiveness. They are included in the Europe 2020 strategy for smart, sustainable and inclusive growth, which recognises that tackling the climate and energy challenge contributes to the creation of jobs, the generation of "green" growth and a strengthening of Europe's competitiveness.

1 For more information on the Climate and Energy Package, please visit the Climate Action website

Photo: LIFE08 NAT/FIN/000596/Ulla Ahola

LIFE has supported land-use change and rewetting techniques for CO_2 reductions

This package is implemented through various legal acts such as the EU Emissions Trading System (EU ETS)[2]; the Effort Sharing Decision for sectors not covered by the EU ETS (e.g. agriculture, waste and buildings)[3]; the Renewable Energy Sources (RES) Directive;[4] a framework for carbon capture and storage; and a decision governing the inclusion of remissions and removals related to Land Use, Land Use Change and Forestry (LULUCF) into the EU's climate policy. Energy-efficiency is addressed through the 2011 Energy-efficiency Plan and the Energy-efficiency Directive. In addition, the EU has put in place a legal framework to reduce CO_2 emissions from new light duty vehicles and is also taking action to reduce emissions from aviation and international shipping and working with the international community to develop measures with global reach.

This package has already contributed to decoupling growth from GHG emissions: 2012 emissions were 18% below 1990 levels, in spite of the economy having grown by 45% over that period.

The 2030 framework

EU leaders agreed on 23 October 2014 the domestic 2030 GHG reduction target of at least 40% compared to 1990 together with the other main building blocks of the 2030 policy framework for climate and energy. This 2030 policy framework aims to make the European Union's economy and energy system more competitive, secure and sustainable and also sets a target of at least 27% for renewable energy and energy savings by 2030.

Whilst the EU is making good progress towards meeting its climate and energy targets for 2020, an integrated policy framework for the period up to 2030 is under preparation to ensure regulatory certainty for investors and a coordinated approach amongst Member States.

The framework presented will drive continued progress towards a low-emission economy. It aims to build a competitive and secure energy system that ensures affordable energy for all consumers, increases the security of the EU's energy supplies, reduces our dependence on energy imports and creates new opportunities for growth and jobs.

40% greenhouse gas reduction

A centrepiece of the 2030 framework is the binding target to reduce EU domestic GHG emissions by at least 40% below the 1990 level by 2030.

This target will ensure that the EU is on a cost-effective track towards meeting its objective of cutting emissions by at least 80% by 2050. By setting its level of climate ambition for 2030, the EU will also be able to engage actively in the negotiations on a new international climate agreement that should take effect in 2020.

To achieve the overall 40% target, the sectors covered by the EU ETS have to reduce their emissions by 43% compared to 2005. Emissions from sectors outside the EU ETS need to be cut by 30% below the 2005 level. This will be translated into national targets in

2 It was reformed to introduce a single EU-wide cap on emission allowances in place of the existing system of national caps. The cap will be cut each year so that by 2020 emissions will be 21% below the 2005 level. The free allocation of allowances will be progressively replaced by auctioning, starting with the power sector. The sectors and gases covered by the system will be slightly widened.

3 The national targets, covering the period 2013-2020, are differentiated according to Member States' relative wealth. They range from a 20% emissions reduction (compared to 2005) by the richest Member States to a 20% increase by the least wealthy (though this will still requires a limitation effort by all countries). Member States must report on their emissions annually under the EU monitoring mechanism.

4 Member States have taken on binding national targets for raising the share of renewable energy in their energy consumption by 2020. These targets, which reflect Member States' different starting points and potential for increasing renewables production, range from 10% in Malta to 49% in Sweden. The national targets will enable the EU as a whole to reach its 20% renewable energy target for 2020 as well as a 10% share of renewable energy in the transport sector and help reduce the EU's dependence on imported energy.

line with the main principles outlined by the European Council.

The EU leaders also concluded that a comprehensive and technically-neutral approach for promoting emissions from transport was necessary. With this in mind the Commission expects to propose further CO_2 standards for cars and vans for the period beyond 2020.

Increasing the share of renewables

Renewable energy will play a key role in the transition towards a competitive, secure and sustainable energy system. Therefore the EU has set an objective of increasing the share of renewable energy to at least 27% of the EU's energy consumption by 2030.

Increasing energy-efficiency

The European Commission proposed a 30% energy savings target for 2030, following a review of the Energy-efficiency Directive. The proposed target builds on the achievements already reached: new buildings use half the energy they did in the 1980s and industry is about 19% less energy intensive than in 2001. The European Council, however, endorsed an indicative target of 27% to be reviewed in 2020, having in mind a 30% target.

Reforming the EU ETS

The EU ETS remains the cornerstone of EU climate policy and the main instrument for reducing industrial GHG emissions in a cost-effective way. In the post-2020 period, the EU ETS will be reformed and further strengthened.

To achieve the 40%-reduction target in GHG emissions, set out in the 2030 framework for climate and energy policy, the total amount of emission allowances will need to be further reduced[5].

Currently, the ETS faces a challenge in addressing the surplus of emission allowances, which have accumulated largely as a consequence of the economic crisis.

The Commission has therefore proposed to establish a market stability reserve from 2021 onwards. This is to address the surplus of emission allowances in the EU ETS that has built up in recent years and to improve the system's resilience to major shocks. This will ensure that the future EU ETS is more robust and effective in promoting low-emission investment at least cost to society.

New governance system

The 2030 framework proposed a new governance framework based on national plans for competitive, secure and sustainable energy as well as a set of key indicators to assess progress over time. The European Council agreed that a reliable and transparent governance system will be developed to help ensure that the EU meets its energy policy goals.

The road to 2050

With its Roadmap for moving to a competitive low-emission economy in 2050, the European Commission has looked beyond these short- and medium-term objectives and set out a cost-effective pathway for achieving much deeper emission cuts by the middle of the century. All major economies will need to make deep emission reductions if global warming is to be held below 2°C compared to the temperature in pre-industrial times.

The Roadmap suggests that, by 2050, the EU should cut its emissions to 80% below 1990 levels through domestic reductions alone. It sets out milestones which form a cost-effective pathway to this goal - reductions of the order of 40% by 2030 and 60% by 2040. It also shows how the main sectors responsible for Europe's emissions - power generation, industry, transport, buildings and construction, as well as agriculture - can make the transition to a low-emission economy most cost-effectively.

Electric Vehicles (EVs) are a promising technology for reducing emissions of CO_2, air pollutants and noise

Photo: LIFE09 ENV/AT/000226/Helge Bauer

5 The cap will need to be lowered by 2.2% per year from 2021, compared with 1.74% currently. This would reduce emissions from fixed installations to around 43% below 2005 levels by 2030.

INTRODUCTION

LIFE and climate change mitigation

LIFE has been one of the main sources of funding for demonstration projects that have explored ways to facilitate the implementation and enforcement of EU climate mitigation policy and legislation throughout the Union.

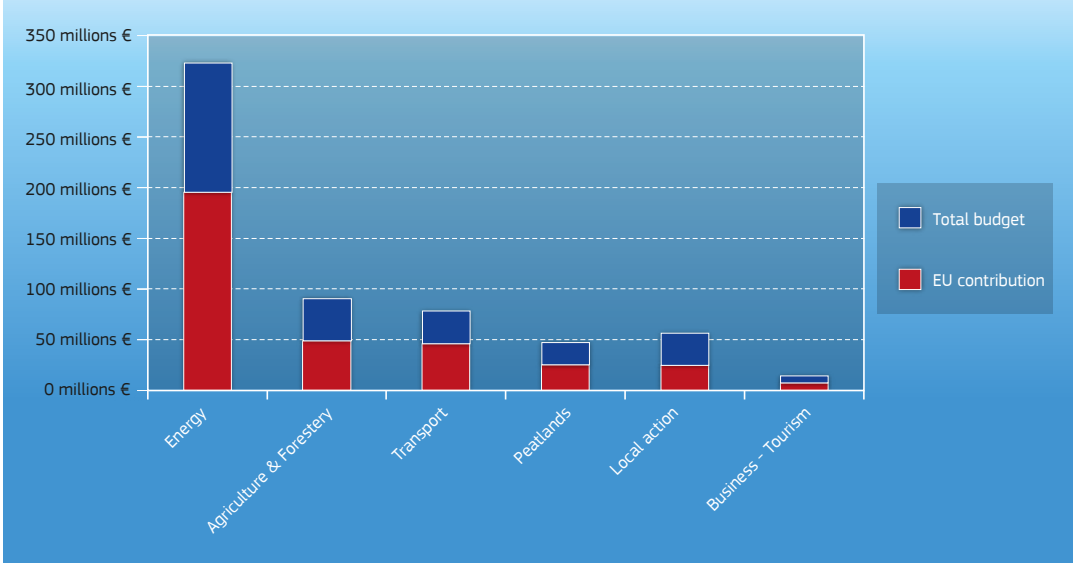
Although the LIFE programme began in 1992, it took some years for the impact of the United Nations Framework Convention on Climate Change (UNFCCC, 1992) and the Kyoto Protocol (1997) to feed through into specific projects on climate change mitigation. The first wave of notable projects in this area was funded in 1999, in anticipation of the adoption of the first European Climate Change Programme (ECCP) in 2000. A second major wave came with the LIFE+ programme (2007-2013), which identified climate change as a funding priority.

An analysis of the LIFE project database indicates that there have been 242 projects that have produced positive climate change mitigation results. This figure does not include most peatland restoration projects, since only some 20 of the 230 LIFE projects of this latter type have included direct monitoring or modelling of the impact of their conservation measures on reducing carbon loss.

The 242 LIFE climate change mitigation projects represent a combined budget of €609 million, of which the European Commission has contributed some €261 million. The energy sector has the largest proportion of projects (120 in total, or 49%), followed by agriculture and forestry (19%) and transport (14%).

LIFE has been a useful tool for implementing climate change mitigation policy on the ground. However, in certain areas much more can be done, notably in terms of: support for climate planning by local and regional authorities (LRAs); helping promising low-emission technologies to market and helping them to succeed once they are there; increasing uptake of climate-friendly farming practices and peatland res-

Fig. 1: **LIFE climate change mitigation projects: total budget and EU contribution per sector (1999 - 2012)**



Source: LIFE database

toration; and supporting efforts to improve renewable energy infrastructure.

The LIFE programme now has an even-greater focus on climate change mitigation in the current EU programming period, thanks to the creation of the new sub-programme for Climate Action, with a budget of €864 million in co-financing for climate projects between 2014 and 2020.

Supporting local action

LIFE already has helped some local and regional authorities in Europe take the initiative to integrate climate issues into their areas of competence, investing nearly €22 million since 1999. The small number of projects of this type indicates that there is scope for further funding in this area, particularly of projects that build the capacity to draft, adopt and implement local climate plans, for instance by developing monitoring and modelling tools that incorporate a cost-benefit analysis.

LIFE should place increased emphasis on capacity-building measures, building on the lessons of prior projects that have given training to LRA staff to facilitate the uptake of new tools and helped in developing collaborations between the scientific community (environmental agencies) and LRAs in developing climate or energy plans[1]. Future funding could also be used to build networks and platforms to exchange best practice amongst local and regional administrations, ultimately feeding in to other EU initiatives such as the Covenant of Mayors and the European Innovation Partnership on Smart Cities and Communities.

LIFE projects have had significant success in working with LRAs to actively engage citizens in climate change mitigation. Further opportunities exist for future projects to explore and demonstrate cost-effective ways of collaborating with other stakeholders, including industry, the banking sector and local businesses. In this respect, the Commission is working very closely with the European Investment Bank to explore ways of using public money more efficiently and more effectively in order to leverage a lot of private finance[2].

1 The barriers faced by local and regional authorities consist of developing emission inventories, use of monitoring and modelling tools, and translating results into technically-sound and economically-viable measures that will effectively reach the foreseen climate targets

2 Artur Runge-Metzger – Director responsible for International Negotiations and Climate Strategy, DG CLIMA

Photo: LIFE08 ENV/SK/000240

LIFE has helped raise awareness on the use of renewable energy

Energy-efficiency and renewable energy

LIFE has backed nearly 120 relevant renewable energy and energy-efficiency projects since 2000, contributing €128 million and mobilising €322 million in total. The most-supported project categories include biogas production from wastewater treatment plants or closed landfills (31 projects), energy-efficient buildings (27 projects), biofuel production (19 projects) and biomass production (15 projects). Less LIFE funding has been devoted to other renewable energy sources (e.g. solar, tidal, geothermal).

Whilst new technologies or governance models can continue to be successfully piloted at the local level, there is a need for more projects addressing the development of low-emission strategies at regional or sub-regional levels or within specific sectors. There is also a need for more work to address barriers that prevent market penetration of renewables and energy-efficient technologies.

Given the growing demand for forest-sourced biomass feedstock, there is room also to expand the number of LIFE projects promoting agroforestry and sustainable forest management, in conjunction with developing pathways for bioenergy.

LIFE has been at the forefront of promoting the use of residues arising from the management of Natura 2000 sites and other protected areas to generate energy. Projects have helped to promote sustainable ways of harvesting biomass from Natura 2000 sites and to contribute to the production of renewable energy, whilst supporting rural economic development.

Demonstration projects involving the conversion of biowaste to energy have contributed to the EU goal of increased energy production from renewable sources, as outlined in the Renewable Energy Sources Directive (2009/28/EC) and the 2030 framework. Furthermore, by diverting biowaste from landfills and by substituting the treatment methods that produce CO_2, NOx and methane emissions (i.e. incineration or composting), these projects have avoided producing resultant greenhouse gases (GHGs).

With the launch of the Climate Action sub-programme, LIFE strengthens its position as a means of developing and demonstrating innovative renewable energy and energy-efficient technologies and methodologies. It can therefore enhance the extent of its contribution towards the achievement of EU climate policy objectives.

Additional support for projects targeting energy-efficiency comes from the recent adoption of the Private Finance for Energy-efficiency Initiative – PF_4EE, a new element of the LIFE programme for 2014-2020. This financial instrument commits €80 million of guarantees from the LIFE Programme, combined with lending from the European Investment Bank, with the aim of leveraging eight times that amount from private sources. Financial intermediaries will thus be compensated for expected losses associated with issuing loans for energy-efficiency projects. The PF_4EE will also help intermediary banks in Member States to develop and offer specific loan programmes for energy-efficiency projects.

Finance, industry and enterprise

In the financial sector, one LIFE project already has produced a pioneering model that estimates climate change impacts and mitigation practices for businesses (see pp. 81-82). Giving banks the ability to incorporate climate risk into credit risk management strategies should increase flows of private sector funding into mitigation action.

In a number of industrial sectors (e.g. pulp and paper, tanneries, ceramics, steel, textiles), LIFE projects have developed resource efficient technologies that reduce GHG emissions and save energy. Whilst these energy-efficiency projects have contributed to climate mitigation goals, future LIFE projects could focus more on development of new, low-carbon technologies in energy-intensive industries. Further technological development of industrial processes and products across Europe will facilitate the transition to a low-carbon economy.

LIFE Climate Action provides opportunities for enterprises, large and small, to develop projects that support them in the shift towards a low-emission economy. These projects should also aim at providing easily transferable carbon-friendly solutions to other businesses across the EU and to develop low-emission technologies that will take into account, from the proposal stage, potential barriers to uptake at market level.

Transport

LIFE has helped local policy-makers make transport and urban mobility more climate friendly. A total of 33 LIFE projects with a combined budget of some €78 million have focused on transport or mobility issues around climate change mitigation.

Ten of these projects have focused on electric vehicles, mainly for use in public transport fleets, but also by private road users. In addition to electric buses and cars, LIFE projects have also trialled electric bike and scooter options. LIFE co-funding has been used to demonstrate alternatives to the internal combustion engine, including hydrogen, methane, solar, wind and liquefied natural gas-powered vehicles.

Other LIFE projects have focused on making alternative transport modes more attractive to citizens (e.g. promoting low-emission options such as cycling), improving traffic flows, and implementing low emission zones and multi-modal solutions within cities. One weakness of the programme has been that projects have tended to focus on single solutions, rather than demonstrating how several different measures could be integrated into a sustainable urban mobility plan.

Wind propulsion technology achieved 5% fuel savings, corresponding to 530 tonnes of CO_2 per year

Photo: LIFE06 ENV/D/000479

Future LIFE projects aimed at reducing energy and resource use in transport and lowering greenhouse gas emissions should focus on the different elements of the Avoid-Shift-Improve concept[3]. In particular it is desirable to carry out projects integrated with other sectors where important co-benefits will be delivered. These could include the health sector for active transport and air quality improvements, public sector organisations for effective use of the Clean Vehicle Directive, transport operators for the promotion of cost-effective energy and GHG-saving technologies such as bus hybridisation, and urban planners through, for example, Sustainable Urban Mobility Plans. Projects should aim to share best practices where these deliver multiple benefits including energy saving and GHG reduction and where these are mainstreamed into other policy areas and objectives. Preference will be given to proposals that are oriented towards measurable climate and energy outcomes rather than focused on specific technologies.

Photo: LIFE11 ENV/SE/000838

A Swedish project is testing the use of solar thermal collectors with a zero electricity heat pump and energy storage for sustainable heating and cooling

Tourism

Besides transport, tourism is the service sector where LIFE has had the greatest impact. Projects here have demonstrated how tour operators and tourists alike can reduce their carbon footprint, taking a whole lifecycle approach to carbon neutrality. This has encompassed tourism-related transport (including of goods and services, as well as people), improving energy-efficiency in holiday accommodation, green procurement and training tour operators to engage with their customers in developing and promoting low-emission trip options.

Agriculture

Since 1999, the EU has contributed some €41 million towards funding 45 LIFE projects (total budget €90 million) that have either demonstrated agricultural practices leading to meaningful reductions in nitrous oxide and ammonia emissions, or that have furthered the production of farm biomass.

The LIFE programme has been at the forefront of efforts to show farmers the benefits of adopting

Many useful climate-friendly farming practices have been learnt by farmers across rural Europe

Photo: LIFE06 ENV/IT/000266

3 Avoid - replace the need for motorised travel through high-density urban planning or by substituting travel with telecommunication; Shift - switch from private motorised travel to more-energy-efficient modes, including public transit, walking and cycling; Improve - introduce more-energy-efficient fuel and vehicle policies.

practices to take the full nitrogen cycle into account. Projects have cut methane and nitrous oxide emissions by optimising nitrogen application through precision farming as well as through livestock management, low-emission approaches to the spreading and storage of manure and slurry and through composting systems. Carbon levels have been maintained or enhanced through proper soil management and land management. Examples include conservation agriculture, no tillage farming, maintenance of soil cover, protection of organic matter in carbon-rich soils and restoration of peatlands, grasslands and degraded soil. Proper land management involves diversifying crop rotations, conversion of arable land to grasslands, organic farming and afforestation.

In the future, there is scope for more projects that explore the development of carbon audits for agribusinesses. By identifying and benchmarking their GHG emissions, farmers would be able to identify cost savings and ways of reducing those emissions through improved use of inputs and energy-efficiency. There is also a need for further projects aimed at linking farms with the production and use of renewable energy. So far, the LIFE programme has funded six projects of this type.

The Operation CO_2 project used the latest data-gathering methods to produce an inventory of a forested area

Photo : LIFE11 ENV/ES/000535/Jose Luis Marcos Robles

LIFE has helped reduce the carbon footprint of tourism busnesses

Photo: LIFE11 ENV/IE/000922

LIFE offers many examples of successful engagement with the farming sector, providing on-farm demonstrations in real-world conditions. Education and targeted knowledge transfer have been an integral part of the projects in the sector. LIFE projects take account of the economic viability of their proposed solutions, and their cost assessments have been suitably robust to address concerns from EU farming communities. Furthermore, establishing conditions that enable farmers to continue to receive expert advice from agronomists after co-funding ends demonstrates the long-term sustainability of LIFE solutions.

Technological development in agriculture is one of the main priorities for LIFE Climate Action. More projects from the agriculture and forestry sectors need to test promising practices at a larger scale. Integrated Projects give Member States in the same agri-ecological zone the chance to work together and have an impact on a broader territorial scale. Member States are obliged to report on their actions to decrease GHG emissions from agro-forestry activities, thus more proposals are welcomed from this sector, which has been targeted by only two climate mitigation projects to date.

Peatlands

Between 1992 and 2013, more than 370 LIFE Nature projects carried out conservation measures on

a range of peatland, wetland and grassland habitats. The contribution that these projects have made to climate change mitigation varies according to the habitat and is difficult to ascertain yet, because the impact of rewetting of land takes a long time to become visible. Furthermore, the vast majority of the peatland and wetland projects targeted nature conservation and conducted little or no monitoring of the impact on climate mitigation. Thirteen projects have however developed calculation models for assessing the contribution of their actions to reducing carbon loss. These are highlighted in this publication.

Although baseline GHG figures for a range of habitat types are now available, enabling comparative studies, direct monitoring has been beyond the reach and timeframe of individual LIFE projects. The programme should thus focus on this aspect and on developing monitoring tools and calculation models for measuring reductions of carbon loss, whilst maintaining agricultural production and rural economies.

Despite the lack of quantifiable data concerning mitigation effects, LIFE peatland and wetland projects have had notable benefits, including promoting cooperation between conservationists and farmers, and providing a template for actions under other funding streams to prevent further land drainage and ensure that agriculture continues to be a mainstay of rural economies.

LIFE projects have put in place a number of measures at farm and rural community level to ensure that wetland restoration can coexist with sustainable farming. These include: planning and advisory services, investment in local water infrastructure (changing drainage systems), investment aid and agri-environment-climate measures at farm level.

Peatland restoration will be a priority area for LIFE Climate Action because greater emission reductions can be obtained from it than from other agricultural practices, and with fewer resources.

The way forward

LIFE projects have invested considerably in climate change mitigation, delivering tangible results. The number of projects and amount of funding mobilised is even more impressive given that climate change only became a LIFE programme priority in 2007. However, LIFE has also clearly been stronger in some areas - renewable energy production, energy-efficiency, agriculture and transport - than in others.

Photo: LIFE99 NAT/NL/006280

More than 370 LIFE projects have carried out conservation measures on a range of peatlands, thus reducing carbon loss

LIFE Climate Action offers an opportunity to redress these shortcomings and to strengthen climate mitigation projects as a whole. The new sub-programme aims to build on past experiences and, at the same time, make the programme more focused and aligned with policy-making priorities for the future. Furthermore, the PF_4EE financial instrument is dedicated to increasing private investment in energy-efficiency projects.

The effective transfer of results is of the upmost importance. This means that projects need to investigate ways of removing barriers that could impede uptake of a technology or a best practice. They also need to propose and deliver a clear and effective strategy for applying their technologies and solutions in other situations and other Member States. This is essential to ensure that project results continue to resonate throughout the EU, rather than being lost when LIFE funding ends.

Lastly, projects need to reach policy-makers at local, regional, national and EU level to communicate their findings, feeding results into the process of implementing policy and influencing the development of appropriate new targets.

INTRODUCTION

Meeting mitigation challenges: **DG CLIMA's perspective**

Artur Runge-Metzger is Director responsible for International Negotiations and Climate Strategy, DG CLIMA. In this wide-ranging interview he highlights the policy context in which LIFE Climate Action will operate and what the European Commission hopes to achieve with the new action grants in terms of climate change mitigation.

Each of the four main pieces of legislation in the 2020 climate and energy package has its own challenges in implementation. Firstly, the EU ETS is suffering from a decline in the EU's economy and from very cheap prices for international emission reduction credits. Both factors have led to a lowering of demand for emission allowances in Europe.

Secondly, the national non-ETS emission targets are the responsibility of individual Member States. The Commission needs to help Member States through secondary legislation, e.g. for efficient cars, energy-efficient buildings.

Many national support schemes for reaching Member States' renewable energy targets have recently suffered not only from the economic and particularly the financial crisis, but also from the success of renewables. Policies that have been designed at Member State level – subsidy schemes; green certificate trading schemes – together with rapidly falling unit costs of these technologies, have pushed renewables very effectively into the energy mix. Some technologies have become quite competitive, leading in some Member States to more widespread diffusion and higher total subsidy costs than previously expected, or indeed necessary, had the schemes been better designed.

As a result, a lot of changes to national support schemes for renewables were made over the past two years, a fact which has upset investors. It's very important to bring back calm so that investments can continue into the future, while at the same time preserving the consumers' wish for affordable electricity.

Photo: WWW.DERIBAUCOURT.COM

Artur Runge-Metzger

Thirdly, Carbon Capture and Storage has its own challenges: it's a very expensive technology so finding sufficient support for large-scale implementation is not easy. Another challenge is reassuring public opinion that it is safe and environmentally sound. This requires successful large-scale demonstration.

The role of cities and local authorities

Many cities and local authorities in Europe are doing a great job on climate action. They have taken ambitious initiatives, showing that in Europe citizens broadly support the fight against climate change.

In order to increase climate smart investments one needs to look at how public money can be used more efficiently and more effectively and how to mobilise more private capital. This is something the

Commission is working on, for instance with the European Investment Bank – to seek possibilities to chip in a little public money in order to leverage a lot of private finance. It's an approach that a few Member States are already using with the help of structural funds, but not yet to the fullest extent possible.

The 2030 package: what does it mean for business?

The new package gives predictability – and that comes in several ways. One is that those companies that are big emitters in Europe know the direction of travel and thereby have certainty. A level playing field across Europe allows them to feel confident about making the necessary investments to reduce emissions. That goes across the energy sector and industry.

Furthermore, all those companies producing advanced clean technologies that reduce emissions see that there will be demand for these technologies. So, there is less risk to invest more into research and technology development, for instance into the next generation of renewable energy technologies. For this, certainty is extremely important.

In terms of transport, there will be an incentive for car manufacturers to search for new ways for car engines to consume less fuel. In that way European business as a whole can gain from a first-mover advantage in the coming decades. For many clean technologies, Europe is a first mover already.

Small changes, big impacts

Agriculture is a sector where we have seen emission reductions over the last decades. Nevertheless, there are some areas with big emissions. Particular 'hot spots' are peatlands, wetlands and grasslands. These probably provide some of the cheaper ways to further reduce emissions from agriculture, but it requires a different way of producing on these types of lands. Re-wetting certain areas, and turning them back into grasslands, can lead to big gains in reducing emissions, benefitting the global climate without affecting much land or many farmers. Climate-friendly agricultural practices such as more precise fertilisation techniques can also help not only in reducing emissions, but also in saving costs for expensive farm inputs.

Funding focus of LIFE action grants

Technological development in agriculture and forestry is one of the main priorities for LIFE Climate Action. We would like to see new techniques being tested at larger scale under real farming conditions and also to see proposals where different Member States in the same agri-ecological zone work together, having a broader impact than just in one location.

Photo: LIFE07 INF/ES/000852/Aixa Sopena

The EU's 2020 Climate and Energy Package sets targets for raising the share of renewable energy used to 20%

Another area will be industrial processes, where we would like to see if there are ideas and technologies that merit being tested and that then can be rolled out later this decade. Low-emission technologies should be developed and projects should identify how legislation may be tailored to help deploy them.

Finally, we hope that by putting a little money from LIFE in risk sharing, one can raise the technical capacity of local banks to look more favourably into the whole area of loans to improve energy-efficiency. A limited amount of seed money from the public side should attract significant money from the private capital market.

Effective results transfer

The process of communicating project results to final beneficiaries, policy-makers, the scientific community or other stakeholders needs to start at the stage of formulating the project proposal. Ideally, stakeholders should not only be involved at the end of the project, but also at certain stages of project implementation. This should be part of the necessary outreach.

Dissemination needs to be tailored to the project itself and to the technology being promoted. For an energy technology, trade fairs can reach out to the specialist community that is going to install or sell those technologies later on. To reach policy-makers or influencers, it is often a good idea to organise seminars or outreach events in Brussels. Projects should also do the same in the Member States they work in.

INTRODUCTION

Meeting mitigation challenges: **an NGO perspective**

Trees Robijns is Senior EU Agriculture and Bioenergy Policy Officer, BirdLife Europe. She gives an external perspective on the climate change mitigation challenges ahead in her areas of expertise and the role of the LIFE programme in meeting those challenges.

With regards to agriculture, there are several issues in terms of delivering the EU's climate mitigation objectives: one is how to deal with emissions from existing production, such as diminishing the use of artificial inputs; another is the fact that a part of the industry still wants to expand in a traditional way.

The question is how do you deal in a smart way with mitigation without potentially also damaging both biodiversity and animal welfare? We and our partners are thinking about holistic solutions in which we diminish our emissions in an environmentally benign way, such as looking at different types of mitigation measures and ranking them according to a traffic light system depending on whether they are also effective for biodiversity.

Nature-friendly renewables

Europe needs to urgently look at the sustainability of bioenergy within the whole of the renewables target. Whether talking about wood for heat or agricultural waste streams for fuel or gas, renewables must be much more in harmony with nature. The basis of a lot of this is good planning and preparation. LIFE could support this but, there needs to be a sustainability framework around the whole of bioenergy. It is important to look at whether these types of bioenergy are actually delivering for the climate. This means looking at direct impacts, indirect impacts – such as indirect land use change – and the carbon debt. It is positive that the volume target of the transport sector has been removed from the 2030 framework and that sustainability criteria for all bioenergy are under consideration.

Mainstreaming LIFE success

Through LIFE, a lot of innovative climate mitigation projects have been set up. For example, OTOP (BirdLife in Poland) recaptured reeds mown for aquatic warbler habitat restoration, turning them into briquettes for heating a local school. This is really a way forward. These kinds of things have been very good and very inspiring for a lot of people in a lot of different places. It is really important that LIFE funding be applied for more innovative ways of looking at mitigation issues in general given all of the challenges we face.

For bioenergy, it could be looking at ways to reuse the different waste streams from forestry and the agricultural sector and thereby not only substituting fossil fuels, but also diversifying farmers' incomes. LIFE could also help to develop the necessary processing chains, ensuring that the best technology is available to actors in the field etc.

One way to build on LIFE is to mainstream success stories through the Rural Development Programmes and Regional Development Programmes. To do that more connections need to be built. The next LIFE projects should support real innovation, such as large peatland restoration projects and innovative ways of using waste streams for energy; all of this should go together with social innovation on how to diversify and stabilise the income streams of the farmer and other actors in rural areas.

Trees Robijns

Photo: LIFE12 INF/SK/000165

INTRODUCTION

LIFE's role in the transition to low-emission agriculture

Antonia Andúgar Miñarro is Senior Policy Advisor, Copa-Cogeca. She explains how the LIFE Climate Action sub-programme can help farmers further reduce GHG emissions and help in the development of a low-emission economy.

European farmers have welcomed the LIFE Climate Action sub-programme for 2014-2020. Farmers have already been extensively involved in LIFE projects, either as coordinating beneficiaries or as partners in projects alongside local authorities, NGOs and local communities across the EU.

This instrument has made an important contribution to the implementation of nature, biodiversity and environment related-actions at local, regional, national and transnational levels.

The LIFE Climate Action sub-programme opens new opportunities with its three priority areas: Mitigation, Adaptation, and Governance and Information. In particular, the priority area on mitigation can be an attractive tool, via the financing of action grants, to scale-up existing best practices and to foster pilot and demonstration projects related to agriculture and forestry. Such projects can stimulate climate-smart practices aiming at further reducing greenhouse gas (GHG) emissions from agriculture whilst sustainably increasing agricultural productivity. The priority today lies in boosting knowledge practice application in order to better understand trade-offs and to define cost-effective solutions.

The EU farming sector's focus is firmly set on increasing resource use efficiency on farms and therefore lowering their emissions by adopting sustainable practices. Indeed, since 1990 EU agriculture has achieved CO_2 equivalent reductions of 18% and has made additional contributions by increasing energy-efficiency and generating renewable energies for other sectors. It should be noted that the sector will not be able to maintain this pace of GHG reductions in the EU in the coming years. One of the reasons for this is that the mitigation potential of farming is limited by the biological nature of its emissions and their variability, which depends on weather conditions or the natural nitrogen cycle in crop production.

More than food

Agriculture is not only food. Its production of renewable energy and materials means it has a key role to play in fighting climate change and transitioning towards an EU low-emission economy. Increased use of agricultural and forestry commodities in the production of industrial materials can also help to reduce the need for petrochemistry-based products, offering opportunities to diversify agri-production systems and agri-ecosystems.

The evolution of global demand for food and renewables requires coordinated policy responses ensuring resilience of agriculture to the threats of climate change, and promoting synergies to reduce emissions. Innovation is pushing forward measures that enable farmers to improve the environment whilst increasing their productivity, profitability and competitiveness, and which encourage them to contribute to combating climate change (e.g. the bioeconomy, carbon sequestration).

The LIFE programme has already created a framework for showcasing the proactive nature of the farming community via successful actions. The EU agriculture sector has a huge task ahead: contributing to global food security and independence from fossil fuels. This is why initiatives such as LIFE Climate Action are needed to bridge the gaps between science and farm-level realities and between different land users.

Photo: Claudio Gervasi

Antonia Andúgar Miñarro

LOCAL AND NATIONAL ACTION

Integrating **local and regional levels into climate action**

Europe's local and regional authorities play essential roles in mitigating climate change. LIFE has helped improve the capacity of many of those authorities to plan, manage and monitor a useful mix of mitigation measures.

International agreements and EU policy oblige Member States to reduce greenhouse gas (GHG) emissions. To meet their obligations, the Member States must adopt National Strategies and subsequent National Plans for Climate Change. Effective implementation of such measures depends on successful integration of the national, regional and local levels, since many of those national obligations are devolved to regional authorities and many critical actions to address GHG emissions are best initiated locally.

Citizen involvement encourages a wider uptake and support of mitigation measures

Photo: LIFE02 ENV/F/000289

Vigorous region-level strategic planning is thus vital to the delivery of national commitments, and specific regional opportunities for low-emission development must be identified. According to the EC communication "Regional Policy Contributing to Sustainable Growth in Europe 2020", it is necessary to mobilise and empower regions and cities to deliver on the vision of a low-emission, resource-efficient Europe. Stakeholders in regional development must focus on opportunities that maximise economic, environmental and social benefits whilst minimising climate change risks.

Supporting local action

There are a number of EU initiatives that support local and regional authorities (LRAs) in their climate mitigation action, such as the Covenant of Mayors (see box) and the European Innovation Partnership on Smart Cities and Communities (EIP-SCC[1]).

1 http://ec.europa.eu/eip/smartcities

The EIP-SCC seeks to improve urban life by bringing together cities, industry and citizens. One goal is to progress towards a 40% GHG emission reduction by 2020 through energy-efficiency and innovation. The partnership has considerable potential to have a positive impact because some 80% of energy consumption and CO_2 emissions come from urban zones.

Well positioned

LRAs have responsibility for policy in areas that have a direct impact on GHG emissions - including municipal utilities, land use and urban forestry, the energy-efficiency of buildings, waste management, transportation, financing and environmental programmes. This gives them a significant role to play in translating abstract, global climate-change objectives into concrete measures.

As both consumers and service providers, LRAs have the capacity to implement energy-efficiency measures (such as by introducing energy-saving actions in public buildings, for street lighting and on public transport). In their role as a planner, developer and regulator, they can make considerable energy savings through proper land use planning, organisation of the transport system and improving performance standards of renewable energy equipment in new buildings.

As an advisor, motivator and role model, local and regional governments can help to inform and involve residents, businesses and other local stakeholders in initiatives to use energy more efficiently and reduce their carbon footprint.

Finally, LRAs have the scope to set up networks or offer consulting services to local agencies and businesses for developing and implementing specific projects.

Effective climate planning

Adopting a climate plan at local or regional level can be a complex process, involving not only the initial work of drafting and winning approval for the plan, but also a number of feedback loops to monitor, review and, when necessary, amend the plan over time. The four steps of this process can be defined as follows:

- Establishing a Baseline Emission Inventory. The BEI requires the collection of data about the territory's GHG emissions and energy balance;
- Setting emission reduction targets;
- Implementation and monitoring; and
- Revision and reporting - essential components of a plan's lifecycle that need to be programmed so that they are carried out systematically.

Photo: LIFE07/ENV/FIN/000138

LRAs are best placed to adopt measures that have an impact on GHG emissions, such as from transportation

The first stage of the process is essential, but it is often the most difficult to deliver because many LRAs do not collect energy balance and GHG emissions data within their existing territorial monitoring systems. Clarifying the energy balance means taking into account both energy supply and energy use. It also requires an analysis of all current policies and plans that impact on energy issues in the territory. The second element of the BEI requires LRAs to identify and collect data on the principal sources of CO_2 emissions and their respective reduction potentials in the territory within a given period of time.

Covenant of Mayors

Launched in 2008 after Member States adopted the EU Climate and Energy Package, this mainstream LRA network plans to meet and exceed the EU's 20% CO_2 reduction objective by 2020. Sustainable energy practice is the prime focus of its work programme and the Covenant of Mayors has been heralded as a model of multi-level governance. It represents the only model of its kind to have mobilised and channelled so much LRA effort towards tackling a high-level EU priority.

All signatories to this climate Covenant commit to boosting their mitigation know-how though a Baseline Emission Inventory (BEI), which provides them with evidence to draw up Sustainable Energy Action Plans (SEAPs). The Covenant has published a SEAPs catalogue and 'Benchmarks of Excellence' to help signatories achieve the goal of creating skilled and stable jobs whilst fostering a healthier environment and quality of life through enhanced economic competitiveness and greater energy independence.

Photo: LIFE07 ENV/FIN/000138

LIFE has supported capacity development amongst local and regional authorities to address climate change through planning

Since LRAs often lack the capacity to gather and interpret these vital baseline data, they need external support. This can come in the form of contracting the work out to external specialists or working with those specialists to develop tools and skills for internal use (here the external experts provide training and advice).

Confirming the inventory provides a starting point from which to start analysing the feasibility of different mitigation scenarios. Cost-benefit modelling should be applied to the scenarios and stakeholders should be involved in the drafting of local and regional climate plans to ensure the widest possible support for proposed mitigation measures. Talking to citizens, businesses, and other partners during this process also helps to raise awareness and encourage involvement – this can contribute to cost sharing through, for example, private-public partnerships in areas such as energy-efficiency, mobility and waste.

Once a plan has been adopted, its successful implementation requires a clear delineation of responsibilities and a clear timeline for different actions. Such clarity makes it easier to monitor the progress of the plan through the use of appropriate indicators and later to review the plan and adopt new measures.

The review cycle should also take into account the need to keep the territory's BEI up to date to ensure that calculations of mitigation achievements are accurate - based on the latest information, rather than on a baseline that may not reflect changes in people's behaviour or the availability of finance that had not previously been envisaged for the territory.

LIFE and climate planning

Co-finance from LIFE has been and can be used to offset many of the costs involved with the climate plan lifecycle. LIFE's proficiency in these areas continues to be enhanced and builds on more than a decade of support to LRAs for climate mitigation.

LIFE funds have been used by some 22 different projects covering nine Member States (Austria, Denmark, Finland, France, Italy, Poland, Spain, Sweden and the UK). Together, these LIFE projects have developed a broad knowledge base of transferable LRA practices in climate change mitigation dating back to 2002. They have demonstrated a host of different tactics, tools, and techniques for converting global goals into on-the-ground action.

In terms of strategic planning, the LIFE Preparatory project EC4MACS developed tools that can help Member States in improving their emission strategies for GHGs and air pollutants. The project integrated all major contributors to climate and air quality problems by sector, in order to provide a full economic analysis of costs and benefits for mitigation methods and to identify the synergies and trade-offs resulting from policy responses in different regions and sectors. EC4MACS was the first fully-integrated study for assessing government actions to reduce air pollution and GHG emissions across Europe and

fed into policy including the revision of the Thematic Strategy on Air Pollution (2013), the European Climate Change Programme, the 2050 Roadmap and the NEC Directive

LRAs can use the EC4MACS toolbox (www.ec4macs.eu) to benchmark their situation against real GHG and air pollutant emissions by economic sector, as well as to view projections for future emissions.

Energy and climate plans have featured strongly in 12 projects, which incorporate activities by individual LRAs as well as groups of authorities (see LAIKA box). These plans typically focus on energy-efficiency in buildings (including workplaces); improved urban mobility; renewable energy production; waste management; incentives for local businesses and banks; and the creation of green urban areas or afforestation.

Photo: LIFE09 ENV/DK/000366

Process model for municipalities and companies to engage in climate planning and carbon reduction

The creation of transferable tools and toolkits has been an important output of LIFE's climate action work with LRAs (mostly at the local level). These include effective methods for producing emission inventories, modelling scenarios and setting targets, as well as tools for monitoring GHG emissions over time, and revising climate plans.

To improve uptake of project tools and toolkits, beneficiaries should, from the outset (i.e. project proposal), include clear networking and outreach strategies for the solutions that they are developing. Transferability should be built into projects, rather than added as an afterthought.

LIFE projects have also used information and communication technology (ICT) to facilitate green public procurement and build capacity; they have promoted networking and exchange of best practice, involved citizens and facilitated public-private partnerships.

In some cases (CLIM-LOCAL2020 – see pp. 24-26 - and FACTOR20), LIFE co-funding was used to produce SEAPs that were submitted to the Covenant of Mayors, thus creating synergies with this high profile EU network.

Emission inventories

Several LIFE projects have succeeded in producing effective emission inventories. Projects including CARRA, FACTOR20, LAKS, Julia 2030 and LAIKA helped LRAs to determine their baseline status in terms of GHG sources and energy balances.

The workings of a capacity-building exercise designed to help LRAs in Finland tackle climate change

Photo: LIFE07 ENV/FIN/000138

Guidelines developed by LAIKA on how to set up an inventory by delimiting a geographical area are especially pertinent for other LRAs interested in climate mitigation planning (see box).

CARRA LIFE demonstrated ways of using estimates to determine baseline situations when there is a lack of primary data. Within a pilot area, the project team derived estimates for five sectors - domestic, commercial, education, street lighting and transport – using a combination of Geographical Information Systems (MapInfo), traffic emissions modelling software (DMRB) Standard Assessment Procedures (SAP) ratings analysis (NHER Auto Evaluator), and national energy benchmarks for buildings.

France's CLIMATE project showed another means of collecting inventory data using the Bilan Carbone (carbon footprint assessment) method developed by ADEME (the French environment and energy agency).

LIFE09 ENV/IT/000200

LAIKA

The project, an acronym for 'Local Authorities Improving Kyoto Actions' saw the cities of Milan, Turin, Bologna and Lucca join forces to adopt harmonised accounting, planning and reporting methods for projects and plans targeting GHG emission reductions. This knowledge-sharing initiative helped update emission inventories for SEAPs for three of the cities and enabled Lucca to draft for the first time a 'Climate Commitment Plan'.

The project's scientific coordinator, Fabio Iraldo explains that the project, "overcame problems associated with defining the Business as Usual (BAU) scenario, setting eligibility criteria for target sectors, agreeing monitoring indicators, determining the ownership of carbon credits, and avoiding 'double counting' risks."

The participating municipalities' climate plans include measures that show the potential impact of small behavioural changes by citizens (e.g. to private transport use and room heating). If all the measures are successfully implemented the LAIKA team calculates a reduction in CO_2 emissions of some 3 million tonnes/yr.

The project showed how harmonisation of climate action planning across municipalities not only benefits local decision-making, it also improves reporting on results of mitigation actions at national and EU levels.

LAIKA also piloted a voluntary carbon credit market in the four cities. Although high compliance costs meant that uptake was lower than expected, companies operating locally successfully used city carbon credits as a public relations tool and demonstration of corporate social responsibility. The project noted how carbon credits could also be recognised at a higher institutional level (i.e. regional, national, and European) in the evaluation criteria of funding programmes.

This enabled the project to assess contributions to emissions of carbon and other GHGs (methane, nitrous oxide, etc.). Such carbon assessment methods make it possible to quantify direct and indirect GHG emissions from an entity over a given period.

The FACTOR20 project was based in the Lombardy Region of Italy, but also involved close partnership with LRAs in Basilicata and Sicily. Its aim was to standardise regional databases on electrical energy systems to provide a full picture of energy consumption, generation and network infrastructure (and thus provide a benchmark to monitor the impacts of energy activity on GHG emissions). The project used this information to create a 'burden-sharing' tool called Sirena-Factor 20 that was able to set regional and local targets for sectors outside the EU Emissions Trading System (ETS), such as construction and transport.

Participating LRAs shared methodologies to optimise the setting and monitoring of targets. The project involved stakeholders in testing the feasibility of implementing local action plans for energy sustainability. From these tests, each participating authority was able to select the most promising actions in terms of cost benefits and transferability. As a result of the project almost all local authorities that adhere to the Covenant of Mayors initiative in Lombardy (about 800) and Sicily (50) are using it to define their measures and to fulfil monitoring obligations.

Modelling and monitoring

The tool developed by FACTOR20 is one of a host of examples from LIFE climate change mitigation projects demonstrating how baseline data can be used to model the outcomes of various mitigation scenarios. However, it is the only project to have actually developed such a model, even if several others (LAIKA, Julia 2030, CLIMATE) have produced guidelines on how to develop plans containing a business-as-usual scenario and a range of strategic measures

Photo: LIFE07 ENV/IT/000045

Photo: LIFE08 ENV/E/000101

Las Rozas por el clima created carbon sinks through the re-naturalisation of approximately 26 ha of green public areas

for climate change mitigation. Clearly, there is scope for future LIFE projects to further develop measuring and modelling tools and disseminate them to LRAs to help facilitate their planning work.

Once a climate plan has been adopted it is necessary to monitor GHG emissions to see if targets have been reached or if the plan needs to be revised. LIFE projects that have developed monitoring tools for use by LRAs include Soria CO2Cero, as well as the aforementioned LAIKA, Julia 2030 and FACTOR20.

Based in Helsinki, Julia 2030 introduced simple tools for calculating GHG emissions from different sectors - transport, waste management and public buildings - to measure the impact of different ways of reducing emissions. The calculators are available on line (www.hsy.fi/julia2030/en/project/transport/Pages/default.aspx) and they allowed the beneficiary to monitor the implementation of measures and revise them.

There is scope to apply monitoring tools developed by these LIFE projects in other parts of Europe. There is also an opportunity to apply tools designed to monitor other types of emissions to the monitoring of greenhouse gases. For example, the Italian project OPERA focused on air quality, but its tools could be used to manage GHG emissions produced by a given territory.

Capacity building

As mentioned above, LRAs need external support to develop and adopt effective climate and energy action plans. Expert training and advice also gives staff at LRA level the confidence to use tools that can translate emissions scenarios into tangible measures, such as in the CCCRP project. One of the strengths of the LIFE programme has been its usefulness as a means of building synergies between LRAs and environmental bodies to give the former the tools to implement climate action plans.

The LAKS project is a good example of how LIFE co-funding can be used to help train key staff in local and regional government to use modelling tools and translate scenario data into mitigation targets. The LAKS team trained staff at local authorities in Italy, Spain and Poland in the use of a tool for developing emissions inventories. Training also encompassed how to establish appropriate local measures and how to use a 'climate balance' monitoring system to evaluate on an annual basis the state of implementation of policies and subsequent results.

Another way in which LIFE can help build capacity is through the creation of networks. For instance, the Polish project DOKLIP is establishing a pool of experts to train LRAs to produce climate and energy plans. The project will run 85 training courses

LIFE07 ENV/FI/000138

CHAMP

The project built capacity amongst LRAs, trainers and auditors in the use of an integrated management system (IMS) for climate change. To achieve this it established independent training hubs in Finland, Germany, Hungary and Italy run by organisations already working with LRAs who integrated the IMS support into their portfolio of services.

These have since been joined by further hubs in Poland, Romania, Spain and the UK, benefitting 58 LRAs in total, explains Esther Kreutz from the Union of the Baltic Cities, the project's coordinating beneficiary.

The CHAMP team produced a handbook that taught trainers how to organise IMS training sessions and use the project toolkit, which included checklists, templates and other material that can be used at different stages of LRA mitigation work programmes.

"This capacity-building process helped the partners to tackle challenges involved with developing and implementing an integrated climate strategy, which includes all climate aspects, all relevant municipal departments, and a range of external stakeholders," says Ms Kreutz. The project also worked to nurture political commitments for mitigation measures by addressing ways of involving decision-makers throughout the process. EU-level recognition of the benefits of the IMS approach to climate work was demonstrated by the inclusion of CHAMP in a Committee of the Regions position paper on "Climate change mainstreaming and the future budget".

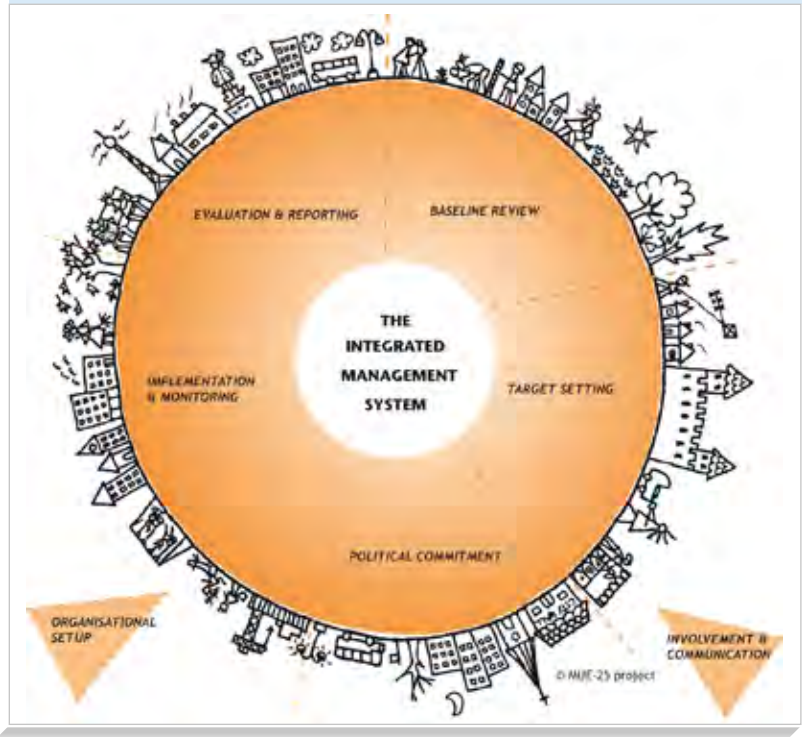


Photo: LIFE07 ENV/FIN/000138

for a total of 1 400 local leaders from Polish counties. Lessons will be further transferred through the publication of a best practice manual showing how mitigation measures can contribute to local development and job creation.

The MedClima project created a network of Mediterranean LRAs, which has expanded from the initial partnership to include other cities. Its success highlights the potential of cooperation between local authorities as a means of tackling climate change.

One of MedClima's key innovations has been the development and pilot implementation of a rapid CO_2 emissions assessment method. It also developed a checklist of climate protection measures that led to a common action plan and tailored local action plans for each participating municipality. During the project's short implementation period, participating LRAs managed to achieve an average reduction in CO_2 emissions of some 3%. The MedClima cities continue to expand their network post-LIFE and to disseminate widely the project results.

Another way in which LIFE can help build capacity at local level is by enabling the integration of climate and energy-efficiency concerns into green public procurement processes. LIFE GREEN TIC, for instance, developed ICT tools that help public bodies to quantify their carbon footprint, validate best practices, and set standards that can be used by LRAs for benchmarking. RomaPerKyoto and Julia 2030 have also produced general guidelines for green public procurement. In the case of the latter, these guidelines include a comprehensive study of public procurement regulations and practical instructions on how to arrange competitive tendering for various purchases of goods and services. The project developed a tool (JUHILAS) to calculate the carbon footprint of five types of product. This is now being used in competitive tendering to calculate GHG emissions over a product's lifecycle. This emissions figure is then taken into account by LRAs in their assessment of tender proposals.

Involving stakeholders

It is clear that climate mitigation plans need to involve interested parties from the very beginning to ensure stakeholder support and success. Identifying which stakeholders to involve, and how and when to involve them is not always as straightforward however. The LIFE programme offers a plethora of useful lessons in this regard, although it should be noted that projects have tended to engage with the general public, enterprise or industry as a whole, rather than targeting specific sub-groups, even if some (such as

Photo: LIFE09 ENV/FR/000598

The Soria CO_2Cero project raised citizen awareness on the need to combat climate change

farmers) can make a significant difference to emissions and land-use change.

One notable example of stakeholder involvement comes from the PRIVILEGES project, which developed an LRA climate plan in France. This ambitious project developed an energy-efficiency action plan for two of the largest industrial facilities in the Chalon basin. It also used a tool developed by ADEME to identify mitigation measures that minimise the risk of adverse economic performance for the participating industrial sites. PRIVILEGES led to a 10% reduction in energy use, saving some 5 220 tonnes/yr of CO_2.

Along similar lines, the Las Rozas por el clima project incentivised businesses to get involved in climate action through an eco-labelling scheme, 'Create Environment'. More than 40 companies – including Audi, Banco Santander, Esker, and ING Direct – have been awarded the Create Environment label for their carbon-friendly practices.

LIFE's greatest impact in terms of stakeholder involvement has been its work with the general public, particularly the way in which projects have applied ICT as an instrument that citizens can easily use to monitor their carbon footprint in the areas of energy, transport, food and waste.

Sweden's CLICC for example is encouraging households in Malmö to track their CO_2 emissions using a web-based instrument and compare their performance against the project's overall targets. Data from the CLICC monitors will be used to generate statistics and reports based on the results. The project is also developing a strategy to reduce the carbon footprint of Malmö's households by 50% by 2020, equivalent to 106.1 tonnes/yr of CO_2.

Similarly, SUSTAIN-ICT is connecting electricity and water meters and temperature gauges to an ICT system called 'the kiosk' that allows citizens living in social housing to monitor their carbon footprint.

LIFE09 ENV/DK/000366

Climate Partnerships - Carbon 20

This Danish project encouraged the formation of public-private partnerships (PPPs) between municipalities and local companies to deliver climate mitigation measures. The local dimension was very important, believes Lone Pie Kelstrup, Program Manager (Green Growth) at the project beneficiary, Gate 21: "It strengthened the commitment of partners because there was a strong interest among companies to improve their networking arrangements and relations with other companies locally, as well as with the local authority."

The PPPs entered into cooperation agreements with companies that provide energy saving services to other companies; and with companies that committed themselves to 20% CO_2 savings. LIFE co-funding helped the PPPs set common targets and transfer relevant technical know-how (such as how to make cooperation agreements with service providers). The result of the project was a reduction in CO_2 emissions of 21.2% on average for the 119 participating companies.

The beneficiary expects the project will lead to a 343 tonne/yr reduction in CO_2 emissions.

The Julia 2030 project developed online CO_2 calculators to enable Helsinki's citizens to calculate their waste and mobility-related carbon footprint. These were accompanied by tips for changing behaviour to reduce emissions.

Citizen involvement can be fostered in other ways as well and LIFE has developed useful experience of working with groups of citizens who voluntarily act as intermediaries between the general public and civil society. These 'mitigation messengers' help deliver awareness raising or training actions targeting fellow local residents. As members of the community they can create a sense of trust in the validity of mitigation measures and encourage wider uptake and support.

One example of this comes from the CLICC project, which used 'climate coaches' to run training sessions for participating households on mobility, waste, and energy savings. For the EKO-LIFE project, the climate mitigation message was delivered by so-called 'change ambassadors' who have helped to develop scenarios that demonstrate to the citizens of Vorarlberg (Austria) that it is possible to make more climate-friendly choices in their everyday lives concerning mobility, food, consumption and housing.

Soria CO2Cero in Spain created a 'network of territorial guards' whose role included convincing residents to perform eco-audits in order to firstly understand their own carbon footprint, and secondly to reduce it. The 'territorial guards' were also involved in promoting eco-investments among Soria's citizens, such as the creation of a biomass plant and a new district heating system that brought considerable energy savings and CO_2 reductions.

Another useful set of ongoing LIFE experiences in this area is being developed by a nationwide Italian project tasked with changing citizen behaviour. This EcoLife initiative is being carried out in 30 local communities. It promotes low-emission lifestyles and is being piloted in selected communities in advance of a broader expansion throughout Italy. Citizens will be able to monitor the effectiveness of their new lifestyles using information about individual and collective contributions. All such data is being made available on the project's website and the beneficiary predicts CO_2 emission savings of up to 500 kg/yr for each inhabitant – leading to a total reduction of 5 000 tonnes/yr in the pilot area.

Future opportunities

This review of LIFE's support for LRA planning in climate change mitigation confirms LIFE's potential as a useful source of co-finance for LRAs, especially when it comes to stakeholder engagement. Although the number of LIFE projects that have helped LRAs in their climate action planning has been relatively limited, there is scope for further funding in this area, particularly of projects that build capacity and develop monitoring and modelling tools to make it easier to adopt and implement such plans.

The ROMAPERKYOTO project led to the approval and implementation of Rome's climate mitigation plan

Photo: LIFE04 ENV/IT/000453

LOCAL AND REGIONAL ACTION

Greek city demonstrates **local climate change mitigation model**

The city of Volos is on target to significantly reduce its GHG emissions by 2020: It has a methodology, tools and a local action plan to mitigate climate change and recently pledged further energy-efficiency actions under the Covenant of Mayors.

A growing number of European cities are taking action to reduce their greenhouse gas (GHG) emissions. As highlighted in the introduction to this publication, local and regional authorities (LRAs) are in a strong position to alter their GHG emission patterns through their influence over key policy areas such as in public utilities, services and buildings and through local transport and environmental schemes.

In addressing climate change, local governments can take action in several or all of their possible roles (e.g. as consumers and service providers; planners; developers; and regulators). A number of municipalities have already signed voluntary agreements and committed to join forces to help mitigate climate change - for instance through the implementation of sustainable energy action plans under the Covenant of Mayors (see p.17). Energy-related actions are the key measures of the action plans, considering the fact that cities consume some 80% of the world's energy.

In this context, the CLIM-LOCAL2020 project (**LIFE07 ENV/GR/000282**) was implemented between 2009 and 2012, with an overarching goal of helping local authorities to reduce their GHG emissions in line with global and national climate protection efforts.

Situated in the coastal city of Volos in Thessalia in central Greece, the project was coordinated by the municipality of Volos (population approx. 145 000), an important agricultural and industrial centre, with its port providing a bridge between Europe, the Middle East and Asia. Other partners were the Volos development company (ANEVO), the municipal water and sewage treatment company (DEYAMV), and the environmental planning and engineering consultancy, EPEM SA.

Photo: LIFE07 ENV/GR/000282

CLIM-LOCAL2020 carried out energy audits on 15 public buildings, mostly schools

Amongst its main goals were two key objectives: to raise awareness at the local level about climate change and its mitigation; and to initiate GHG emission reductions in Volos over 10-15 years, involving the local community.

Working with its municipal partners and external advisors, the beneficiary devised a similar methodology to those mentioned in the previous chapter for the development of general climate and energy action plans. The difference being that this plan was geared specifically to Volos. "The first thing that was needed was a comprehensive dataset of the CO_2 and GHG

emissions produced in the area," explains Georgios Gangas, director of planning and programmes for development company ANEVO. "We also needed to carry out an 'energy balance' for Volos." Here, he explains they were fortunate in that ANEVO had already amassed much of the required data. He concedes that for other local authorities without such data, this task could be onerous.

The next step was to prepare baseline (2007) emission inventories by sector, using an IPCC-based software tool. These were then used to make projections and to develop scenarios of CO_2 and GHG emissions until 2020. The beneficiary was then able to convert the figures into practical measures with the potential to significantly reduce emissions in the time period, whilst also being cost-efficient.

Cost-benefit analysis

Using the tool to determine the cost of measures in advance, makes it especially useful to public administrations, says Mr Giorgios, explaining that without a cost-benefit analysis, the measures could be either overestimated or underestimated, which would result in the longer term projections being 'off target'. "Local authorities would not be able to work on their own with these tools, but would need the support and continuous collaboration of a consultancy or another external agency to make it work," he maintains.

Project manager, Evi Karaiskou, agrees: "Usually LRAs don't have these tools, capacity building or experts/consultancies to help to develop and run such projections and then to interpret and translate the results into cost-efficient measures to be incorporated into a plan. We were enormously fortunate in having this external support."

Photo: LIFE07 ENV/GR/000282

Public consultations were also carried out to win support, acceptance and collaboration of all stakeholders. "Having this support is very important to the successful implementation of measures. You need active collaboration if you want a plan to work," says Ms Karaiskou.

The "Volos Local Action Plan on Climate Change 2010-20" was officially approved and endorsed by the city council in April 2010. It covers not only energy consumption and carbon dioxide (CO_2) emissions, but all greenhouse gas emissions across all sector emitters.

Results

At the start of the project, the longer term target was to cut GHGs for Volos by 7% below 2007 levels by 2020. According to estimates this would mean savings of 70 000 tonnes CO_2 eq. by 2020. To achieve this, the plan identified 49 key measures to be implemented, grouped into six sectors by emission sources: buildings, transportation, water supply and sanitation, municipal solid waste, city operation and prospect actions.

It showed that energy consumption was the main contributor towards the GHG emissions for Volos. In the non-ETS sector (for ETS, industrial installations were the highest consumers) the main consumption came from the residential sector, followed by transport.

Best energy savings

Addressing privately-owned buildings, for example, the project team worked with householders to find the correct energy balance for their properties. According to Mr Gangas, the best energy efficiencies came from renovating roofs (40% savings) and walls (27%), whereas new windows brought only 8% energy efficiencies. "It was very difficult to explain this to families who preferred renovating their windows for aesthetic reasons," he says. Energy audits were also carried out on 15 public buildings, mostly schools, during the project, with each building achieving a B+ classification in energy-efficiency through various improvements.

The project also put considerable effort into raising awareness about the issues. This not only meant participating in public events and talking to householders; the team also produced a game about saving energy aimed at children. "Educating children on the importance of energy efficiencies is very important as they in turn educate their parents and are also the future users," believes Ms Karaiskou.

Another measure involved partner DEYAMV. Here Stefanos Katartzis, manager of the planning department, explains that the aim was to reduce the indirect energy emissions emanating through old machinery: "The system wasted a lot of energy, so we decided to invest and upgrade all the equipment in order to obtain significant reductions," he says, adding that already in 2014, with these investments the company has made 5% savings in energy consumption.

A third measure concerned the collection of green organic waste. A pilot composting plant was built during the project to handle the green waste from the maintenance of parks and trees in the city, as well as organic waste (bio-waste) produced by households. As part of this initiative to promote composting, 350 garden home-composters (bins) were distributed to Volos householders (see box), following a public lottery. Margarita Ligoura: agriculturist for the Volos department of sustainable development, says: "The composting bins have been very popular and we will be providing more in the future to other citizens."

The project gave 350 families home organic composters

Photo: LIFE07 ENV/GR/000282

An economic analysis carried out by the project shows that around 60% of the identified GHG emission reduction potential concerns 'win-win measures' (i.e. interventions that provide an economic benefit to end users without requiring economic subsidies or other similar policies). This win-win potential concerns all Volos stakeholders from local authority services to individual householders. The full implementation of the energy conservation measures for municipal buildings, for instance, will lead to estimated annual reductions in energy expenses of some €80 000. Other significant savings will be achieved from the separate collection of green- and other organic wastes in the pilot composting plant: as some €190 000 was paid every year for the disposal in landfill of this waste.

Home composting

A delighted John Ginidis owns one of these home composter bins: "I have always composted, but this bin is very practical as it keeps the organic material at the right temperature for composting and there are fewer odours," he says, adding that he applies the compost he produces on his own vegetable plot."

Good start ... more to be done

Evi Karaiskou says the LIFE project has been "a good start" for the municipality – which as a result of the measures implemented is on target to meet its initial forecasts of achieving a 7% reduction of all its GHG emissions by 2020. She concedes, that there is now "more work to be done" in reducing emissions further, as a result of the approval of the city's Sustainable Energy Action Plan in October 2014 by the Covenant of Mayors scheme, however, she is convinced that "our tools, method and measures will help us reach the 20% reduction target."

Project number: LIFE07 ENV/GR/000282

Title: CLIM-LOCAL2020 - Developing Local Plans for Climate Mitigation by 2020

Beneficiary: Municipality of Volos, Department of Planning and New Technologies

Contact: Evi Karaiskou
Email: dprogram@volos-city.gr
Website: www.epem.gr/climlocal
Period: 01-Jan-2009 to 30-Jun-2012
Total budget: €2 778 000
LIFE contribution: €1 086 000

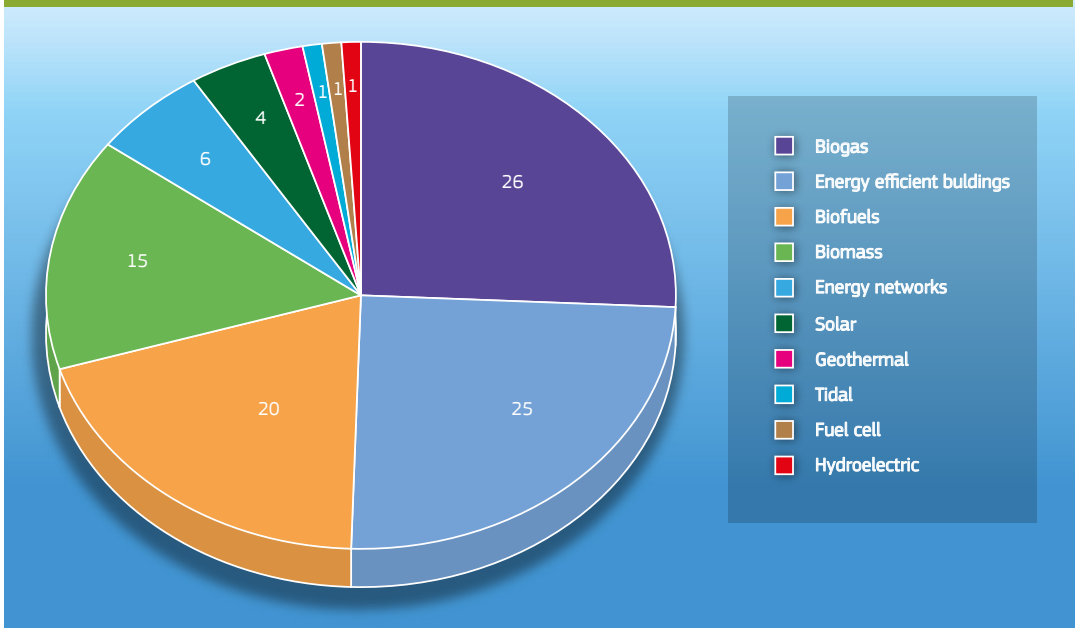
ENERGY

Renewable energy and energy-efficiency

LIFE projects have developed and demonstrated new technologies to exploit renewable energy sources and new methodologies for more efficient use of energy. Uptake of proven results could help reduce greenhouse gas emissions to help meet EU policy targets.

The energy sector will play a crucial role in meeting the EU's climate mitigation objectives. In order to achieve the targets set out in the introduction to this publication (see pp. 3-5) and to be on the right track for moving towards a low-emission economy it is necessary both to increase renewable energy production in line with the EU's sustainability criteria, and to improve energy-efficiency in new and existing buildings, industry, transport and energy supply.

Fig. 1: **Energy projects (1999-2012)**



Source: LIFE database

The LIFE programme has supported a swathe of renewables and energy-efficiency projects. LIFE funding has focused on many types of renewable energy, including biomass, biogas, geothermal, solar and tidal power. In addition to helping Member States achieve the targets set out in the Renewables Directive (RED – 2009/28/EC) – namely to increase the use of renewable energy and facilitate reduction in greenhouse gas (GHG) emissions – such projects demonstrate ways of reducing the EU's dependence on imported energy, stimulating high-tech industries and developing a low-emission 'green' economy.

Energy-efficiency projects have concentrated on improvements in the building and transport sectors, such as innovative localised electricity generation and heat production from decentralised energy sources.

Bioenergy and sustainability criteria

Replacing fossil fuels with sustainable biofuels or bioliquids is essential to guarantee the future security of energy supply in Europe. The sustainability of biofuels has been a source of much debate, with increasing concern about the use of first-generation biofuels derived from food crops. A number of factors must be considered when assessing the overall carbon footprint and environmental impact of biofuels, including competition with food crops (the "food vs fuel" issue), release of stored carbon from soil, and impacts on biodiversity from changes of land use to grow energy crops.

Such issues are being addressed by EC certification schemes, as well as through the development of advanced second- and third-generation biofuels technology and new bioenergy crops that grow on land less suited to food production. Advanced biofuels, are presumed to have more favourable carbon intensities and environmental impacts, which is the reason why they are eligible for multiple counting.

Articles 17-19 of the RED outline sustainability criteria for the production of biofuels and bioliquids (see box). However, there are no mandatory sustainability criteria for solid and gaseous biomass across the EU - instead Member States can choose whether or not to introduce criteria[1].

1 *Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling SEC(2010) 65 final SEC(2010) 66 final*

One of the sustainability issues revolves around the lifecycle performance of biomass cultivation and biofuel production in terms of land use and GHG emissions. Whilst land use, land use change and forestry (LULUCF) activities generally act as a carbon sink, certain activities such as deforestation, forest degradation and some agricultural practices can result in a significant loss of terrestrial biogenic carbon. A first step to addressing these issues and including LULUCF emissions in EU climate policy is establishing mandatory, common and robust accounting, monitoring and reporting rules for forests, croplands and grazing land. Biomass cultivation can also cause the introduction of invasive alien species and other effects on biodiversity, which is why the RED restricts production of biofuels from land with a high biodiversity value (e.g. primary forest and biodiverse grasslands) or land with a high carbon stock (e.g. peatlands).

Biomass from forests

Wood and wood waste is one of the main sources of biomass in the EU. The use of trees as biomass for bioenergy production can negatively affect forest biodiversity and carbon stocks through direct land use change (deforestation) and unsustainable forest management. At present, the supply of biomass feedstock from Europe's forests is sustainable, because it is mostly produced as a by-product of management activities. However, in order to meet future demand for renewable energy, as set out in National Renewable Energy Action Plans (NREAPs), it is expected that the

RED sustainability criteria for biofuels

To be sustainable, raw material for biofuel production cannot be taken from:

- primary forest and other wooded land;
- areas designated for nature protection purposes or for the protection of rare, threatened or endangered ecosystems or species;
- highly biodiverse grassland;
- Land with high carbon stocks, such as wetland or peatland, can only be used if the land was already in use for this purpose before January 2008;
- Agricultural raw material must comply with the CAP's cross compliance requirements;
- The GHG emission savings from the use of the biofuel must be at least 35% compared with the use of a reference fossil fuel[1].

1 *The GHG savings constraint increases over time: by the year 2017 the saving must be 50%; from 2018 savings must be at least 60% for biofuels produced in plants taken into operation after 1 January 2017.*

Photo: LIFE10 ENV/ES/000458

The ECOGLAUCA ÉRGON project will produce biomass from a wild tobacco species (Nicotiana glauca) that is being cultivated on abandoned land to combat soil erosion and desertification

supply of forest biomass used to generate electricity and heat will need to increase substantially[2].

Few LIFE projects to date have addressed the need for new forest management practices to sustainably increase forest biomass production for bioenergy. Two Spanish projects have aimed to reduce forest fire risks by removing flammable scrub biomass and converting it into solid biofuel. BIOENERGY & FIRE PREV. developed management practices that created jobs and helped to develop green skills among forestry workers. Forest biomass was selectively harvested using an inventory to determine its heating value and power-generation efficiency. Biomass was produced in the form of pellets for use in a rural area. The recently-started project LIFE ENERBIOSCRUB aims to demonstrate the technical and economic feasibility of mechanised harvesting and the processing of forest shrub biomass into pellets. The project will also determine the quality parameters of shrub biomass for the production of eight types of standardised pellets and the operational patterns for biomass combustion. The goal is to reach the most restrictive emission thresholds currently in force in Europe.

Another ongoing Spanish project (LIFE BIOBALE) is developing an innovative combustion system for energy production from large forest bale biomass without pre-treatment. This is expected to lead to a reduction in operating costs of up to 50% in comparison with cogeneration plants where biomass has to be transformed into pellets. The project will generate energy for use in public buildings, with an estimated reduction in GHG emissions of 690 tonnes/yr of CO_2.

As with many recent biomass-burning projects, LIFE BIOBALE also takes a range of other air quality parameters into consideration. This is important because a lowering of CO_2 could be accompanied by increases in NOx, SOx and particulate matter (PM). The project is predicting reductions in the range of 1 267 kg/yr for SO_2 emissions and 784 kg/yr for NOx emissions. In areas with a high usage of biomass-fired heating installations, there remains a need to address the issue of local air quality, targeting in particular emissions of PM in potential "hotspot" locations.

LIFE funding also has been used to trial the application of wood ash and biochar residues from biomass energy production as forest fertilisers (e.g. by the RecAsh project in Sweden). Solutions of this kind provide a resource-efficient approach to dealing with waste products from the bioenergy sector and will become increasingly important in the future.

2 *The 2005 Biomass Action Plan sets out measures to increase the development of biomass energy from wood, wastes and agricultural crops by creating market-based incentives to its use and removing barriers to the development of the market.*

Harvesting Miscanthus grasses as part of the GREEN PELLETS project

Photo: LIFE07 ENV/F/000178

Agricultural biomass

The main sustainability issue around agricultural biomass concerns the impact of intensive production of energy crops on food production. Reducing the amount of land available to grow food has implications for food security, soil fertility, biodiversity and water resources. A positive balance should ideally be obtained for land converted for biofuel production, with carbon stock loss being compensated for by GHG emissions savings. This issue has been addressed in two LIFE projects.

GREEN PELLETS assessed the biomass potential of herbaceous crops on agricultural land. Working with farmers, the project team conducted a socio-economic study which concluded that energy crops could be planted on 98 000 ha (2.7% of the agricultural area in use) without jeopardising food production. An environmental assessment showed that when burnt for heat, the biomass produced 10 times less CO_2 than natural gas. By using herbaceous pellets at the 10 pilot sites, GHG emissions would be reduced by 13 200 tonnes/yr of CO_2eq. However, two barriers remain to the uptake of this herbaceous biofuel: firstly, it is more likely to cause air acidification than gas or wood, and secondly, production costs are much higher than for wood.

The BIOSIT project validated a GIS tool to optimise land-use development for the effective exploitation of biomass resources in thermal power plants. The project promoted the efficient management of forestry and agricultural land, whilst also calculating the expected CO_2 emission reductions arising from different biomass scenarios. The project demonstrated that by using herbaceous pellets instead of wood pellets, GHG emissions would be reduced by the equivalent of 13 200 tonnes/yr of CO_2. However, this project also concluded that costs were too high at present when compared to wood pellets.

The Renewables Directive proposes that more land could be made available for cultivation by restoring severely degraded or heavily contaminated land. The LIFE programme has funded two projects involving bioremediation and soil improvement coupled with renewable energy. BioReGen demonstrated the reuse of brownfield sites for four energy crops (Miscanthus, switchgrass, reed canary grass and willow) that act as bio-accumulators of metals to remediate contaminated soils. The project found that reed canary grass was the most suitable crop for brownfields, since it grew on a range of soil types, matured in 18 months and could be harvested annually to make biomass pellets. The ECOGLAUCA ÉRGON project is cultivating a wild tobacco species (*Nicotiana glauca*) on abandoned land to combat soil erosion and desertification under arid Mediterranean conditions. The species will be harvested to produce biomass or bio-ethanol.

Biomass and carbon loss

Agriculture practices associated with biomass production can result in a significant loss of biogenic carbon. The GHG emission balance of biomass energy applications differs, depending on several lifecycle factors (e.g. type of feedstock, transport, energy conversion efficiency). However, the area of greatest uncertainty relates to the often implicit assumption that the biogenic carbon initially released from biomass is almost immediately sequestered via plant re-growth; in fact, in the case of forest biomass, carbon release and sequestration may not be in temporal balance with each other.

LIFE Eucalyptus Energy is demonstrating the incorporation of biochar from leaves and branches, which are usually treated as waste in eucalyptus plantations, into biomass for energy. The project is studying the effectiveness of biochar pellets as a carbon storage tool, through a complete carbon balance assessment. The project is also testing the potential of other biomass sources, such as municipal green waste and agricultural residues, to supplement the eucalyptus material, with the aim of improving forest sustainability, reducing waste and improving economic activity in rural areas.

Photo: LIFE06 ENV/IT/000266

The Seq-Cure project set up demonstration energy farms in Emilia-Romagna (Italy) to analyse the potential of biogas, wood fibre and raw vegetable oil short production chains

The BIOSIT project assessed CO_2 emission reductions and costs for different biomass scenarios

Photo: LIFE00 ENV/IT/000054

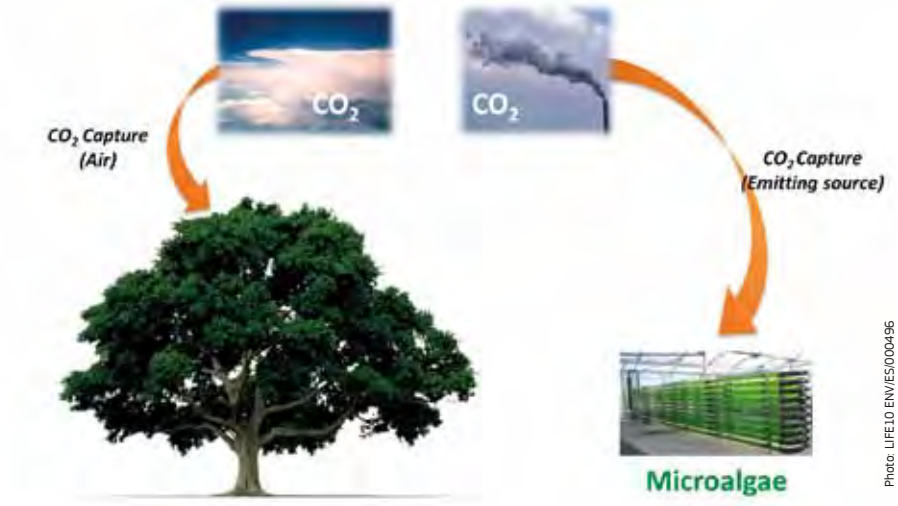


Photo: LIFE10 ENV/ES/000496

CO2ALGAEFIX hopes to achieve increased CO_2 bio-fixation and the photosynthetic efficiency of microalgal cultures.

The LIFE programme has also funded the development of a modelling tool for the "top-down" assessment of carbon sinks. The Finnish project SNOWCARBO combined different data sets and modelled CO_2 balances over a large geographical area. This resulted in improved knowledge of the size and location of natural carbon sources and sinks, and improvements in the assessment of the levels of anthropogenic sources and the monitoring of the long-term impacts of increased use of forest biomass.

Bioenergy and nature conservation

The sustainability criteria for biofuels state that they shall not be made from raw material obtained from land with high biodiversity value[3]. Aside from forest and woodland of native species, this means highly biodiverse grassland and land with high carbon stock (e.g. wetlands and peatlands, see pp.68-75). LIFE has made a major contribution to enhancing and expanding the Natura 2000 network, and this helps to prevent the conversion of protected grassland and wetland habitats into agricultural land for energy crops. Furthermore, an interesting cluster of LIFE projects have successfully demonstrated the use of sustainably-harvested biomass from Natura 2000 sites, and also abandoned agricultural and industrial sites, to generate heat and electricity. Farmers have been key stakeholders in such projects, which demonstrate that energy crops can be grown on land other than that used for food. As well as providing an alternative source of rural income, such actions can help protect soils and bioremediate contaminated land, and also generate income for ongoing restoration and conservation activities.

There are extensive areas of abandoned grassland in Europe, whose conservation status can be improved by late harvesting. Mature grassland has been harvested and converted into biomass in two demonstration projects: PROGRASS (see feature article, pp. 41-43) and LIFE GRASSSERVICE. The latter project is demonstrating alternative uses of biomass as the basis for economically-sustainable management models to preserve grassland biodiversity and ecosystem services.

On protected wetlands, the Bittern project increased the conservation status of the bittern (*Botaurus stellaris*) in the UK, by expanding the reed-bed habitat where it breeds and using the cut reeds for the production of biomass. The Aquatic warbler project investigated the possibility of using the hay cut from aquatic warbler (*Acrocephalus paludicola*) habitat in Poland for bioenergy. A follow-up project conducted feasibility studies on alternative uses of this biomass which showed that conservation management could be made economically viable through biofuel production.

"Third-generation" biofuel

The term "third-generation" biofuel refers to fuel derived from algae, which are capable of much higher yields with lower resource inputs than other feedstock. Algae can produce oil that can easily be refined into diesel or even certain components of gasoline. It can also be genetically manipulated to produce many products, from ethanol and butanol to gasoline and diesel fuel. Two LIFE projects, CO_2ALGAEFIX and BUCEFALOS, plan to valorise the use of microalgal biomass in a variety of sectors. The large-scale cultivation of algae for biomass could capture large amounts of CO_2 from the atmosphere. The BUCEFALOSA project, for instance, estimates it will reduce CO_2 emissions by 400 tonnes/yr for its sites in the Baltic Sea.

3 *Communication on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52010XC0619(02):EN:NOT*

BUCEFALOS is establishing algae cultivation sites with the dual purpose of cleaning water and producing biomass for biogas

Photo: LIFE11 ENV/SE/000839/Tomaz Lundstedt

Biomass cascading

Under the EU Forest Strategy and the EU Bio-economy Strategy and Action Plan, the European Commission is conducting research to identify good practices on the cascading use of biomass.[4] This hierarchy is not set in stone: whilst energy conversion is typically recognised as the last step in this broad hierarchy, in some cases energy conversion may be the only economically-valuable option for the use of biomass resources.

As biomass cascading is a relatively recent concept, few LIFE projects have so far contributed to this emerging area. However, projects developing new feedstocks from wood wastes and other residues could provide useful inputs for guidelines on biomass cascading. Logging residues can be used sustainably to produce biofuel, for instance, by recycling wood ash in the forest (RecAsh), or through biomass pellet production (WARM-WOOD, CleanWood and CHEFUB). WARM-WOOD produced 3 500 tonnes of wood that were used for medium-sized biomass heating systems. This saved 617 tonnes of oil-based fuel, cut CO_2 emissions by 2 277 tonnes/yr and had co-benefits such as reducing emissions of NOx and particulate matter. The project calculated that the new heating systems saved each user some €3 130/yr on average. The CHEFUB project made 2 000 tonnes/yr of high-quality pellets from sawdust (equating to 3 500 tonnes/yr fewer CO_2 emissions). Such projects show the potential for further lowering of CO_2 emissions from biomass burning, for example, because cleaner systems lead to less driving by maintenance engineers.

Biogas

There is no specific EU policy on biogas, however it is included in both the RED and the Waste Framework Directive. The RED highlights the benefits of in terms of GHG emission savings of reusing waste streams from agriculture (e.g. manure and slurry) to produce heat and power. Decentralised biogas installations also have the potential to support sustainable development in rural areas, as well as giving farmers another income stream. Further processing of biogas creates biomethane, which could be used to fuel vehicles or be injected into the grid alongside natural gas (as demonstrated by the LIFE project, BIOGRID).

4 *Biomass cascading is where the same biomass is used more than once, from raw material uses (e.g. timber) to the subsequent use of recovered or recycled materials (e.g. particle board or pellets).*

LIFE09 ENV/SE/000348

BIOGASSYS

This project aims to demonstrate the wider potential of biogas, both as a means of energy production and as a tool for climate change mitigation. By increasing biogas production in Skåne (Sweden), the project is targeting a reduction in CO_2 emissions of 180 000 tonnes.

"Since the biogas system is intricate, it has been important to identify a number of critical stages," says Desirée Grahn, project manager at Biogas Syd and the LIFE project's work package leader. Ms Grahn describes how different activities have been developed to address these stages, such as food waste collection, increasing the number of biogas vehicles on the roads, and ensuring offset by utilising by-products.

"For example, the City of Malmö has carried out a campaign, together with waste and sewage company VA Syd, in order to inform inhabitants of coming food waste collections and that the substrates collected are transformed into biogas," explains Ms Grahn. Creating partnerships between businesses and other organisations has also been an important part of the project. "In affiliation with the new Jordberga biogas plant, a new partnership model was used," she continues. Farmers were contracted to provide the biogas plant with substrates, receiving bio-fertiliser from the process in return.

Photo: LIFE09 ENV/SE/000348/Christiaan Dirksen

The LIFE programme has supported a wide range of biogas-related projects. These have demonstrated innovative anaerobic digestion and gasification techniques for production of biogas from manure, looked at ways of converting sludge to energy, trialled new incineration techniques, proved the efficacy of fuel cells and membrane bioreactors at industrial-scale and are now looking at integrating technologies into complete systems and networks (see box, BIOGASSYS).

A cluster of LIFE projects - including SludgeisBiofuel, ES-WAMAR and BioSOFC - have demonstrated innovative anaerobic digestion and gasification techniques for production of biogas from manure.

Photo: LIFE07 ENV/E/000847/ACCUSOFT INC.

The BIOCELL project tested the viability of two methodologies for producing electricity from the biogas produced at wastewater treatment plants: Solid Oxid Fuel Cells (SOFC) and Proton Exchange Membrane Fuel Cells (PEMFC)

Innovative processes such as dry fermentation, methanation of syngas, and small-scale upgrading are being tested by BIOGAS XPOSE, for example, using existing waste streams and new substrates, such as combining horse manure with sewage sludge. The project aims to obtain a 1 000 GWh increase in biogas production with a 400 000 tonne reduction in total CO_2 emissions in the transportation sector.

Since 2007, the majority of LIFE biogas projects have addressed the conversion of sludge to energy[5]. Such projects have demonstrated a number of different approaches, including co-digestion in anaerobic reactors, mainly using sewage sludge at urban wastewater treatment plants. In the case of WW4ENVIRONMENT, a co-digestion regime using 90% sludge and 10% grease from pre-treatment increased specific methane production by 25% and biogas production by up to 78%.

Other attempts to improve on the performance of standard anaerobic digestion, include LIFE NECOVERY's use of a continuously stirred-tank reactor to produce biogas more efficiently than conventional anaerobic digestion. This method is expected to cover 60% of the treatment plant's energy needs. Another ongoing project, LIFEecodigestion, is combining anaerobic digestion with a new technology that continuously measures the quantity and composition of biogas generated to optimise the mixture dosage (and therefore digestion) and increases yields by 20% through the most favourable waste and mixture dosage. The treatment plant is also expected to produce some 115.59 Mwh/yr, equivalent to a GHG emissions saving of 27.97 tonnes/yr of CO_2.

The SludgeisBiofuel project in Sweden is demonstrating an energy-efficient method for drying sludge and manure to obtain biomass for burning. It will show that the energy needed to dry the biomass is less than that which can be extracted from the dried biomass through incineration. Achieving 100% energy recovery from biogas (today it is 50%) will prove the commercial feasibility of full-scale plants.

LIFE funding has also been directed into biogas production from industrial waste. For instance, alkaline hydrolysis and microbe fermentation has

5 Previously funded projects, between 1992-2006 mainly focused on water quality issues and the reuse of sludge as fertiliser

been used to treat sludge from the chemical industry to produce biogas (Sludge Redox). This project achieved a notable saving in CO_2 emissions (4 000 to 5 000 tonnes), but high costs (€140 per metric tonne of sewage sludge, in comparison with €50-100 for existing methods) create a barrier to commercial uptake. The Sludge's Wealth project developed a specialised sludge treatment plant for offshore oil rigs, based on a hybrid microwave and hot air heating technology. This system, which has a 50% lower carbon footprint than existing treatment plants on offshore facilities, successfully converted 650 tonnes of sludge into 280 tonnes of agglomerated products with high calorific power.

LIFE projects (BIOSOFC, BIOCELL and LIFE MEMORY) have pioneered the use of Solid Oxide Fuel Cells (SOFC), Proton Exchange Membrane Fuel Cells (PEMFC) and Submerged Anaerobic Membrane Bioreactors (SAnMBR) in biogas plants using urban wastewater sludge. These methods, typically using aerobic digestion of the organic fraction, could provide up to 60-70% of the electricity requirements of a wastewater treatment plant and lower CO_2 emissions by 80% (LIFE MEMORY).

The LIFE programme is also demonstrating how gasification technologies can be integrated into complete systems. For example, the LIFE COGENERATION PL project is building a gasification plant capable of processing 25 000 tonnes/yr of municipal waste and sewage sludge to cogenerate heat and electricity. The plant integrates five units - fuel preparation, gasification, syngas purification, syngas combustion, the production of electricity and heat, and exhaust gases purification – and will generate 180 kWh of electric power, 250 kWh of thermal power and fuel with an energy potential of 1.3 MW.

Energy from landfill

Methane is a potent greenhouse gas and its emission from landfill sites contributes to climate change, but this gas can be captured to generate heat and electricity. Where such uses are uneconomic, a range of mitigation techniques including flaring and bio-oxidisation are available. LIFE has supported 13 projects dealing with the mitigation and use of landfill gas (examples include GHERL, BIOCOVER and CLIM-WASTENER). These include, in recent years, a small cluster of projects demonstrating ways of dealing with methane generated by disused landfills, such as the featured project, ACUMEN (see box). Closed landfill sites require different solutions to those still in use, since they tend to produce low flow rates of low calorific value landfill gas. If energy production from closed landfills can be proven to be technically and economically viable, it will help offset the ongoing management costs of such sites.

LIFE11 ENV/UK/000402

ACUMEN

The ACUMEN project is demonstrating the capture and use of methane from closed landfill sites. Landfill operators typically use large-scale engines to burn the gas and generate energy, or flares that recover no energy. These methods struggle on older sites with declining gas production, and in some cases operators let the remaining methane vent directly into the atmosphere.

"Combusting landfill gas becomes increasingly difficult as the methane content falls," says Matt Askin, an advisor on the project team. "ACUMEN is demonstrating new types of engines and flares that can reliably combust low-calorific landfill gas." The LIFE project is demonstrating five innovative and cost-effective approaches at different closed landfill sites in England. "All of the technologies can easily be transferred to landfills around the EU," notes Mr Askin.

The project could make a major contribution to reducing greenhouse gas emissions. "Methane is a highly potent greenhouse gas," adds Mr Askin. "The reductions from individual site are quite modest, typically a few hundred or thousand tonnes of CO_2 equivalents per year. However, there are many thousands of landfills around Europe that could benefit from an ACUMEN-like approach, so the overall savings are potentially huge."

Photo: LIFE11 ENV/UK/000402/Stephen Nottingham

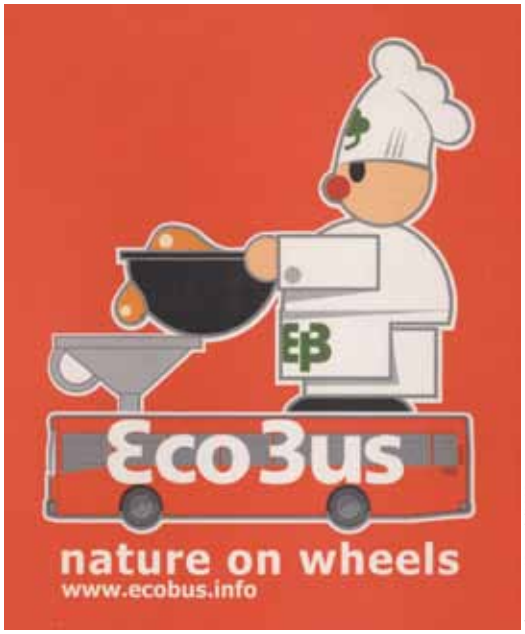


Photo: LIFE02 ENV/E/000253

Biowaste to biofuel

Biowaste is defined as biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises, and comparable waste from food processing plants. Whilst there is no specific legislation governing biowaste, the Landfill Directive sets a target for a 35% reduction, compared to 1995 levels, in biodegradable municipal waste going to landfill by 2016. Furthermore, both the RED and the Fuel Quality Directive[6] support the use of all types of biomass for energy purposes.

6 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC and the Fuel Quality Directive (FQD), EU Directive 2009/30/EC

A report by the European Environment Agency concluded that municipal solid waste could potentially account for around 7% of all renewable energy by 2020, assuming that all biowaste currently landfilled is instead used for energy recovery and then composted. The use of this type of waste to produce "second generation" biofuel avoids any problem connected with land use and land conversion or other issues connected with sustainability criteria. It also has the beneficial effect that the waste is not sent to landfill.

The LIFE programme could play a more significant role in helping Member States meet Landfill Directive targets, through the demonstration of waste collection and separation techniques, and the decentralised conversion of biowaste into energy. Since 1997, LIFE has funded around 20 projects where energy has been produced from biowaste. In all cases, these projects not only have contributed to the global aim of increasing the production of renewable energy - thus cutting GHGs, in line with the RED - but by diverting biowaste from landfills or avoiding other types of treatment (i.e. incineration or biological treatment), that produce CO_2, NOx and methane emissions, they have avoided the production of further GHGs (which come from landfilling, incineration or composting).

The largest sub-category of biowaste projects are those that involve production of biodiesel from used cooking oils. Collection systems developed have ranged from the small-scale, (e.g. BIOFUELS-2G and EDUCO), to fully-integrated systems covering whole towns. Used cooking oil has been converted into biofuel to power public transport in Oeiras (Portugal) and Valencia (Spain), in the OIL PRODIESEL and

The Biofuels-2G LIFE project developed a network for the collection of Waste Cooking Oils (WCO), in Thessaloniki (Greece)

Photo: LIFE08 ENV/GR/000569

ECOBUS projects respectively, whilst other projects have powered municipal trucks (e.g. for refuse collection).

OIL PRODIESEL achieved a 15% reduction in CO_2 emissions using a trans-etherification process for converting used frying oils into biodiesel. Demonstrating the advance of trans-esterification techniques, the recently-started BIOSEVILLE project is seeking to cut emissions from public transport in Seville by 30% using an innovative methyl esters and membrane technology to produce glycerine with a high degree of purity. The project team will mix the methyl esters and glycerine esters to produce a more efficient biofuel for a municipal bus fleet. As well as cutting CO_2 emissions, the project is also expected to reduce emissions of air pollutants such as NOx and PM in line with EU air quality requirements.

LIFE projects have also converted other food wastes into biofuels, such as featured project Integral-b (see box). In addition, LIFE+ VALPORC used animal fats, whilst CITROFUEL produced bioethanol from citrus-processing waste (fruit peel and pulp), and reduced CO_2 emissions by more than half compared to equivalent gasoline usage (180 gr. CO_2/km compared to 70 gr. CO_2/km). However, the conversion ratio index for this technology needs to improve in order to make it viable at industrial scale.

Municipal solid waste (MSW) is another waste stream with reuse potential. LIFE projects that have addressed this potential include Waste2Bio, which is developing a pilot-scale plant using catalytic depolymerisation technology to convert 70% of the combined urban biowaste into bioethanol. The BIOFUEL project developed drying technology so that residual municipal waste could be utilised in coal-burning power stations. Such solutions diversify sources and meet a growing demand for feedstock and, if biomass cascading is applied correctly, increase resource use efficiency.

Calculating the benefits

Demonstrating the cost effectiveness of biowaste solutions is essential to increasing their uptake. The OIL PRODIESEL project calculated that producing biodiesel from sewage sludge could save urban wastewater treatment plants some €4 000/yr in maintenance costs. BIOFUELS-2G showed the cost benefits of using waste cooking oil as a feedstock instead of vegetable oil from the field – a cost per tonne for biofuels of €200-600, as opposed to €800/tonne.

Photo: LIFE11 ENV/ES/000557

The EDUCO project collected used cooking oil at schools and taught children the value of recycling and use of renewable energy

LIFE projects have also motivated public-private partnerships for promoting biowaste recycling and integration of biofuels in the energy market. Regarding social co-benefits produced by projects, only one project (EDUCO) specifically mentions job creation as a contribution to EU green growth and jobs policy.

LIFE07 ENV/E/000820

Integral-b

The project demonstrated a more sustainable solution for biodiesel production from used cooking oils, by developing a joint biodiesel and biogas system. Biogas was obtained from wastes generated in biodiesel production, including oil filtration waste, and the surplus non-marketable glycerine by-product. The biogas was used to generate heat and power for use in the biodiesel process.

"The use of the energy generated in situ in the anaerobic digestion system involves relevant energy savings and it allows a reduction in CO_2 emissions greater than with conventional biodiesel production systems," explains Alfredo Rodrigo Señer of project beneficiary AINIA.

The synergies exploited in the Integral-b system provide economic and environmental benefits, as quantified by Life Cycle Assessment tools. The unitary cost by tonne of waste is lower than for conventional systems, although the project notes that taxes for compensating the cost of management remain necessary to make reuse of used organic catering waste profitable.

Photo: LIFE06 ENV/D/000485

The Moveable HEPP project built a hydropower dam with turbines that fish can pass through, renconciling the need for renewable energy with nature conservation

Other renewable energy technologies

Funding instruments such as Intelligent Energy Europe may be better known for their role in helping to develop other types of renewable energy technology, but the LIFE programme has also made an important contribution to geothermal, hydro and solar sectors, as well as energy distribution. A number of projects have also utilised fuel cells (e.g. BIOCELL) and hydrogen production (e.g. GREENLYSIS), while featured project BLUETEC demonstrated a full-scale device for harnessing tidal energy (see box).

LIFE09 ENV/NL/000426

BLUETEC

The BLUETEC project is demonstrating an innovative 1 MW off-shore prototype comprising four Kobold turbines mounted on a floating steel platform.

According to project manager Bram Delfos, the self-aligning tidal device has a number of advantages: easy installation, accessibility, relatively low maintenance costs, and high energy production. It is also visible to shipping, though not highly visible from land, and its modular design makes it easily scalable in large wind farm situations.

Project beneficiary, Bluewater Energy Services, stresses the cost-effectiveness of the tidal device, arising from its light weight, making it easy to move, and the ability to fabricate and test it on-shore. The project aims to generate 1 600 MWh/yr, with a corresponding CO_2 reduction target of 652g/kWh, or 1 045 tonnes/yr of CO_2.

In the geothermal sector, LIFE has co-funded the SuperC and GeoPryz projects. The former used geothermal energy to heat and cool a school in Aachen, Germany. The project was able to cover 80% (620 MWh) of the school's total annual heat consumption, saving 340 tonnes/yr of CO_2 in heating and cooling. The Polish project GeoPyrz used an integrated technology combining soft and super soft acidising methods in order to reduce fuel consumption by 400 000 m^3/yr and CO_2 emissions by 500 Mg/yr.

LIFE has played a particularly significant role in recent developments in hydropower. The Moveable HEPP project, for instance, helped restore the natural ecosystem functions of rivers by installing fish ladders whilst maintaining the climate mitigation benefits of renewable energy generation using moveable turbines.

Solar energy has also been targeted. SUNCOOL patented solar thermal collectors. By using zero electricity heat pumps and energy storage for sustainable heating and cooling, the technology reduces energy consumption and CO_2 emissions by 90%. Greater benefits can be achieved through the use of thin-film solar cells connected directly to steel-frame roof structures; these give a 30% reduction of global warming potential in comparison to conventional framed photovoltaic (PV) modules, as demonstrated by the LIFE PHOSTER project. In another project (LIFE Solar Highways), modular blocks of PV cells are being added to roadside

noise barriers in the Netherlands for an 18 month test period. The project aims to show that these are capable of producing 300 MWh/yr of electricity, thereby reducing CO_2 emissions by 356 tonnes/yr.

LIFE has also addressed another of the limitations to wider use of renewables - the integration of energy from solar, wind and other sources into 'smart grids' - through projects such as LIFE+SmartPV and DRIP (see box).

Energy-efficiency in buildings

Homes and commercial buildings accounted for almost 40% of EU energy consumption in 2010, equating to 36% of greenhouse gas emissions. Therefore, improving the energy-efficiency of buildings represents a key contribution to meeting EU 2020 Climate and Energy Package targets. In policy terms, this is driven primarily by the Energy Performance of Buildings Directive; but further efforts are required, in light of the Energy Roadmap 2050 and given the relatively low rate of increase (about 1.4% per year) in building energy-efficiency. This will involve high energy-efficiency standards in new buildings and the renovation of existing buildings to reduce demand for heat, cooling and power.

The LIFE programme has funded some 25 projects that demonstrate and share best practice in the energy-efficient renovation of social housing, offices, factories and technology parks, schools and other public buildings. These projects provide direct energy-saving benefits and also raise awareness about energy-efficiency within local communities. The projects RENEW BUILDING and GRACC have taught construction professionals about renovating and retrofitting techniques, and about materials and technologies that promote energy-efficiency. Through provision of training they ensure that the latest approaches become more widespread and help to realise the full energy saving performance potential of buildings, as well as helping to develop green skills.

Some LIFE projects have focused on the use in construction of local organic materials, such as straw and Neptune grass (*Posidonia oceanica)*, to improve the thermal efficiency of buildings. For instance, the LIFE REUSING POSIDONIA project is using Neptune grass in the construction of a test building in Spain that is designed to have a class A energy rating. The project aims to halve CO_2 emissions during the construction phase, equivalent to saving 325 tonnes of carbon dioxide.

LIFE11 ENV/DE/000340

DRIP

The project is aiming to reduce CO_2 emissions by facilitating the integration of renewable energy sources into electricity grids. Unlike fossil fuel energy, wind and solar power generation is dependent on external conditions and supply is not therefore directly controllable. Carmen Calpe, project manager with beneficiary RWE, explains that the aim is to shift demand from large commercial customers from peak times to cheaper valley times, when that demand can be met by renewable energy sources: "We can state that, in a future scenario with a high penetration of renewables, practically all the energy on valley period could be produced from renewables."

DRIP is therefore facilitating the uptake of Demand Response (DR) in industrial production, where normal consumption patterns of electricity usage are changed in response to the price of electricity over time. In order to demonstrate the benefits of more flexible energy consumption for industrial customers, the project has produced a DRIP Roadmap summarising its key results, conclusions and recommendations. "A list of more than 40 handicaps that may prevent the implementation of Demand Response has been identified and analysed to consider who is affected, how barriers can be overcome and who should take the initiative," says Ms Calpe. DR is central to the Smart Grid concept for achieving European Union 20/20/20 goals, for reducing greenhouse gas emissions, increasing the share of energy generated by renewable sources, and improving energy-efficiency.

LIFE has also funded a small cluster of projects that demonstrate the use of automated controls to optimise the management of heating, cooling and electricity in buildings. The Autonomous Office project will construct an office building that does not need to connect to the electricity grid. Instead, it will be powered by an integrated set of renewable energy technologies – photo-voltaic cells; a small wind turbine; a biomass boiler; and a Proton Exchange Membrane

BBMPassiv is one of some 25 LIFE projects dealing with energy efficiency in buildings

Photo: LIFE02 ENV/A/000285

(PEM) fuel cell – supported by bioclimatic design. Thanks to the renewable technologies), the energy-autonomous office should prevent 48.19 tonnes/yr of CO_2 emissions[7].

Another ongoing project, DOMOTIC plans to use automated controls to provide energy savings of up to 50% for air-conditioning and 80% for lighting, compared to conventional facilities. For the three pilot buildings in Valladolid (Spain), this should equate to total savings of more than 750 000 Kw/yr of electricity and 40 000 m^3/yr of natural gas, reducing GHG emissions by 400 tonnes/yr.

One role for future LIFE funding could be in helping to assess the impacts of energy-efficiency policy in a number of different areas. The INSULATE project is already demonstrating how this can be done: this project is developing a common protocol for assessing the impacts of a building's energy performance on indoor environmental quality and health.

Conclusions

With the addition of the Climate Action sub-programme, the LIFE programme has strengthened its ability to develop and demonstrate innovative renewable energy and energy-efficient technologies and methodologies. LIFE can therefore make a greater contribution towards the achievement of EU policy objectives. In particular, the programme is well-placed to identify and fill emerging gaps in the implementation of EU climate change, renewable energy and energy-efficiency policy.

There is room to expand the number of LIFE projects promoting agroforestry and sustainable forest management, in conjunction with developing pathways for bioenergy, particularly given the growing demand for forest-sourced biomass feedstock. However, LIFE has been at the forefront of efforts to generate sustainable energy from the management of Natura 2000 network sites and other protected areas.

Another success of the programme has been in implementing green economy concepts, and achieving resource efficiency in the development of new sources of biomass feedstock and biogas. Demonstration projects involving the conversion of biowaste to energy have contributed to the aim of limiting landfill to non-recyclable and non-recoverable materials. With increasing demand for biomass feedstock, and the pressing need to better manage biowaste, there is a significant opportunity for LIFE to support projects that promote the use of biomass feedstocks on a wider scale and generate jobs to grow the green economy.

Photo: LIFE07 ENV/UK/000936/ASTRALE GEIE/LUNAN Donald

The GRACC project showed that green roofs reduce the heating and cooling needs of buildings

7 This figure is broken down into 15.9 tonnes/yr from photovoltaics; 15.9 tonnes/yr from the fuel cell; 5.04 tonnes tonnes/yr from the wind turbine; and 11.35 tonnes /yr from the biomass boiler.

The EDEA project explored energy efficient methods and technologies for building public social housing in Extremadura

Photo: LIFE07 ENV/E/000805/ASTRALE GEIE/FERRÃO Filipa

ENERGY

Bioenergy production helps conserve grasslands

The PROGRASS project developed an approach for bioenergy production from protected grasslands to help achieve renewable energy and climate mitigation policy goals alongside nature conservation.

Extensive areas of semi-natural grassland across Europe within Natura 2000 network areas require management in order to conserve their biodiversity and enhance the conservation status of species listed in the Habitats and Birds directives. This involves the late harvesting of grass, after protected flora and fauna have reproduced.

However, this grass is considered low-quality for conventional bioenergy production. A concept called Integrated Generation of Solid Fuel and Biogas from Biomass (IFBB), developed in the early 2000s at the University of Kassel (Germany) by Konrad Scheffer, offered a solution to this difficult problem. The key principle of IFBB is the separation of biomass into solid and liquid components. The PROGRASS project used the IFBB concept to separate grassland cuttings (silage) into a solid fraction for combustion and a liquid fraction for biogas production.

Biomass and biogas

"The fibre content of late-harvest grass is much higher than in the early-cut material, and that makes it more difficult for bacteria to convert it to biogas using standard anaerobic digestion," says Lutz Bühle of the Faculty of Grassland Science and Renewable Plant Resources at the University of Kassel. The IFBB process gets around this by producing biogas from the liquid fraction. "The high fibre, however, makes late-harvest grass more suitable for use in biomass boilers," notes Dr Bühle, "but it has more mineral content compared to wood, for example, and that is why we need a warm pre-treatment wash in the IFBB process." This washes minerals, and particularly potassium, into the liquid fraction, which causes less ash to be produced and combustion to proceed more efficiently.

The project team constructed a mobile PROGRASS prototype (the "Blue Conrad") to demonstrate the technical and economic feasibility of using the IFBB process with plant wastes generated by nature conservation management. Large bales were transported to the unit from surrounding grassland areas and fed in via a conveyor belt. After being mashed in warm water, the material proceeds through a screw press that separates it into press cake and press fluid. The fluid is held in large containers for only a few hours, to prevent anaerobic degradation, before its conversion to biogas (methane), which is burnt to produce heat that promotes drying and fermentation in the unit. If attached to a Combined Heat and Power (CHP) plant, the biogas can also be used to generate electricity to power the system.

PROGRASS aimed to demonstrate that grass harvested late for nature conservation purposes can be a useful source of solid biomass

Photo: LIFE07 ENV/D/000222

Most (80%) of the organic material ends up as solid biomass, which is dried and cut into briquettes or pellets for use locally in adapted boilers. "We are focusing on bigger boilers that heat school buildings, municipal buildings, swimming pools or district heating systems," says Dr Bühle.

The technical and economic feasibility studies demonstrated that the IFBB process was more cost-effective and could contribute to the highest potential savings of fossil fuel and greenhouse gas emissions when added on to an existing biogas plant. Tim Scholze of project partner BUPNET explains: "Biogas plants usually generate electricity and heat, though the heat is not generally used for any particular purpose. If we can combine a standard biogas plant with an IFBB system, then we can use the existing waste heat from the biogas plant for our drying processes – so that is a very good synergy between both systems."

According to Dr Scholze, there are two major advantages of the PROGRASS approach: "One is that we produce storable energy, in the form of briquettes, and the second is that it works with a relatively small catchment area and, of course, with substrates that you cannot directly use in biogas plants." He adds: "The project took the IFBB approach from the laboratory into a pilot-scale demonstration for the first time, and we are now in the phase of further upscaling to the investment stage. That is the real success story as far as LIFE is concerned."

The 'Blue Conrad' mobile IFBB demonstration unit

Photo: LIFE07 ENV/D/000222

The mobile demonstration unit was operated by partners in Germany, Wales and Estonia during the LIFE project. This enabled feasibility studies to be done on a representative range of vegetation types found in European grasslands. Frank Hensgen of the University of Kassel is part of the team that continues to tour the demonstration unit around Europe: "The PROGRASS approach can work under different environmental conditions. We have now done tests with a lot of biomass, including dry and wet grasslands, and it is not a problem." The approach therefore has very good transferability and could be upscaled anywhere in Europe.

However, Dr Hensgen notes that the availability of biomass source material is a key factor. Recent results from Poland, for instance, show good economic prospects and the highest CO_2 emission-saving potential, due to the availability of large areas of grassland landscapes that need to be managed. This biomass source is also, importantly, not going to be in competition with food production for land anywhere in Europe.

Greenhouse gas emissions

"Greenhouse gas balances were calculated according to Life Cycle Assessment methodology," explains Dr Bühle. "So, we considered the entire process chain from the very beginning, from harvest of the biomass through conservation, transport, processing, until the final supply of energy. Taking into account all energy inputs, it was then compared to the fossil fuel alternatives." Calculated CO_2 emission-saving potentials of up to 2.9 to 3.7 tonnes CO_2-equivalent ha-1 and non-renewable fuel savings of between 44 and 54 GJ ha-1 per year were based on the energy recovery from grassland biomass.

"The fact is that we have an unused resource and a lot of scattered sources of energy that are not fossil-based. So, heat produced by grasslands and urban green grass are among many different sources of renewable energy that have to contribute to our targets to replace fossil fuels," says Dr Bühle. In this way, the aim of constructing full-scale PROGRASS energy units all across Europe to obtain bioenergy from protected grassland sites could also play a part in helping EU Member States meet targets set out in the Renewable Energy Sources Directive (2009/28/EC) and the 2020 Climate and Energy Package.

A systems approach

"The demonstration unit illustrates the whole chain, but it is not possible to do something economically viable at those small dimensions," says Dr Scholze. "Now there is already a large-scale plant and pre-investment plans for other plants in Europe." The first commercially-operating IFBB process, in the German city of Baden-Baden, is around 10 times the size of the demonstration unit. The press fluid from the process is added in to an existing biogas and CHP plant. For briquette production, the press cake from mature grasslands is added to multiple urban waste streams that includes grass cuttings from gardens and municipal park areas.

"We need more of a systems methodology," emphasises Dr Scholze, "with PROGRASS providing an explorative and management approach whose kernel is IFBB." The idea is to exploit all available synergies. The approach can generate green jobs and provide additional sources of income in rural regions, for instance, with decentralised bioenergy potentially attracting other small industries. The IFBB process is also flexible and can be added on to wastewater treatment plants or combined with a pyrolysis plant. Pyrolysis involves the conversion of waste biomass at a very high temperature without oxygen to produce gas and carbon char, which has potential for carbon capture and storage as a means of climate change mitigation.

The LIFE project initiated a PROGRASS network to promote and disseminate the branded 'IFBB technique' and the 'PROGRASS approach' in Europe. The network currently comprises partners from several universities, energy agencies and other companies, and non-profit organisations from 11 countries.

Managing wetlands

The PROGRASS approach is now starting to be used to manage other habitat types, including roadside verges and wetlands; the latter being of particular interest for climate change mitigation. Peatland has a high carbon content, for instance, and degradation

Photo: LIFE07 ENV/D/000222

The project converted late-harvest grass into solid biomass briquettes

of this habitat reduces its effectiveness as a carbon sink. The University of Kassel and partners have proposed a project to manage degraded bogs, fens and mires in Natura 2000 network areas, to promote nature conservation and climate mitigation objectives.

"If we are rewetting landscapes, the grass from these areas becomes less suitable for use as cow fodder, for instance, because of the increased plant biodiversity. The PROGRASS approach could play an important role, because you have to find ways of making this conservation management technologically and economically feasible," explains Dr Scholze.

In areas where farmers are under pressure to extend agricultural activities into peatlands, he stresses, it is important that alternative sources of income are offered for activities that protect ecosystem services; in this case the use of cuttings from grasses, sedges, rushes and other wetland vegetation to produce bioenergy. Dr Scholze concludes: "The application of the PROGRASS approach to particularly climate-sensitive habitats, like bogs, fens and mires, therefore promotes nature conservation, has benefits for tourism and rural economies, and can also have a positive climate mitigation effect."

Project number: LIFE07 ENV/D/000222

Title: PROGRASS – Securing the conservation of Natura grassland habitats with a distributed bioenergy production

Beneficiary: University of Kassel

Contact: Michael Wachendorf
Email: mwach@uni-kassel.de
Website: http://www.prograss.eu
Period: 01-Jan-2009 to 30-Jun-2012
Total budget: €3 231 000
LIFE contribution: €1 614 000

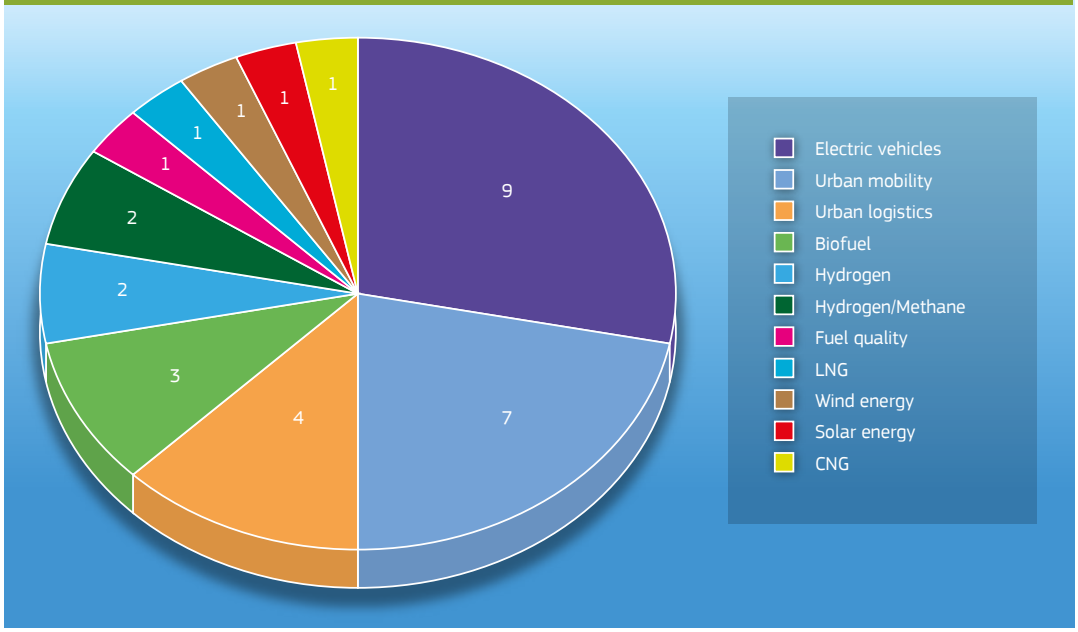
TRANSPORT

Transport and climate change mitigation

LIFE has demonstrated a range of approaches to support EU policies and laws aimed at lowering greenhouse gas emissions from the transport sector.

Transport is responsible for around a quarter of greenhouse gas (GHG) emissions in the European Union (see Figure 1). According to the European Environment Agency (EEA), this makes it the second biggest GHG-emitting sector after energy. EEA data (2012) show that whilst sources of GHG emissions in other EU sectors fell 15% between 1990 and 2007, those from transport increased over the same period, and are continuing to rise for most modes of transport. This increase is attributed to the growth in personal and freight transport and comes in spite of improved vehicle efficiency.

Fig. 1: **Transport projects (1999-2012)**



Source: LIFE database

Road transport accounts for more than two-thirds of transport-related GHG emissions (see Figure 2). The aviation and maritime sectors also generate significant emissions.

In recognition of the significant contribution of the transport sector to greenhouse gas emissions, the EU has put in place a range of policies and legislation aimed at lowering GHG transport emissions and mitigating their impact on climate change. These include:

- Mandatory emission targets to reduce emissions from cars and vans;[1]
- A strategy to curb emissions from heavy-duty vehicles;
- The inclusion of aviation in the EU Emissions Trading System (EU ETS);
- The introduction of rolling resistance limits and tyre-labelling requirements and mandatory tyre pressure monitors on new vehicles;
- A target to reduce the greenhouse gas intensity of fuels; and
- A requirement for public authorities to take account of lifetime energy use and CO_2 emissions when procuring vehicles.

Photo: LIFE09 ENV/AT/000226

LIFE has helped to renew the public fleets of Europe's cities with electric buses

Road transport and LIFE

Although there have been LIFE projects that have focused on reducing CO_2 emissions from ships and rail (two projects apiece), LIFE funding has mainly been used to support projects that help to reduce CO_2 emissions from cars (10 projects). There have been no LIFE projects targeting emissions from aviation.

Aside from car emissions, the LIFE programme's other main focus in this area has been public transport (10 projects). Such projects have demonstrated in particular options for renewing the public fleets of Europe's cities with buses powered by electricity, methane or hydrogen. Four projects have helped address the impact of emissions from vans by developing sustainable urban logistics to mitigate the affect of deliveries in towns and cities. There has also been one project targeting heavy goods vehicles.

It is noticeable that projects funded in recent years have begun to take a more holistic approach. Thus, rather than focus on one aspect – such as the introduction of electric vehicles – they combine different approaches (planning, private car use, public transport, city logistics and removing some of the barriers that impede the uptake of alternative technologies in the transport sector, such as providing adequate infrastructure and fast recharging points for electric vehicles).

Diesel innovations

In the automotive industry, new technologies are also required to allow diesel engines to adapt to current and future emission standards (better Diesel Particle Filter (DPF) regeneration, greater compatibility of biofuels with diesel engines etc.). The ongoing French project LIFE AUTO could play an important demonstration role for manufacturers of diesel vehicles (see box).

LIFE12 ENV/FR/000480

LIFE AUTO

The project, which runs until 2016, will demonstrate a more environmentally-friendly replacement for the fuel filter, additive tank, dosing pump and electric controller in diesel vehicles. It will also develop new fuel additives for biofuels to overcome issues such as engine fouling and reduced performance. The goal of the project is to increase the durability of exhaust technologies in vehicles using a diesel particle filter (DPF). This will make diesel vehicles more flexible (potentially opening up new markets) and should lead to significant reductions in GHG emissions.

Project manager, Thierry Seguelong, says the project is working with car manufacturers with strong diesel market share in Europe and worldwide to ensure their new diesel car fleets are "well below" the EU target CO_2 emission target of 95 g CO_2/ km. In parallel, the project addresses newcomers into the European market with new diesel product lines, for instance car manufacturers from China and India.

1 For vans the mandatory target is 175 g CO_2/Km by 2017 and 147g by 2020. In terms of fuel consumption, the 2017 target is approximately equivalent to 7.5 litres per 100 km (l/100 km) of petrol or 6.6 l/100 km of diesel. The 2020 target equates to approximately to 6.3 l/100 km of petrol or 5.5 l/100 km of diesel

Photo: LIFE10 ENV/MT/000088/Peter Paul Barbara

DemoEV is evaluating if PV panels installed on buildings can produce enough energy to recharge an electric vehicle and thus create carbon neutral transportation

Sustainable urban mobility

Since 1992, the LIFE programme has funded approximately 40 projects addressing urban mobility. Close to half of these have targeted reductions in CO_2 emissions in urban areas, with air pollution and noise emission reductions being the other main targets. These goals are in line with the Commission's urban mobility strategy, and in particular the need for sustainable urban mobility plans (SUMPs)[2]. Such plans define a set of interrelated measures aimed at encouraging an integrated approach to planning that addresses all modes of transport in cities and their surroundings with the goal of achieving a low GHG transport system.

LIFE projects have mostly addressed specific urban mobility measures and have therefore helped a number of cities set up relevant measures as a precursor to the implementation of more holistic strategies on sustainable urban mobility.

The UK project CATCH, which attempted to address all stages of the process of developing a SUMP - from the development of advanced pollution monitoring techniques and infrastructure and use of hybrid buses, to the development of community mobility plans and partnership initiatives with cities in Italy (Potenza) and Romania (Suceava). The project demonstrated the difficulty of devising an implementing a complete urban mobility plan within the three or four-year timeframe of a traditional LIFE project. Although CATCH reduced emissions of airborne pollutants from bus fleets it had a limited impact on CO_2 emissions. Furthermore, without a cost-benefit analysis of all measures, it was impossible to win sufficient support to enable SUMP implementation.

Several LIFE projects – examples include KALAIR, ATMOSYS and OPERA – have developed tools and methodologies that can help administrations improve their capacity to take decisions and adopt suitable measures to reduce harmful emissions, including CO_2, with a view to developing a SUMP. Improving monitoring and modelling processes is central to this. OPERA developed a methodology and software - tested in Alsace (France) and Emilia-Romagna (Italy) - to help authorities with limited budgets, to reduce emissions: The RIAT+ tool (http://www.operatool.eu/html/eng/tool.html) acts both as a regional assessment tool and as an integrated modelling environment. enabling users to produce simulations of air-quality, including CO_2 emissions, accompanied by a cost-benefit analysis of the measures proposed by the tool.

Multi-modality

Travel is 'multi-modal' when the traveller switches between different modes of transport in the course of a single journey (e.g. on foot, by bicycle, bus, tram, train, etc). The ongoing LIFE project PERHT, which

2 In order to achieve EU policy objectives for a competitive and resource-efficient European transport system SUMPs should be produced at local level, even if the organisation of urban mobility is primarily a responsibility of the competent authorities at national level

runs until 2016, is combining multi-modality with urban logistics by seeking to integrate car parking with public transport, bikes and taxi-sharing as part of an overall urban mobility scheme. Combining park and ride services with a bicycle-sharing scheme is expected to cut emissions in Treviso city centre by 60 tonnes of CO_2 eq/yr. The introduction of policies favouring the use of electric vehicles and optimised freight loads should cut emissions by a further 50 tonnes of CO_2 eq/yr.

Intelligent Transport Systems (ITS) can be of particular help in towns and cities with a historical centre, where the impacts of individual and commercial traffic are more severe. PERHT is trialling an ICT-based system for delivering multi-modal travel information to commuters, visitors and businesses before and during trips. This ICT-based solution provides an integrated overview of different mobility services - including public transport, car parks (location, state, routing), bike-sharing, taxi-sharing and bike stations. As this project illustrates, there is scope for LIFE to do much more in terms of ITS.

City logistics

Optimising logistics and transport services in urban areas is essential to the successful functioning of cities. To achieve the goals of economic growth, improved air quality and CO_2 reductions, city logistics need to be well integrated into urban transport and economic development strategies. To this end, those involved need to coordinate their actions.

Urban logistics actors, for instance, need to coordinate their actions and develop a meaningful dialogue with city authorities. A relevant example from the LIFE programme comes from the RAVE project, which fostered public-private sector cooperation to create a 'slow mobility' system that supported alternatives to car use with the goal of reducing emissions (including CO_2) and noise. The slow mobility system included 25 km of newly-created cycle paths and 10 km of secure footpaths, two park and ride points, methane-powered buses and the linking of an existing electric shuttle service with Novara train station (Italy), enabling fully-electric journeys. Significant stakeholder involvement was important to the project achieving its goals, with the measures adopted as part of the slow mobility system taking the needs of citizens as well as the environment into account.

Efficient deliveries are essential to the economic success of urban areas.. The demand for effective city logistics is driven both by the needs of local businesses and the growth of e-commerce, with its rapid delivery of goods and services. LIFE has shown that it's possible to improve efficiencies whilst cutting emissions. Projects including C-DISPATCH, CEDM, CLEANTRUCK and LIFE+ Urbannecy (see box) have demonstrated

CEDM transit point in Lucca, Italy. The project reduced circulation of freight vehicles (and GHG emissions) in the city's historic centre

Photo: LIFE05 ENV/IT/000870

the applicability of using low-emission vehicles for 'last mile' deliveries - i.e. from a transport hub to the final destination - as a means of lowering CO_2 emissions. Such schemes are often linked to the implementation of a low emission zone (LEZ) in the city-centre.

In the case of CEDM and C-DISPATCH, there was also some cooperation between the projects as each sought to implement a last-mile delivery system within a LEZ. The C-DISPATCH team used an IT system to optimise warehouse management at the transport hub and loads and routing of deliveries to shopkeepers by electric and methane-powered vans. Participating businesses indicated that the new system saved them an average of 40 minutes per journey; commercial vehicle traffic flow was cut by 14%. The project achieved a 43% reduction in CO_2 emissions and a 90% reduction in PM_{10} emissions.

The CEDM pilot project implemented eco-friendly freight distribution in the historic centre of the city of Lucca, Tuscany. Central to this was the establishment of a 'city distribution terminal', or warehouse, as the main infrastructure to support eco- and business-efficient distribution schemes. The project led to a 19% reduction in circulation of freight vehicles, with measurable improvements in air quality, as well as energy and CO_2 savings. Importantly, the legacy continues, as Mauro Di Bugno of the Municipality of Lucca, confirms. After the project ended, he says the city has invested resources to further develop the distribution warehouse, now called 'LuccaPort' (www.luccaport.it), in cooperation with all relevant stakeholders and businesses.

Two projects have demonstrated sustainable approaches to peri-urban commuting to industrial areas on the outskirts of cities [GESMOPOLI (Spain) and I.MO.S.M.I.D (Italy)]. In both instances, the projects developed a coordinating body to organise, plan, programme and promote services within the trial district, such as car sharing and public transport using hybrid buses (electricity and methane/clean diesel).

The GESMOPOLI team produced tools and guidelines to enable the development of more sustainable transport solutions in industrial estates. One interesting finding of the project was that there are significant variations in emission savings per journey from the non-fossil fuel public transport, ranging from 112.1 tonnes of CO_2 eq at El Beuló to 8 706 tonnes at El Pla.

I.MO.S.M.I.D reduced emissions by 61 tonnes of CO_2 eq through the use of electric vehicles powered by locally-generated renewable energy, available on-call, , and through the use of hybrid buses (electric-methane/clean diesel) to transfer users between home and work. I.MO.S.M.I.D's comprehensive methodology is easily transferable to similar contexts.

LIFE12 ENV/FR/001125

LIFE+ Urbannecy

Situated in the heart of Annecy in the Haute-Savoie, France, the project aims to demonstrate an integrated approach to city logistics, encouraging cooperation amongst the actors involved, use of new distribution schemes and the implementation of a range of measures that will effectively contribute to the reduction of the negative effects of the current logistics' processes on the centre of this attractive, lakeside city.

Specifically, it aims to develop a new logistics' tool, urban distribution centre (CDU) to reduce the environmental impact of parcel deliveries (GHG and PM emissions) and improve overall quality of life through a reduction of traffic and noise. The project will test the applicability of the tool as a sustainable and economically-viable 'last mile' delivery service – i.e. for deliveries from a transport hub to their final destination. Given the characteristics of the city-centre, and its commercial configuration, the project forecasts, amongst other things, a possible 40% reduction in the number of lorries, which in turn, could result in CO_2 reductions of some 27%.

Photo: LIFE12 ENV/FR/001125

Clean power for transport

Besides reducing CO_2 emissions through planning, logistics and improved vehicle performance, there is also a need to move towards low-emission alternatives to petrol and diesel. Under its Clean Power for Transport Communication, the EU recognises the need for a comprehensive mix of alternative technologies in order to meet the long-term needs to lower GHG emissions of all transport modes.

Market developments, however, are currently constrained by several key challenges: technological and commercial shortcomings; lack of infrastructure; high costs and, linked with this, consumer disinclination. Despite this, LIFE projects have addressed many of the low GHG technologies – with their main focus being on exploring electro mobility.

More recent projects (notably since 2007) have sought to find solutions to issues including the need for improvements in battery and fuel cell technologies, faster recharging and infrastructure, the need to reduce costs and to take into account lifecycle considerations, such as using renewable energy from the grid to recharge the batteries.

A project in Greece, for example (IMMACULATE) trialled the use of different types of electric vehicles (EVs) – bikes, scooters, cars and other hybrids – in the city of Thessaloniki, testing the impact of a system of incentives for EV purchase. The vehicles were tested on the city's streets under real-life conditions using transport telemetry support devices. The project also offered citizens driver training schemes for the EVs. In a cost-benefit analysis, many citizens highlighted the high cost of EV ownership as a barrier to uptake. To overcome this barrier, the project beneficiary introduced an incentive scheme. However, although IMMACULATE was able to offer an 8-10% reduction on the price of a new electric car, most conventional vehicles were still 20-35% cheaper, which may explain the limited uptake.

LIFE09 ENV/AT/000226

CEMOBIL

The aim of the project is to "significantly" reduce air pollution and CO_2 emissions in central Klagenfurt (Austria), by increasing the share of electric vehicles to 10% of all new registrations. To do this, the project has purchased 64 electric vehicles (cars, scooters, bikes, buses and delivery vans), which can be road tested by citizens (who are also trained how to use them). By 'seeding' the market in this way, it is hoped that Klagenfurt's EV test users will purchase a further 1 500 EVs by the end of the project in 2015.

The zero-emission vehicles are supported by a network of 100 charging stations. The project is expected to reduce CO_2 emissions in Klagenfurt by some 1,900 tonnes/y, as well as cutting noise. "It's working very well, people like to test [the vehicles]," says project manager Wolfgang Hafner. "When they give back the car after one week, they really have the feeling that they have also made a good contribution to the environment."

A more recent project, CEMOBIL - see box - is trying a more holistic approach to increase EV use in cities.

Renewable energy

CEMOBIL is one of a small number of LIFE projects that guarantee the electricity powering electric vehicles is derived from renewables. In Spain, the CONNECT project has provided 50 electric vehicles to staff of targeted organisations and is offering free or subsidised recharging via a pilot network of 'zero-emission' charging points. These chargers should, according to the project,

DemoEV gave drivers in Malta the opportunity to try out electric vehicles

Photo: LIFE10 ENV/MT/000088/Peter Paul Barbara

LIFE10 ENV/MT/000088

DemoEV

Working with carmakers Mitsubishi and Renault, the project, run by the Maltese Ministry for Transport & Infrastructure, is conducting trials of two types of battery electric vehicle (BEV). The first type of BEV is charged via the electricity grid; the second type is charged via solar panels on buildings.

Some 30 companies and 109 families volunteered to trial the test vehicles for two months. The project will then compare the performance of the two systems, including in terms of carbon savings. Users have been provided with training to help them get acquainted with the test vehicles. These training courses have been featured in national media (TV, newspapers). As the project nears completion, project manager Gabriella Cassolla says the response has been excellent: "Some businesses and citizens taking part have even sought to purchase their BEV."

provide a direct reduction of more than 200 tonnes/ yr of CO_2 emissions. The DemoEV project in Malta is also sourcing energy from renewables (see box).

Infrastructure issues

A lack of adequate infrastructure (e.g. sufficient charging points) is another one of the main barriers to the faster take-up of electric vehicles in the EU. E-mobility 3 cities NL (see box) provides one example of how this may be addressed.

LIFE11 ENV/NL/000793

E-mobility 3 cities NL

The project is working to introduce a number of fast- and standard-charging points in the cities of Amsterdam, Rotterdam and Utrecht, targeting in particular frequent urban drivers (e.g. minicab and delivery van drivers), as well as those driving to the three cities on business. The fast-chargers can recharge the battery of an EV in around 30 minutes, thus making this type of vehicle more attractive to the target groups of drivers.

Project manager Pieter Looitjestijn explains that the project is important because growth in the number of electric vehicles in the Netherlands has not been matched by growth in the number of public charging points. "Without sufficient access to chargers, hybrid vehicles are not optimally used and full electric vehicles become less attractive," he says. At the half-way point, the project has already installed over 100 regular chargers (with more to come in 2015), as well as nine of the 16 planned fast chargers. "As part of our stakeholder strategy we have been advising Schiphol Airport and taxi companies on how to implement electric driving," adds Mr Looitjestijn. Some 167 electric taxis are now based at the airport thanks to the project. Mr Looitjestijn is confident that, upon completion in 2016, the project's results will demonstrate a clear contribution to reducing emissions of CO_2 and PM_{10} from traffic.

Other transport modes

LIFE projects are also seeking electro mobility solutions for other means of transport, such as buses (see HYPER BUS feature article, pp. 53-55). Another example is the Italian project, ETRUSCAN, which is developing two hybrid buses that run on biofuels and electricity from renewable sources. The biofuel comes from its own used oil refining plants; whilst the bus batteries are re-charged using solar-power Another two Italian projects (MHyBus and H2POWER) are developing hydrogen/methane-fuelled city buses with the aim of reducing CO_2 emissions.

The SLIDE IN project in Sweden is using power generated from its existing electric tram-lines to recharge the battery of new hybrid electric bus/trolley buses. A study by the project showed that the vehicles, which use 'sliding in' technology rather than 'plugging in', could contribute to annual reductions of 275 tonnes of CO_2, compared with the (Euro 4) diesel buses. The project is already in service in the city of Landskrona and performance is meeting expectations.

Alternative transport technologies

LIFE has also helped test a number of alternative, potentially fossil-free transport technologies, including CNG (compressed natural gas), LNG (liquefied natural gas), hydrogen and biofuels.

An innovative project from Gothenburg (CLEANOWA), saw the city develop and build a CNG electric-hybrid waste collection vehicle in cooperation with Volvo. The vehicle combined a CNG engine with catalytic converter and electric-powered waste compactor. As well as

The Zemships project pioneered the use of a fuel cell passenger ship on Hamburg's waterways

Photo: LIFE06 ENV/D/000465

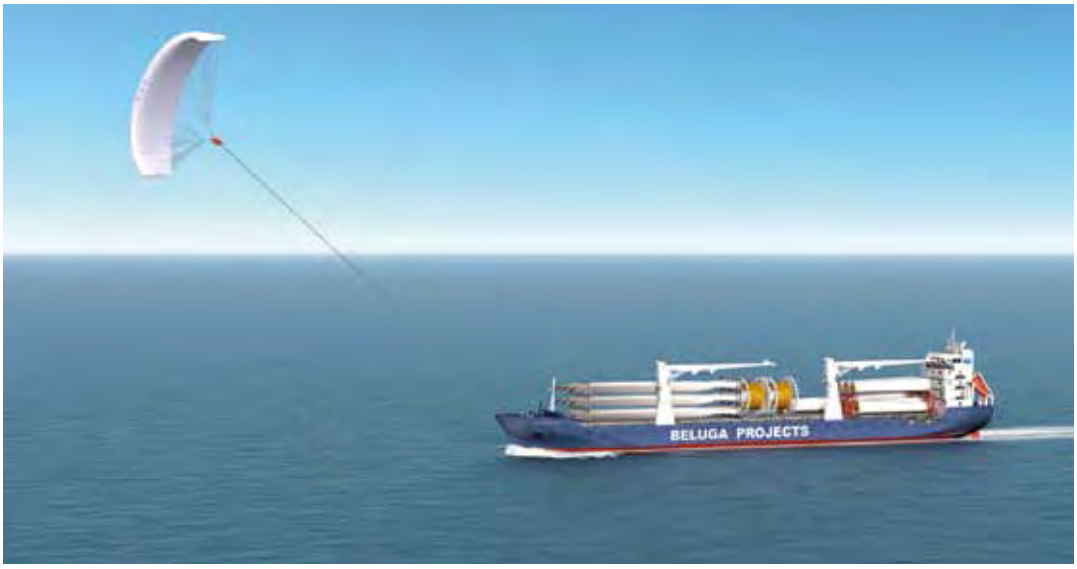


Photo: LIFE06 ENV/D/000479

The WINTTEC project explored the use of wind propulsion for powering cargo vessels

reducing CO_2 emissions by 20%, the project's lessons could generate further developments in this type of heavy-duty vehicle.

One aspect of the city of Bremen's PARFUM project also focused on the use of compressed natural gas. LIFE funding helped to put a total of 154 CNG vehicles into service, supported by a network of gas stations. Incentivising citizens and companies to switch to CNG-powered transport has significantly reduced emissions of CO_2, PM_{10}, $PM_{2.5}$ and NOx, and helped win acceptance for the establishment of a LEZ within the city.

In the maritime sector, LNG can be used in ships as an alternative to diesel. The LNG Tanker project developed one of the world's smallest LNG carriers for use on inland waterways in Norway. The vehicle's gas engine produces 30% lower emissions than comparable diesel vessels.

The WINTECC project successfully demonstrated a wind-propulsion technology for cargo ships. It ran the first full-scale tests of an automatically-controlled towing kite system for cargo vessels, achieving 5% fuel savings, equivalent to a reduction of 530 tonnes/yr of CO_2 for the vessel.

Another innovative German project, Zemships, developed the first fuel cell passenger ship for use on Hamburg's waterways. With zero local emissions, the project calculated that the test vehicle produced 47 tonnes/yr fewer CO_2 emissions than an equivalent conventional diesel-electric passenger ship.

Solar power has been used by an Italian LIFE project focusing on rail transport. The PVTRAIN project showed how photovoltaic cells could be used to charge accumulators on board locomotives, railway coaches and freight wagons. Resulting CO_2 emission reductions ranged from 1 033 kg for the energy used by the coaches, to 120 kg for the locomotives and 405 kg for the freight wagons.

LIFE and biofuels

There have been numerous LIFE projects focusing on biofuel development for general energy production (see pp. 28-43), but only a few projects about biofuels for transport. Three such projects have focused on developing biofuels from used vegetable oil. In Portugal, OIL PRODIESEL collected more than 11 000 kg of used frying oil during a nine-month period. This represented savings of approximately €4 000 in the maintenance costs of the urban sewage system and

MHyBus demonstrated the potential of hydro-methane powered buses for reducing CO_2 emissions from public transport fleets

Photo: LIFE07 ENV/IT/000434

Photo: LIFE09 ENV/AT/000226

The CEMOBIL project rolled out a fleet of electric vehicles and charging stations in the Austrian city of Klagenfurt, increasing awareness of low-emission transport options

sewage treatment plant and, compared with diesel, saved an estimated 15% in CO_2 and SOx emissions (biodiesel doesn't contain sulphur).

In Spain, the ECOBUS project collected 800 000 litres of used cooking oil and converted it into biodiesel in order to fuel some 25% of Valencia's buses (approximately 120 vehicles). The proportion of biodiesel used in the fuel mix rose from 5% to 30%.

Another (still ongoing) project, BIOSEVILLE, aims to construct a pilot processing plant to produce a more efficient biofuel from used cooking oil and then test it into Seville's buses. The goal is to produce at least 40 m^3 of a new, high quality biofuel – meeting European standards (EN 14214); whilst reducing CO_2 emissions across the full lifecycle by 50-85% compared with standard diesel. Finally, BIOLCA is demonstrating an innovative web-based tool that can identify from the sustainability point of view, different scenarios of development, production and use of biofuels in transport.

Awareness and involvement

All LIFE projects include an obligation to raise awareness about their work amongst target audience(s). Many projects go beyond this simple requirement to actively engage with citizens and do much to raise awareness of climate-friendly transport options.

Indeed, an early LIFE project (1999), European Day, 'In town without my car!' was a trailblazer – acting as a catalyst for the growth of car-free days. The project went on to become a platform for cities exploring innovations in sustainable mobility, such as cycle lanes, new bus routes and pedestrian-only zones. In a similar vein, a follow-on project (SMILE) compared the impact of the car-free initiatives introduced by over 400 towns and cities to determine which had achieved their goals, why they had been successful, which initiatives were still active and which could be transferred to other urban areas. This project has then gone on to produce European Mobility Week.[3]

Nowadays LIFE transport projects work closely with stakeholders. Through various awareness-raising campaigns and initiatives (e.g. testing of new vehicles and means of transport, eco-driving training, electric charging) they are helping to influence consumer behaviour – encouraging support and wider acceptance for cleaner, low carbon, more efficient EU transport systems and services.

Photo: LIFE99 ENV/F/000459

3 See the LIFE and air quality brochure for more details

TRANSPORT

Going greener aboard Gothenburg's rapid-charge Hyper Bus

Supported by LIFE, three new plug-in hybrid buses with fast charging batteries have been successfully operated in Gothenburg for a year. Trialled for the first time in regular service, the Hyper Buses have achieved better-than-expected results.

Located in Gothenburg, Sweden, the recently completed LIFE+ Hyper Bus project is a public-private sector collaboration whose overall objective was to demonstrate a pilot fleet of public transport city buses with an outstanding performance in low-energy consumption. .

More efficient, cleaner and quieter

Specific project aims were; to introduce a newly developed plug-in technology for hybrid city buses; to demonstrate a fast charging service, whereby, the bus batteries can be re-charged at the bus route terminus in a matter of minutes; and to demonstrate the new plug-in technology and charging service on a busy, public bus line.

Another broader goal was to demonstrate to other European cities a public transport alternative that is more efficient, cleaner and quieter.

The project was led by Business Region Göteborg in partnership with Volvo Buses (bus supplier), Göteborg Energi (charging stations), the city's transport department, Trafikkontoret (metering and calculations) and Västtrafik (bus routing and drivers).

"Collaboration is a key factor in the success of initiatives to electrify transportation infrastructure in major cities," says project manager Lars Bern. "In this project we were fortunate as three of the five partners have some connection with the city, which obviously helps. It is also important that the stakeholders all share high goals in terms of reductions of greenhouse gas emissions and in the amount of renewables to be used in public transport."

Photo: LIFE10 ENV/SE/000041

One of three Hyper Buses tested for 12 months in Gothenburg

Gothenburg targets

Although focused on the city, the initiative forms an important part of work on sustainable growth for the Gothenburg region, which includes development plans to increase the number of journeys made by public transport, to 40% of all journeys by 2030. Plug-in hybrids, as well as fully electric vehicles, are an important part of the work of creating cleaner and more attractive options for local journeys. Another goal is for its public transport to be 95% fossil free in energy use by 2025, promoting a switch to renewables. Significantly the electricity used to power the prototype plug-in hybrid (Hyper Bus) is locally-generated wind power.

The Hyper Bus is a further development of the Volvo 7900 Hybrid already available on the market. It is equipped with a larger, energy-optimised battery,

Photo: LIFE10 ENV/SE/000041

which combined with a short recharging time, enables the bus to run on battery power alone for much longer than conventional hybrids.

"Its main advantage is much lower energy consumption, compared with a conventional hybrid, which gives you lower emissions," explains Per Bengtsson of Volvo Buses. Also, with a regular hybrid you have an electric 'take off', meaning that the diesel engine shuts off during stand-still, the bus takes off in electric mode and then the diesel engine starts at approx. 15-20 km/h. In this case [with the Hyper Bus] you can drive through the whole town, more-or-less, in electric mode."

As well as creating a much quieter journey for passengers and local residents, this is more comfortable for the drivers. "The [six] drivers say they prefer the greener buses, because they are more comfortable and because they are so much quieter," confirms Christoffer Widegren of Trafikkontoret.

The (Number 60) route chosen for the bus trials covers a distance of 8.3 km in one direction. It has steep hills at both ends and a largely flat central section that provided a good opportunity to demonstrate that the plug-in climbs hills well and can operate over long distances in electric mode.

The plug-in technology allows the battery to be charged with external electricity, corded via two charging stations – located one at each end of the route. Each charging station is connected to a 400V AC supply, has a charging capacity of 100 kW. To completely charge the bus takes 10 kWh, which – says the project team, works out at around SEK 12-15 per charge (€1.30-1.62).

At present, each charging station requires an initial investment of some SEK 3 million, including development costs. However, in a mass production scenario, the project team says the price could fall below SEK 1 million per station. Importantly, the charging infrastructure uses open standard protocols, which means it is not restricted to Volvo buses, but available to other manufacturers.

To justify this investment it is necessary to take into account factors such as length of route, bus capacity, passenger capacity and overall passenger numbers, says Mr Bern from Business Region Göteborg: "In the end it comes down to the number of hours you would like to operate the bus. Preferably you want 3-4 charging sessions per hour, as that would keep the operation running economically."

There are electro mobility projects elsewhere, he continues, that are not using fast chargers, but are instead operating overnight charging. He says this can work on shorter routes, or where it may be possible to top up the battery during lunch-hour. But it would not work on a busy city-line where you need to have as many buses running through as possible.

In electric mode, the Hyper Bus's range is approximately 7 km. But, if for any reason the bus is unable to download energy from the charging station, it can function on diesel alone. Fredrik Persson (Göteborg Energi) explains why this was important: "This was a new area for us. If the buses had been fully electric and you had a case say of not being able to deliver the power for a number of hours, it could have been catastrophic."

The plug-in hybrid buses can be charged rapidly at each end of the route

Photo: LIFE10 ENV/SE/000041

Despite these fears, there have been few problems with the buses. "Considering the quite short lead time from development to putting them on the road, they have been very reliable," says Volvo's Per Bengtsson.

Broad public support

The project commissioned a public attitude survey which showed showed that the majority (70%) of those polled were aware of the project and were positive about it. The vast majority of respondents

(76%) expressed the desire for more plug-in hybrid buses in public transport even if it meant a small increase in fares (e.g. SEK 0.50 per journey).

These positive findings are backed up by practical experiences. Mr Persson, reports that, when buses arrive together, some passengers have been known to switch from a regular bus onto a Hyper Bus – and the reason given is, "That's the green bus I want to get on that one"!

Results exceed expectations

The new plug-in hybrid consumes less than 11 litres of fuel for every 100 km, an 81% fuel saving in comparison with the equivalent (Euro 5) diesel bus – the project initially targeted a 65% saving. There has been a 75% reduction in CO_2 emissions compared with standard diesel buses. The project also met its objective of reducing average tailpipe emissions of NOx, PM, HC and CO by more than 75%.

The project has contributed to Gothenburg's goal of establishing 'zero-emission' areas for public transport, since 80% of the route is driven in electric mode. Noise emission levels, a key concern for the region, have also been improved. In electric mode, the noise reduction is approximately 20 dBA.

Driving the market

The project ended in September 2014. Already the Hyper Bus is on the market; and will be mass produced from the beginning of 2016 under the name Volvo 7900 Electric Hybrid. Four European cities have already placed firm orders: Gothenburg, Stockholm, Hamburg and Luxembourg.

As a measure of the international interest in the project, in September 2013, the technology behind the Hyper Bus was showcased to US President Barack Obama during his visit to Sweden. According to the partners, he was particularly interested in costs. The USA – alongside China, Japan, Germany and France is investing heavily in hybrid bus technology. The US government has invested $2.4 billion to accelerate the manufacturing and deployment of the next generation of batteries and electric vehicles.

Photo: LIFE10 ENV/SE/000041

US President, Barack Obama, is shown the technology behind the Hyper Bus on a visit to Sweden in September 2013

ElectriCity

The Hyper Bus project constitutes a first step in a broader initiative to enable wider implementation of hybrid plug-in technology in city buses in Europe. It is an important step in the development of fully electric buses. Another major electro mobility project is underway in Gothenburg, known as ElectriCity. The project, another collaboration between public and private partners, focuses on developing and testing new services and products and will include three fully electric buses from Volvo.

"From our standpoint, a conventional hybrid, plug-in hybrid (Hyper Bus) and full electric bus are all needed within the city infrastructure. We don't believe that full electric buses will take over completely within the foreseeable future – but rather that there will be a 'mix' of the three types of technologies because they each have their particular advantages," says Helena Lind, manager media relations, Volvo Group.

DID YOU KNOW?

The Hyper Bus emits 75% less CO_2 than a conventional diesel bus. If all the buses in Gothenburg's public transport network used the same technology, the City would reduce emissions by 10 000 tonnes of CO_2 every year.

Project number: LIFE10 ENV/SE/000041

Title: HYPER BUS - Hybrid and plug-in extended range bus system

Beneficiary: Business Region Göteborg

Contact: Lars Bern
Email: lars.bern@businessregion.se
Website: www.hyperbus.se
Period: 01-Sept-2011 to 30-Sept-2014
Total budget: €3 249 000
LIFE contribution: €1 546 000

AGRICULTURE & FORESTRY

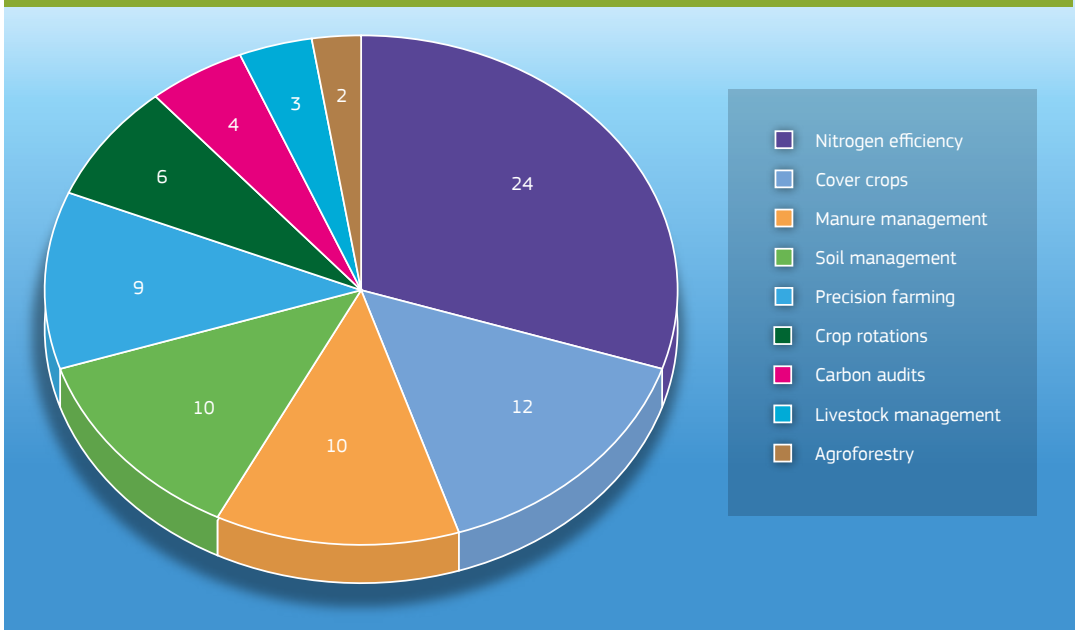
LIFE and **farm-based climate action**

Agriculture holds many opportunities to be a major force for mitigating climate change and LIFE co-funding has been used well by Member States to demonstrate this.

More of the EU's land is used for agriculture than for any other purpose. Europe's farmlands act as highly important carbon pools. Farms can therefore be a significant source of greenhouse gas (GHG) emissions and so all Member States recognise the long-term value of adopting sustainable approaches to the production of our food, fibre, and energy from farmland.

Data from the European Environment Agency highlight that in 2012, CH_4 and N_2O emissions on EU farms accounted for 469 $MtCO_2e$, or approximately

Fig. 1: **Agriculture & Foresty projects (1999-2012)**



Source: LIFE database

10% of total EU28 GHG emissions. Farms therefore are a high priority for climate action and Figure 1 illustrates the breakdown by source in order of importance.

Agri-climate challenges

The challenge for the agriculture sector is how to reduce GHG emissions - and overall environmental performance - at the same time as meeting the need for increased production in order to keep pace with growing global food and energy demand.

Agriculture is, however, one of the few sectors that can both contribute to mitigation and sequestration of carbon emissions. It also can contribute indirectly to emission reductions in other sectors through the supply of biomass for the production of bioenergy and renewable materials. However, it is hard to quantify GHG emissions from agricultural activities: the atomistic nature of production (many individual farmers) in a wide range of geographic and climatic conditions means that emissions are not only highly variable but also difficult and costly to measure precisely.

National and EU support is available to help meet the challenges outlined above and, in particular, to facilitate on-farm investment in climate action. One of the largest support sources is the Common Agricultural Policy (CAP), which combines EU funds with national co-finance and includes scope to encourage more sustainable agricultural practice. So-called 'direct payments' through Pillar 1 of the CAP for instance, have recently increased their emphasis on mandatory environmental standards that assist mitigation. Rural Development Programme (RDP) aid, through Pillar 2 of the CAP, has also put in place strong new priorities (including compulsory elements) for tackling climate challenges.

Agri-climate opportunities

There are a number of farming practices that have the potential to reduce GHG emissions below current levels. Methane and nitrous oxide emissions can be cut by optimising nitrogen application or precision farming, as well through livestock management and improving manure management (storage and production of biogas). Carbon losses can be reduced by maintaining and optimising carbon levels. Ways to achieve this include proper soil management (conservation agriculture, no tillage, maintenance of soil cover, protection of organic matter in carbon-rich soils, restoration of peatlands, grasslands and degraded soil) and land management (diversifying crop rotations, conversion of arable land to grasslands, organic farming, afforestation).

The mitigation potential of soil and land management practices varies considerably, but overall they have the advantage of being readily available and low-cost (no advanced technology). Other ways in which agriculture can contribute to CO_2 emission reductions include: modernising farms to use more energy-efficient equipment and buildings; providing support for the production and use of renewable energy; and offering compensation for extra costs incurred by farmers who voluntarily help protect the environment (agri-environment climate schemes).

Climate mitigation in EU agri-climate policies

Mitigating GHG emissions is a core objective of EU agri-climate policies, which focus on three main GHGs:

- Methane (CH_4) – this gas is created by ruminant livestock (mainly cattle, sheep, and goats) and methane is also released as farm manure decomposes.
- Nitrous oxide (N_2O) – these emissions occur when manure and synthetic fertilisers are applied to land. Livestock urine is another source of agricultural N_2O.
- Carbon dioxide (CO_2) – agri-energy use is a key driver of CO_2 emissions from farms but land use change (ploughing, crop choice etc.) also affects the ability of agrarian areas to fix and store carbon.

Monitoring the use of natural zeolites that reduce ammonia release from fertilisers

Photo: LIFE10/ENV/IT/000321/Massimo Coltorti

Training, knowledge exchange and advisory services play vital roles in implementing such actions. These should be further promoted by (and between) Member States in ways that help reduce GHG emissions. Awareness needs to be raised amongst food producers and land managers about how they can help themselves and others to reduce emissions and increase carbon storage.

Farmers should also be made more aware of the economic advantages that such mitigation opportunities offer for them – particularly from savings in costs, management, and/or maintenance inputs, as this is another incentive for change towards climate-friendly agricultural practices.

LIFE's role

LIFE co-financing has been used by Member States to test and demonstrate a valuable collection of new climate-action methods and mitigation techniques in the aforementioned areas. Many useful lessons have been learnt across rural Europe and successful project outcomes continue to be incorporated into today's climate-friendly farm practices.

LIFE projects dating back to the 1990s have produced helpful reductions in GHG emissions even if, in most cases, this has been an indirect consequence of actions aimed at implementing the Water Framework Directive or other environmental policies.

The AGRICARBON project showed how precision and conservation agriculture techniques can contribute to GHG emission reductions

Photo: LIFE08/ENV/E/000129

Increasing nitrogen efficiency

LIFE has funded over 20 projects targeting nitrogen efficiency in agriculture that have produced multi-purpose environmental outcomes. In the Petrigano project for example, a programme of work was launched in 2000 demonstrating agronomic techniques where nitrogenous fertilisers were adapted to specific cultivation objectives, soil types and type of crop. A farm-by-farm and crop-by-crop calculation achieved a reduction of 50%, without reducing the yield. Such findings remain relevant for Europe's air, water, biodiversity, and climate simultaneously The use of zeolites that significantly reduce the release of unused nitrates from fertilisers are being shown by two LIFE projects (ZeoLIFE, UNIZEO).

Other examples of multifunctional outcomes from earlier LIFE projects include AGRI-PERON's satellite techniques for helping farmers to adopt tailored practices, and thereby reduce their nitrogen inputs. LIFE has highlighted the value of applying real-time monitoring data to establish a farm's ideal nitrogen requirements (OptiMaN). This approach has attracted the interest of policy-makers, since LIFE project results showed that nitrate usage levels on EU farms may be overestimated (and thereby reduced) by as much as 30%.

When climate issues became a strategic priority for LIFE in 2007, agricultural projects started to be aimed more directly at climate matters. Nitrogen management continued to be pivotal for much of LIFE's agricultural portfolio, as it moved from profiling general good practices to more targeted methods for minimising N_2O emissions from specific types of farms, crops, and soils.

This can be seen in modern-day projects such as IPNOA, which is demonstrating new opportunities for measuring N_2O fluxes in farm soils. The IPNOA team is testing a portable tool to identify emission levels from different soils at farm level, and a complementary technology is increasing knowledge about emission variability across wider-scale agri-ecosystems. Project results due in 2016 are predicted to help reduce emissions by as much as 20% from their baseline position.

Improving agriculture's ability to quantify emission levels, carbon storage, and mitigation impacts is highly important for agri-climate projects, programmes, and policies. One of LIFE's most promising sets of results in this area has been achieved

by the AgriClimateChange project (see p.65). This project's toolkit can measure an individual farm's carbon footprint and monitor and quantify emission effects from mitigation measures, as well as incorporating a much-welcomed cost-benefit analysis of the mitigation options for individual farms.

Livestock management

Rising methane (CH_4) emissions are caused by the expansion of livestock farming as a reaction to growing global demand for meat and dairy products. The bacteria that help cattle and sheep digest their food produces CH_4, a powerful greenhouse gas which returns to the atmosphere, contributing to global warming. Alongside extensive forms of pasture management in livestock rearing, breeding and the use of additives to reduce methane emissions, one possible solution to this problem is to change the nutrition patterns of livestock – diet and the timing of food intake influence methane release from ruminants and manure.

LIFE could help identify methods (LIFE Carbon Dairy), support and advisory needs to fill this knowledge gap through more work with farmers and livestock nutrition experts. Importantly, the programme could improve awareness-raising campaigns to advise farming communities of changes that they will be expected to help deliver, such as the need to make use of low-protein feeding strategies for livestock.

Managing manure

Many of LIFE's agricultural projects in the livestock sector address emissions from manure. These waste products have an important role to play in mitigating climate impacts because using manure instead of synthetic fertilisers can decrease N_2O emissions from farms, as well as from fertiliser manufacturing.

On the other hand, manure emits ammonia (NH_3), which breaks down to become GHG. LIFE projects have therefore not just concentrated on highlighting how manure can be used as a cost-effective organic fertiliser, but also how it can be used more reliably through techniques such as 'precision farming'. LIFE projects in this area often have the co-benefit of improving air quality. Indeed, LIFE's manure management knowledge-base represents a mutually useful reference resource for both climate action, and informing the codes or standards proposed by the EU's National Emission Ceilings Directive.

LIFE09 ENV/IT/000214

GAS-OFF

This LIFE project developed good practices for reducing methane from Italian dairy farms by calculating emissions associated with particular diets and specific husbandry methods. Different parts of dairy farms (feeding alleys and resting areas) were shown to produce different GHG emissions and a practical set of mitigation solutions were demonstrated through relatively easy-to-apply husbandry changes.

"We found that the cows' resting areas have major emissions of GHG so it is important to remove frequently the straw and also to clean the floor surfaces," explains Frederica Borgonovo from the GAS-OFF team.

Using rubber floor matting in cattle barns was shown to help reduce emissions because farmyard scrapers can clean a matted floor better than a concrete surface.

Additionally the project team successfully confirmed that nutritional strategies could be applied to reduce emissions. "Tuning of the cows' diet, by acting on starch and protein content, can diminish methane emissions and lead to more cost-efficient milk production," says Gianni Matteo Crovetto, who supervised this aspect of the project.

Similar analysis of livestock diets by the Ammonia LIFE project in Sweden also showed how feeding routines and lactation husbandry could be managed to promote milk production systems that are more climate sensitive.

Photo: LIFE09 ENV/IT/000214

The LIFE programme has funded more than 20 recent projects involving new and proven methods for reducing manure emissions in ways that retain nutrient content. One such case is ECOFILTER, a project that showed how a combination of bio-washers and bio-filters can reduce NH_3 emissions from manure by some 95%.

Pig manure is more polluting than most other animal wastes and so it has been targeted to good effect by projects including ES-WAMAR's low-emission

spreading work. Here, LIFE co-finance helped prepare new approaches for treating piggery waste through coordinating nutrient balances over a network of participating farms – and results created 16 sustainable jobs for the green economy.

The MIX FERTILIZER project is another piggery venture and this combines swine manure with other ingredients to create a new type of fertiliser containing a special inhibitor (3-4 dimethyl pyrazole phosphate). The project plans to achieve 45-50% reductions of N_2O emissions from wheat plots, as well as a reduction in chemical fertiliser use of 30%.

Good commercial interest in, and thus replication of, these results is anticipated because the slow release means only one application of fertiliser may be needed (saving on operational costs) and increased yields are also expected (by around 10%).

Soil emissions

Organic and precision farming methods have been trialled by LIFE in numerous soil circumstances. Projects involved with advancing these techniques (for example, Sinergia, Crops for better soil, AgriClimateChange, SOLMACC and AGRICARBON) have studied parameters for reducing soil emissions in a host of crop types ranging from wheat and viticulture, to citruses and leguminous plants.

All these projects share nitrogen reduction goals. Between them they have all also furthered our intelligence about soil emission factors linked to crop protection and rotation, tillage, irrigation, and fertilisation (including use of traditional nitrogen fixing crops that need less fertiliser).

LIFE projects continue to contribute to the development of precision agriculture as a farm management concept based on observing and responding to intra-field variations. This may involve use of satellite imagery and geo-positioning systems to help farmers optimise fertiliser rates and use of plant protection products when spraying (AGRICARBON). Reduced use of agri-chemicals and energy delivers multiple benefits for the soil and groundwater - and thus the entire crop cycle - as well as in terms of cost savings and lower N_2O emissions.

LIFE's focus on resource–efficient approaches to precision agriculture can be seen in the real-time monitoring data systems developed by projects such as OptiMaN. These have attracted the interest of authorities dealing with nitrogen regulations, since project results have shown objectively that current nitrate usage levels on EU farms can be over-estimated (and thereby reduced) by as much as 30%. LIFE has demonstrated a decision-support tool for agri-businesses that helps farmers achieve the correct balance of manure inputs and thus avoid GHG emissions (DEMETER). Another acclaimed LIFE project in this field is SOWAP, which carried out successful cost-benefit analysis in a cross-section of Member States for precision farming techniques, including conservation tillage and nutrient management.

ES-WAMAR developed low-emission solutions for spreading pig waste

Photo: LIFE06 ENV/E/000044/SODEMASA

Useful projects like these thus help to provide farmers with the management information they need to make climate-related business decisions, and they also help to improve farmer confidence in climate-mitigation measures. Increased emphasis on cost-benefit analysis in future LIFE projects will add more credibility to their results. New LIFE projects in this area should aim to report on the cost of their climate solutions against a conventional 'control' cost, and new projects could aim to better estimate the cost of commercialising prototypes, or of adapting them to different climates or agricultural sectors.

Soil storage

Agriculture and forestry are the two main sectors of Europe's economy with the ability to remove CO_2 from the atmosphere and store it (in crops, trees, hedgerows, and soil). Soil management practices are therefore important influences on global carbon stocks, and soil management remains a crucial tool for tackling climate change.

The Nature, Environment and Information strands of LIFE have all been used to support sustainable soil management, testing and confirming the suitability of strategies for a diversity of land use categories and soil situations. The utility of the Information & Communication strand in particular is demonstrated by the success of the CHANGING THE CHANGE project (see pp. 66-67).

A sizeable number of LIFE Nature projects also fund soil sustainability actions through their work with extensification of land use and conversion of arable land. Outcomes from such nature conservation activities help to increase pan-European soil carbon stocks through sensitive land management methods that are tailored to the long-term needs of local soil conditions. One of the very many examples of this type of LIFE Nature project is the Egyek-Pusztákocs initiative from Hungary's steppic grasslands.

LIFE Environment projects supporting soil management improvements acknowledge that a soil's ability to store carbon is dependent on the state of its functionality. Effective soil functions are an absolute prerequisite for agricultural productivity. Projects have therefore targeted assistance to help farmers take good care of their soils in order to maintain overall soil functionality and farm profitability.

These actions have been promoted through holistic approaches such as organic production systems or

Photo: LIFE11 ENV/ES/000535

OPERATIONCO$_2$ is transforming two naturally degraded areas into complete agroforest ecosystems

EMAS certification. Once again these projects have targeted other environmental impacts (soil water pollution, air quality) rather than climate mitigation directly; however, they use the same techniques as are needed to promote soil carbon storage.

One of the most effective techniques for soil carbon storage is reduced tillage, which involves less or no soil disturbance (i.e. ploughing, drilling, etc.). Decreasing tillage can reduce farm GHG emissions both by increasing fields' carbon stocks and reducing the use of fossil fuel energy for tillage work.

LIFE12 ENV/IT/000578

LIFE HelpSoil

This ongoing project is testing conservation agriculture and sustainable soil management techniques and is a good example of how farmers can learn through LIFE about options for improving the ecological functions of soil. LIFE HelpSoil is being carried out within the context of promoting healthier soils that better fix GHGs and sequester organic carbon.

"Our project uses monitoring indicators to measure soil ecosystem functions and assess the capacity of conservation agriculture techniques to restore agro-ecosystems to a more sustainable and productive state," explains Alberto Lugoboni. The project team will compare new management techniques with conventional practices at 20 demonstration farms in northern Italy, working closely with farmers and other stakeholders. Results will inform technical guidelines for farmers adapted to the different local agro-ecological conditions and cropping systems occurring in the region." All the Italian regions in which the project is working have conservation agriculture measures in their Rural Development Programmes for 2014-2020, and so our results should help implement these measures," adds Mr Lugoboni.

A host of LIFE projects (including Sinergia, Crops for better soil, AgriClimateChange, Petrignano, SOLMACC, LIFE HelpSoil, and RegaDIOX) have monitored and demonstrated the potential of reduced tillage, with projects such as SOLMACC going further and combining reduced tillage with non-use of herbicides on organic farms.

Soil monitoring is a common component of these and other LIFE projects that provide climate benefits from European farms. Member States have used an assortment of different soil monitoring techniques. The EU also has funded soil monitoring in 2009 and 2015 through its LUCAS programme, which could help redress this gap in the agri-climate policy apparatus.

Crop contributions

Farmers' crop choices affect farm incomes and GHG emissions. Intensification trends over recent decades encouraged the installation of monocultures, but evidence indicates that these highly – mechanised systems have negative impacts on many environmental factors – including climate matters.

LIFE project actions have reflected this fact and worked with farmers to identify cost-effective alternatives to monoculture cropping. Such projects (which include Crops for better soil, AgriClimateChange, AGRI-CARBON and LIFE HelpSoil) have successfully rotated crops (avoiding planting the same crop on the same land each year) as a GHG reduction method. The amount of nutrients that the different crops can provide to the soil is being tested and measured according to the type of soil and climatic conditions.

Photo: Gabriella Camarsa

Leguminous plants fix atmospheric nitrogen into the soil and improve soil quality

The SOLMACC project, for instance, is investigating optimal crop rotations between grass and legumes. This creates both environmental and economic advantages: the legume increases nitrogen fixation in soil (reducing the amount of fertiliser used) and the grass biomass becomes a feedstock to produce biogas for on-farm use.

The Crops for better soil project is also testing leguminous crops and first trials have demonstrated that they have the effect of fixating nitrogen to the roots of the plant. This is then released to the soil, cutting both the need for fertilisers and N_2O emissions. Farmers have already expanded legume cultivation beyond the project's pilot plots. This suggests LIFE has succeeded in its efforts to change the behaviour of farms that previously disregarded such nitrogen-fixing crops on the grounds of poor profitably. The programme's involvement has helped to dispel such myths by proving that the yields and economic

LIFE08 ENV/E/000129

AGRICARBON

The project worked closely with Spanish farmers to help clarify the best ways of boosting soil sustainability, without impinging on agri-profitability. "Our intention has been to promote certain techniques that have proven to be environmentally, socially and economically sustainable. What we are looking for within this broad sustainability framework is to focus on what climate change actually is, and on how to mitigate harmful effects of greenhouse gases through conservation agriculture and precision agriculture," explains project coordinator Emilio Jesús González Sánchez.

Conservation agriculture (CA) principles were applied to reduce tillage, slow the decomposition of plant matter, and thereby promote the storage of fixed CO_2.

Increased understanding by farmers about the dynamics of soil carbon stocks was another useful outcome. "We have been able to prove at a larger plot scale that we are able to mitigate climate change due to an increase in soil carbon by improving the sink effect of these techniques. We have also been able to reduce emissions derived from the use of inputs in farming activities," adds Mr González. He identifies the involvement of farmers and ongoing use of CA techniques after LIFE as one of project's key achievements: "We have witnessed an increase of double the surface area in lands under conservation agriculture in herbaceous crops."

savings from climate-friendly leguminous crops can make commercial sense for farmers.

Another solution that is being tested is the reduction of annual pastures and the introduction of perennial crops. Compared with annual crops, perennials (especially grasses) tend to allocate a relatively high proportion of carbon underground and have a greater number of days per year of active plant primary productivity, resulting in more potential biomass production and carbon storage. LIFE RegaDIOX will test perennial crops, crop rotation, leguminous and permanent pastures using mulches in order to increase carbon capture in soil.

Cover crops

Cover crops have a significant impact on increasing the carbon stock at farm level. A number of LIFE projects are demonstrating this positive mitigation effect, including AGRICARBON, AgriClimateChange, SOLMACC, LIFE HelpSoil and oLIVE-CLIMA.[1]

AgriClimateChange experimented with the use of cover crops. Farmers have now established annual small-scale field trials to test and select the cover crops (mixed species) that satisfy their objectives. The choice of such crops is not predetermined, the farmer's decisions are instead guided by climatic conditions in a given year. The biomass produced by cover crops enhances soil fertility, with a recycling of nutrients of some 20 kg N/ha for the following crop, thus reducing the amount of mineral nitrogen fertilisers purchased.

Retaining crop residues

Agricultural crop residues returned to the soil can help mitigate climate change by increasing carbon sequestration, reducing direct emissions from nitrogen fertilisers and reducing the amount of such fertiliser that needs to be applied to the following crop.

The oLIVE-CLIMA project is sampling and analysing the different material (pruned wood, olive-mill sludge and leaves and other composted material) to determine the amount of carbon returned to the soil. Another project (SOLMACC) is teaching farmers about controlled composting. Techniques include the collection of manure and/or plant residues; how to favour the microbial processes in the compost heap; how to form the compost heaps that facilitate microbiological transformation processes; and regular turning of manure piles using either standard or specialist farm machinery.

1 Cover crops can help to mitigate GHG emissions in four main ways: increase soil organic carbon content, decrease soil erosion during the fallow period, reduce nitrate leaching, and reduce the amount of nitrates that need to be applied to the following crop

oLIVE-CLIMA is demonstrating a range of climate-friendly olive crop management practices, such as the use of cover crops

Photo: LIFE11 ENV/GR/000942

Agricultural carbon audits

Although there is no current EU requirement for farmers to report GHG emissions at farm level, there are many voluntary initiatives to evaluate emissions from agricultural activities and to implement mitigation actions. New RDP measures in Pillar 2 of the CAP can now finance carbon auditing as a contribution to mitigating climate change and the audits can be extended to cover a full lifecycle analysis of farm production, examining factors beyond the farm gate that contribute to GHG emissions in agri-food chains (i.e. in processing, packaging, waste management and haulage).

Carrying out a farm carbon audit can help an agribusiness to identify GHG emissions and benchmark these in order to identify cost savings through improved use of inputs or energy-efficiency. LIFE projects such as AgriClimateChange and ClimatechangE-R represent some of Europe's pioneers in farm-based carbon audits, and their results have been recognised at the highest levels of EU policy (see the feature article on p.65).

Energy use is a key part of carbon audits and an informative collection of energy-efficient approaches has been taken forward by LIFE projects involved in cutting fuel consumption on farms. Reduced tillage, limited frequency of agri-chemical applications, and more efficient irrigation have all been objectively appraised by LIFE as viable tools for making farms less energy dependent. Increased use of renewable energy sources - by projects including Adapt2Change and BIOAGRO - further contribute to the LIFE knowledge-base in this sector. Also, OZERISE is developing an innovative rural development to farmers increase production of renewable energy and to reduce overall energy consumption on farm holdings.

The AGRICLIMATECHANGE project team did much to transfer knowledge about soil conservation techniques

Photo: Tim Hudson

Agroforestry

Forests play an important role in the global carbon balance. As both carbon sources and sinks, they have the potential to form an important component in efforts to mitigate climate change. Accounting for the carbon within forest ecosystems and changes in carbon stocks resulting from human activities is a necessary first step towards the better representation of forests in climate change policy at regional, national and global scales.

Few LIFE projects have targeted agroforestry. SOLMACC is encouraging farmers to combine trees, crops and livestock in one agricultural system and to plant new trees. The project also intends to conduct close scientific monitoring to show how these practices can assist farmers to mitigate climate change, as well as highlighting their economic feasibility and technical requirements. OPERATION CO_2 will demonstrate the economic viability and environmental validity of agroforestry carbon sequestering projects in Europe. It aims to promote active nature conservation and carbon management in forests over an area of 4 500 ha. To this end, it will demonstrate a series of targeted forest and carbon actions resulting in the long-term improvement of carbon sequestering in natural forests.

Looking ahead

This review of LIFE project contributions to mitigating climate challenges in agriculture emphasises the value of the programme as a popular and productive source of support for Europe's farmers. LIFE has helped Member States to test, validate, and implement a broad spectrum of innovations that reinforce farmers' efforts to remain competitive in environmentally-friendly ways.

LIFE's future on the farm therefore looks set to continue and the new LIFE funding period up until 2020 will undoubtedly see Member States using LIFE co-finance to generate an even more impressive set of multi-functional climate-friendly benefits for Europe, and the wider world, from our farms.

AGRICULTURE

AgriClimateChange: **demonstrating LIFE's climate action potential**

A transnational LIFE project targeting cost-effective and quantifiable climate action at farm level has helped to inform new EU policy approaches to climate mitigation.

One of the biggest challenges in helping agriculture to tackle climate change is providing quantifiable evidence about the results of climate action on farms. Many good practice mitigation methods exist but these have yet to be fully recognised in greenhouse gas (GHG) accounting.

Increasing the visibility and validity of such on-farm results are therefore important goals for the EU, and results of LIFE's trail-blazing AgriClimateChange project provide a fully fit-for-purpose tool to measure farm-based climate action. Quantifiable monitoring systems are just one part of this project's much-heralded Agri Climate Change Tool (ACCT), which also helps farmers to identify their most cost-effective options for both mitigating climate change, and adapting farms to new weather-related challenges.

ACCT's ability to help farms carry out carbon and energy audits has garnered much attention. The project team's knowledge has already been sought by the European Parliament during its efforts to promote climate-friendly agriculture, and new European Commission guidance on this topic also points Member States towards ACCT's potential.

Three years of LIFE co-finance was used to test and validate ACCT's various audit and reporting components. These can cover emissions from, livestock, soil, crops, and energy consumption (both direct - electricity, fuel, gas, water - and indirect – fertilisers, feedstuffs, pesticides, seeds, farm buildings, machinery and packaging). Opportunities for avoiding emissions by producing renewable energy at farm-level are factored into the ACCT calculations, which also can audit carbon sequestration from cover crops, agroforestry, crop rotations, and reuse of residues.

Results from 128 trial action plans in four countries (Spain, Italy, France and Germany) showed how an average reduction of 10% in GHG emissions and 10% in energy consumption is attainable at farm level. Higher reductions were proven possible using specific mitigation techniques, including reduced tillage and other aspects of conservation agriculture.

Jordi Domingo, from Fundación Global Nature believes the project's ongoing work with policy and programme decision-makers should ensure an effective legacy. "One year after completion of the LIFE AgriClimateChange project, we are coordinating a multidisciplinary Working Group in Spain for 'Mitigation and Adaptation in the Farming Sector' that includes representatives from key stakeholders. We have also applied the knowledge gained from AgriClimateChange in order to train an additional 120 farm technicians and advisors on the use of assessment tools such as ACCT, and on how to include climate change measures in their regular support to farmers. A baseline reference document for agriculture and climate change has been produced, which has already been delivered to more than 50 000 people," he says.

Project number: LIFE09 ENV/ES/000441

Title: AgriClimateChange - Combating climate change through farming: application of a common evaluation system in the 4 largest agricultural economies of the EU

Beneficiary: Fundación Global Nature

Contact: Eduardo de Miguel
Email: edemiguel@fundacionglobalnature.org
Website: http://www.agriclimatechange.eu/index.php?lang=en
Period: 01-Sept-2010 to 31-Dec-2013
Total budget: €1 589 000
LIFE contribution: €794 000

AGRICULTURE

Involving farmers in climate action

A Spanish Best of the Best LIFE Information & Communication project has identified a suite of success factors for increasing awareness amongst agriculturalists about how they can help to mitigate farm-based climate challenges.

LIFE's CHANGING THE CHANGE project was run by a partnership of farm stakeholders and led by the Uniónes Agrarias – UPA, which has 12 000 members from wine, dairy, meat, and forest businesses. "We knew climate change was becoming a problem for our members and we knew we needed to know more about tackling the scale of the problem. The first phase of our project therefore involved reaching out to farmers and foresters to get their feedback on what climate problems they were incurring," explains Miguel Acuña from the coordinating beneficiary.

Rather than talking about climate change in the abstract, the project team prepared concrete visual communication aids using photographs to show the effects of climate change on crops and livestock. "We took this photo-exhibition on a roadshow of agri-events around Galicia in order to encourage farmers to talk to us if they were suffering similar or additional problems. We also trained staff from our 37 local offices to help gain such feedback from our members. Results of this first diagnostic part of the project were extremely useful," says Mr Acuña .

As a result of this outreach work, the project confirmed that new livestock pests were becoming established in Galicia as the climate becomes more Mediterranean; in forests pests were being found at higher altitudes than previously. Farmers also expressed concern about the impact of drier and more variable weather on fodder quality and crop yields.

This travelling photo exhibition was one of the communication tools that encouraged discussion with farmers about the effects of climate change

Photo: LIFE07 INF/ES/000582

Positive advice

Using visual materials and speaking to farmers 'in their own language' helped the LIFE team to gain a much greater awareness of what climate change meant to Galicia's agri-sector. This provided the impetus for farmers to start asking more about what they could do to help mitigate these new problems.

Anxo Dono Sanchez is one of the farmers who got involved with the LIFE project: "I knew things were changing for the worse on my dairy farm. We were seeing more variation in our fodder crops, water availability was decreasing, and soil erosion was increasing. Storm damage was also more frequent."

Mr Sanchez explained these concerns to the LIFE project team who then advised him on how to help reduce the causes of climate change, through actions including cover crops, composting, reduced fertilisers, diet modifications, and replacing imported feed additives with locally-sourced products that had lower carbon footprints.

The second phase of the LIFE project was advising four target groups (wineries, foresters, milk and meat producers) both how to mitigate future negative impacts and how to adapt to changing weather patterns. Again messages were adapted to the audience's needs, "you can't change agricultural practices by working in a laboratory or office alone. You need to act in the field and you need to present solutions to overcome problems," says Professor Francisco Díaz-Fierros from the University of Santiago, who worked on the project.

The team did this for example by raising awareness in the wine sector about climate-sensitive production

methods including using techniques for cultivation, bottling, and transport that had lower impacts on emissions and that were more resource efficient.

Economic interests

The project found that economic arguments were a good way of interesting farmers in mitigating climate challenges. "We concentrated a lot of effort on using examples with financial facts and figures to show the practical benefits to each sector and each situation from climate actions," explains Jacobo Feijoo, a senior technical advisor at Unións Agrarias – UPA. The beneficiary also drew on its knowledge of funding options available through Galicia's Rural Development Programme (RDP) – it is part of the RDP monitoring committee – to make farmers aware of the financial help to make the changes in which they were interested.

Having strong links with the Common Agricultural Policy (CAP) support mechanisms was another success factor for the project. This meant that the LIFE team could dovetail its climate work with its CAP advisory remit, which increased farmers' trust in the advice being given. "It can be difficult to get farmers to come to a meeting about climate change but we regularly run well-attended events for them about CAP matters," notes Mr Feijoo. "We were able to use these meetings to also talk about climate subjects, and hence this synergy helped us reach a far wider audience."

The beneficiary also used its network of 37 farm advisory officers to roll out the initial diagnostic work done by the LIFE project and cascade all the follow-up information on adaptation and mitigation. Such an approach also had an internal 'multiplier' effect, increasing climate awareness within Galicia's farm advisory sector and leading to a follow-up project, ECOREGA[1], that aims to reduce GHG emissions from cattle farm waste.

1 *http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=3691&docType=pdf*

Photo: LIFE07 INF/E/000852/Unións Agrarias-UPA

The project organised awareness days in schools under the theme "The Galician farmer facing climate change"

The local advisory network already had strong links with the local media channels that farmers tended to use. "We were able to use these contacts to raise awareness about the relevance of our climate action aims," says Paula Conte García from Unións Agrarias – UPA. The project notes that although since 2010 Galicia has shown a 4% growth in solar thermal panels, an additional 32 596 ha under sustainable forest management (PEFC or FSC certification) and a total of 800 000 ha of pasture being organically fertilised, it is difficult to assess CHANGING THE CHANGE's precise contribution to these improvements.

Future work

The project beneficiary is now seeking to develop a new initiative to expand the involvement of Galician farmers in climate action, better quantify their climate contributions, and so justify support for the investments they need to maximise their mitigation and adaptation potentials.

"We want to investigate how 'climate labelling' might differentiate products and help improve consumers' appreciation about farmers' climate action. We believe this can translate into even more climate action by farmers. It will also help our members to remain competitive in vital export markets, like Germany, where certification of product quality and eco-credentials are increasingly essential marketing tools," concludes Mr Acuña.

Project number: LIFE07 INF/E/000852

Title: CHANGING THE CHANGE - LIFE+campaign 'Changing the change'. The Galician agriculture and forest sector facing climate change.

Beneficiary: Unions Agrarias - UPA

Contact: José Rodriguez Blanco
Email: xestion@unionsagrarias.org
Website: www.unionsagrarias.org/life%2Bcambiarocambio
Period: 01-Jan-2009 to 31-Dec-2010
Total budget: €533 000
LIFE contribution: €266 000

PEATLANDS & WETLANDS

Restoring key habitats as carbon sinks

The restoration of wetlands and peatlands is not only improving biodiversity, it is also a valuable climate change mitigation action that several LIFE projects are carrying out and promoting.

Peatlands are commonly referred to as carbon sinks: this means that the vegetation that they maintain extracts from the atmosphere significant amounts of carbon dioxide (CO_2) by photosynthesis and this CO_2 is then deposited as carbon in peat through biological processes.

Many peatlands over the years, however, have been drained for agricultural or forestry use, and often later abandoned as their soil quality degrades, their productivity decreases and the cost of draining them rises. They have also been dug up and burnt for fuel – with a consequent release of CO_2 and negative consequences for their ability to act as carbon sinks.

Peatlands are areas where peat has naturally formed at the surface or where peat is still forming. Though peatlands occur in all EU Member States, they are concentrated mainly in northern European countries (primarily Fennoscandia, the

More than 370 LIFE Nature projects have carried out restoration actions on peatland habitats such as this active raised bog in the Netherlands

Photo: LIFE08 NAT/FIN/000596/Mikko Tiira

Baltic States, UK and Ireland). They store a large amount of carbon – 17 Gigatonnes (Gt) – a far greater amount than a comparable area of other terrestrial ecosystems. For example, in the boreal zone, peatlands contain on average seven times more carbon per hectare than ecosystems on mineral soil. The conservation and restoration of Europe's peatlands is therefore vital for mitigating climate change.

Though peatlands naturally release methane (a greenhouse gas – GHG) as the peat decomposes slowly also under water-saturated conditions, in healthy peatlands the rate of peat accumulation formed by specific wetland vegetation - mainly mosses, sedges and reeds - is greater than the rate of its decomposition, thus maintaining a positive carbon balance. But draining and using peatlands makes them net emitters of GHG. The organic peat material decomposes through the aerobic activities of microbes, resulting in the unchecked release of GHGs such as CO_2 and nitrous oxide (N_2O).

Emissions from drained peatlands generally increase with more intensive land use, deeper drainage depth and warmer climate (see Table 1).

A sufficient rewetting', or raising the water table, ensures that the fast peat decomposition is stopped. With the reestablishment of the peat-producing vegetation the new accumulation of peat may be initiated.

Table 2: **Indicative total emission reduction from rewetting peatlands with various initial land uses[1]**

Initial drained land use	Emission reduction after rewetting [(t CO_2-e ha^{-1} yr^{-1})]	
	Temperate zone	Boreal zone
Forest	6	2
Cropland	28	34
Grassland	20	25
Peat extraction sites	9	11

1 (Joosten et al. 2014, based on IPCC 2014 tier 1 default values for CO_2, CH_4, and N_2O emissions, DOC export, and CH_4 emissions from ditches, assuming for forest land an average nutrient level, for cropland and grassland a rich nutrient level, and for peat extraction sites a poor nutrient level). The higher values in the boreal zone are attributable to lower CH_4 emissions after rewetting and to higher N_2O emissions from drained grasslands.

LIFE measures

The total amount of CO_2 emissions from degraded peat in Europe is around 383 million tonnes/yr, of which 240 million tonnes/yr comes from peatlands drained for agriculture. It is possible to reduce these emissions in two ways: land-use change (i.e. the introduction of agricultural practice and livestock management that reduce peat decomposition and carbon loss); and, rewetting (see Table 2). Both techniques have been supported by the LIFE programme.

Between 1992 and 2013, more than 370 LIFE Nature projects have carried out conservation measures on a

Table 1: **Emission factors for drained peat soils for the combined effect of CO_2, DOC, N_2O (GWP 298) and CH_4 (from drainage ditches, GWP 23, with default ditch density)**

	CO_2 t $ha^{-1}yr^{-1}$	DOC t CO_2 $ha^{-1}yr^{-1}$	CH_4 kg $ha^{-1}yr^{-1}$	N_2O kg ha^{-1} yr^{-1}	Global Warming Potential t CO_2e $ha^{-1}yr^{-1}$
Temperate arable land / cropland	29.0	1.14	0	13	*35.4*
Boreal arable land / cropland	29.0	0.44	0	13	*34.7*
Temperate grassland, nutrient rich, deeply drained	22.4	1.14	16	8.2	*27.7*
Boreal grassland	20.9	0.44	1.4	9.5	*25.5*
Temperate grassland, nutrient poor	19.4	1.14	1.8	4.3	*23.2*
Temperate grassland nutrient rich, shallowly drained	13.2	1.14	39	1.6	*16.3*
Peat extraction	10.3	0.44-1.14	6.1	0.5	*11.7-12.4*
Forest	9.53	1.14	2.5	4.4	*12.2*
Forest, nutrient rich	3.41	0.44	2.0	5.0	*5.4*
Forest, nutrient poor	0.92	0.44	7.0	0.35	*1.7*

Source: After Joosten et al. 2014, based on IPCC 2104

Photo: LIFE06 NAT/UK/000134

LIFE has supported efforts to reduce CO_2 emissions from peatlands drained for agriculture through land-use change and re-wetting, for instance in the Active Blanket Bog in Wales project (pictured)

range of peatland habitats (the Habitats Directive lists 'Aapa mires', 'Active raised bogs', 'Alkaline fens' and 'Degraded raised bogs still capable of natural regeneration', amongst others). The contribution these projects have made to climate change mitigation varies according to the habitat, however, and this impact is also difficult to ascertain as yet, because the rewetting of land is a long-term action. Experts say that it can take decades for degraded organic soils to regain their full potential as carbon sinks. Nevertheless, baseline greenhouse gas figures from a range of habitat types are now available, allowing comparative studies to be made. Despite the fact that – direct monitoring to date has been beyond the reach and timeframe of individual LIFE projects, some projects have developed calculation models for assessing the contribution of LIFE actions to reducing carbon loss (see project boxes).

LIFE projects have also pioneered a range of techniques for the effective and stable rewetting of bog and fen habitats. The rewetting of rain-fed raised bogs and blanket bogs involves filling in drainage ditches or constructing dams in combination with the removal of encroaching shrubs and trees. A good example of this type of restoration work comes from the Dutch project, Fochteloërveen. In order to stop rainwater flowing off the raised bog too quickly (and thus preventing peat from forming), it subdivided the bog into sections by constructing peat-covered dikes and dams. As these sections became inundated, the growth of *Sphagnum* (a peat moss that sequesters CO_2) could be encouraged.

LIFE12 ENV/FI/000150

LIFEPeatLandUse

This project has developed a modelling tool that assists land-use planners and policy-makers in making ecologically and economically sustainable decisions on land re-use. "The evaluation is based on long-term monitoring data and new field data from these re-use options carried out during the project. Based on the existing and new data we can project the development of ecosystem services in the future using predictive models," says Dr Anne Tolvanen of the Finnish Forest Research (Metla), the project beneficiary. Models for GHG fluxes use temperature, hydrology and leaf area data to predict the impact of peatland uses on GHG balances.

"The GHG balance depends to a great extent on the peatland type, re-use option and the timeframe of the modeling. The timeframe is very important, as we know now that the short-term outcome may be the opposite of the long-term estimate. For example, the short-term outcome (a few decades to a century) of reforestation is better for GHG balances than that of restoration, since more carbon is sequestered in tree growth than in the peat. In the long term, the result is the opposite. This presents a challenge for decision-making, which is often based on short-term outcomes," she explains.

The ongoing project has selected peat harvesting areas using the optimisation model in order to show in practice the economic and environmental value of land re-use decisions based on such modelling.

Similarly, dam construction was essential for the hydrological improvement of the peat bogs targeted by a second LIFE project in the Netherlands (Korenburgerveen). In Latvia, the recently-started project LIFE_Wetlands also aims to encourage the recolonisaton of peat moss on restored peatland as part of a suite of actions to conserve and manage priority wetland habitats.

Aapa mire and bog woodland habitats present different restoration challenges. Here, as well as blocking ditches, it is necessary to remove excess trees and shrubs. LIFE has pioneered innovative restoration techniques. For instance, the 2004 Finnish project, GreenBelt recreated 'flarks' (inundated open lawns of sphagnum mosses, sedges, and rushes), peat banks and former streams in addition to blocking ditches and tree clearance. The GreenBelt project built on the work of an earlier Finnish project from 1997 (Lapland/Ostrobothnia), which greatly increased know-how of aapa mire restoration, testing techniques for the recovery of mire vegetation.

Filling in drainage ditches as part of work to restore Boreal peatland ecosystems in Finland

Photo: LIFE08 NAT/FIN/000596/Philippe Fayt

LIFE09 NAT/DE/000009

Hang- und Hoochmoore

This project in Germany's Rhineland-Palatinate region is rebuilding and preserving hanging bogs, raised bogs and transitional mires. Blocking drainage ditches has enabled the project to maintain target water levels in the catchment areas of the bogs.

The beneficiary, in partnership with the regional state department for geology and mining, has carried out studies in two project areas - Truffvenn and Mosbrucher pond - to determine the amount of carbon that the sites can sequester in the long term. These showed that the peat body of Mosbrucher pond (560 000 m^3) can store some 25 570 tonnes of carbon, whilst Truffvenn (49 000 m^3) is capable of sequestering 2 400 tonnes of carbon. "The Truffvenn has a manageable area of almost 8 ha," explains project leader, Jochen Krebühl. "The amount of carbon stored corresponds to around 9 800 tonnes of carbon dioxide – the equivalent of the amount of CO_2 emitted by a car over nearly 100 million km. Moor protection is climate protection!," says Dr Krebühl.

The Finnish restoration techniques differ from those measures carried out on other raised bogs - for example by the Danish project, SMOOTH or Cumbrian Bogs LIFE+ in the UK - owing to the different hydrological composition of the habitats.

LIFE08 NAT/FIN/000596

Boreal Peatland Life

This Finnish project restored peatlands that had been drained for forestry. In the project area, the CO_2 emissions from the aerated and thereby mineralising peat layer are partly counter-balanced by the CO_2 sequestered in the trees and other woody material that have grown on the sites because of drainage. But, as Jouni Penttinen, the project leader, explains: "The amount of carbon sequestered in peat formation, and not lost to the watercourses or the atmosphere after restoration, is always greater than would be sequestered by tree growth if the sites were not restored."

Old aerial photographs are used as a guide for actions to restore the drained peatland to as close to what it was like before drainage as possible.

While carbon fluxes are not being measured, on many of the sites the project is monitoring the effect of restoration on water table levels through the use of automatic data loggers. It is also monitoring vegetation and sites that haven't been drained as controls. Such monitoring is showing that restoration has been successful. "Peat-forming mire species (especially the Sphagnum mosses) are growing very rapidly and replacing the forest species that had invaded the sites after drainage. This is very strong indirect proof that we have been able to stop the release of carbon from the decaying peat layer, and instead the sites are now once again forming new peat and thereby sequestering carbon. On many sites the growth of peat moss is extremely strong which suggests that peat formation may be much faster in restored sites than in pristine mires," says Mr Penttinen.

LIFE11 NAT/DE/000344

Hannoversche Moorgeest

This 11-year project is rewetting four raised bogs in the northern Hannover Region. These have the potential to become "living raised bogs again with growing peat moss vegetation", says project leader, Stefan Heitefuss. To achieve this goal, the project is acquiring some 1 400 ha of land, "to avoid placing proprietors and farmers at an economic disadvantage", says Dr Heitefuss.

Two nationwide projects in Germany have collected extensive data on GHG emissions from areas with different peat types, land uses and groundwater levels. However, "it is too expensive to make measurements on the different land-use or vegetation types in the Hannoversche Moorgeest. Therefore we estimate the emissions," says Heinrich Höper of the Geological Survey of Lower Saxony.

The methodology involves identifying six basic emission types for biotopes in the project areas - intensively-used grassland, grassland with low use intensity, dry bog (heather, etc), rewetted bog, natural bog and flooded bog – then calculating the situation before rewetting and comparing that with forecasts of the situation after rewetting, as determined by experts.

A second set of estimates for the LIFE project areas has been made based on data showing the relationship between the total greenhouse gases and the mean annual water table, as well as the land-use intensity. "With this model we are able to estimate the greenhouse gas emissions, based on the water table," explains Dr Höper. Although the two models provided differing estimates of the amount of GHG emissions, in both cases the difference between levels before and after the rewetting was calculated at some 2 700 tonnes/yr, he adds.

Photo: LIFE13 ENV/ES/001182

Measuring greenhouse gas emissions from delta rice fields

The rewetting of groundwater-fed fens also requires specific measures. As groundwater levels lower in their catchment areas, fen habitats degrade. To restore the water level, it is not only necessary to close drainage structures, it is also essential to remove tree plantations in catchment areas, direct surface waters to those areas or remove topsoil to reduce the distance to the groundwater. The latter measure, which has been carried out on sites that were intensively farmed, also reduces nutrient loads and thus allows the right vegetation to re-emerge.

Wetlands and agriculture

Peatlands are explicitly included in the FAO's MICCA programme (see policy box). The EU Common Agricultural Policy (CAP) also includes voluntary measures that are beneficial for the environment and climate mitigation in its second pillar on sustainability. This may become a strong incentive for peatland conservation and restoration[1]. Agriculture and forestry have been the main drivers of peatland drainage worldwide, but that drainage – through huge GHG emissions and subsidence-associated land loss – is in turn frustrating the aims of a sustainable provision of food, fodder and fuel.

It is possible to prevent further peatland drainage at the same time as ensuring that agriculture continues to be a mainstay of rural economies. To achieve both goals it is necessary to put certain measures in place at local and farm level that allow wetland restoration to coexist with sustainable farming. These measures include: planning and advisory services, investment in local water infrastructure (changing drainage systems), investment aid and agri-environment-climate measures at farm level.

Through a host of projects that have promoted co-operation amongst conservationists and farmers, the LIFE programme provides a model for how such

1 CAP pillar 2 foresees that a marked reduction in GHG emissions from peatland cultivation can in many cases only be achieved when agricultural production is abandoned or at least land-use intensity is significantly reduced. Incompatible operations include investment aid to support land uses that are unsuitable for organic soils (arable farming, horticulture, intensive dairy production). Improving the agricultural productivity of land and water can help to limit the amount of water that is withdrawn from wetlands and discourage their conversion for agriculture. "Mainstreaming climate change into rural development policy post 2013 – Annex 1

Photo: LIFE04 NAT/FI/000078

The support of farmers is essential to efforts to restore and maintain peatlands and wetlands

support can be implemented. A good example of this comes from the UK, where the Active blanket bog in Wales project (2006-2011) successfully involved the local farming community. By the end of the project, many farmers outside the target area had invited the project team to block drains on their land. The project also ensured that the management of bog habitat was included in the 2013 agri-environment scheme for Wales.

A recently-started project from Italy, 'LIFE EBRO-ADMICLIM is aiming to establish a strategy for voluntary reduction of GHG emissions in cooperation with rice-growers in the Ebro Delta, a wetland that contains rice fields. This collaborative approach should demonstrate how changes in management practices, such as introducing more efficient water management systems, can reduce GHG emissions and improve carbon sequestration.

More progress on including peatland and wetland restoration in agri-environment measures is still needed. Whilst the EU provides direct payments to farmers to comply with environmental targets, these payments apply only to mineral soils. Climate-hostile agriculture on deeply drained peat still receives direct payments from the EU. Furthermore, national payment systems do not always favour climate-friendly practices, and biomass production on rewetted peatlands is often unsupported.

Climate change policy for peatlands

- The United Nations Framework Convention on Climate Change (UNFCCC) adopted the new activity 'Wetland drainage and rewetting' under the Kyoto Protocol in 2012 with the specific aim of making the rewetting of peatlands more easily accountable.
- The Convention on Biological Diversity (CBD) recognised, "the importance of the conservation and sustainable use of ... wetlands and, in particular, peatlands in addressing climate change" in May 2008.
- The Food and Agricultural Organisation of the United Nations (FAO) has paid explicit attention to peatlands since 2011 within the framework of its MICCA (Mitigation of Climate Change in Agriculture) programme.
- An EU Decision from 2013 [1] makes it mandatory to account for greenhouse gas fluxes from cropland management and grazing land management from 2021 onwards, effectively including most peatland drainage and rewetting activities.
- The Habitats Directive, the cornerstone of Europe's nature conservation policy, has the target of achieving favourable conservation status for habitats and species of European interest. The first EU-wide assessment (2001-2006) found that 75% of wetland habitat types and more than 60% of the wetland species targeted were in an unfavourable conservation status. These results have been taken into account in the EU Biodiversity Strategy to 2020.
- Article 1 of the EU Water Framework Directive (WFD - 2000/60/EC) protects mires and peatlands against further deterioration. The WFD explicitly refers to the restoration of wetlands, including the rewetting of peatlands, as a means of reaching nutrient target values and reducing water pollution.

1 Decision No. 529/2013/EU of 21 May 2013

PEATLANDS AND WETLANDS

Promoting rewetting for mitigation

A good demonstration of the mitigation impact of restoring wetlands has been taking place on 35 sites across Sweden under the Life to ad(d)mire project.

Many of Sweden's peatland areas have been drained for forestry reasons in the northern parts and for agriculture in the south, with the result that their ability to serve as carbon sinks has been greatly diminished. However, because many of these areas have fallen into economic disuse they have come under state ownership, allowing the regional authority of Jämtlands to lead a nationwide LIFE project that is demonstrating the feasibility of restoring drained and overgrowing wetlands, Life to ad(d)mire (**LIFE08 NAT/S/000268**).

The project is now increasingly emphasising the value of peat habitats for mitigating climate change in its promotional materials and dissemination work – and farmers are proving to be very receptive. "Most farmers get a kind of awakening and they think 'oh, yeah' I can do that with my land as well," says Lisa Tenning, project leader.

One of the peatland areas restored by LIFE to ad(d)mire

Photo: LIFE08/NAT/S/000268/Jon Eldridge

"They have bits and pieces of their land that they are not really using; they are too wet. They get really annoyed that they can't really do anything with that part, so they try to drain it. But we go out with information and say, 'hey, you can do this instead'. You might not make any money out of it – but if we do this and restore it, it has a value," she explains.

Whilst there is government funding for such restoration work, the LIFE project itself is a demonstration initiative, emphasises Ms Tenning. Nevertheless, the area that will benefit from the LIFE-supported actions is vast: around 40 000 ha will have had their hydrological levels raised by the end of the project, which is essential for the formation of peat. To achieve this goal, restoration work is being carried out on 3 800 ha of ditches.

The rewetting of the target habitat types – active raised bogs, degraded raised bogs still capable of natural regeneration, alkaline fens and aapa mires – entails three measures: damming, the filling in of ditches and the removal of vegetation. "Building a dam and getting the hydrology up favours more carbon sequestration than taking the trees down," says Ms Tenning. "If you take the trees down you don't get the hydrology up; you take the trees down to ensure that once you've got the hydrology back, they don't drink all the water."

The type of measures required for each site varies, however. "It depends on the mire basically. The deeper the peat, the bigger the area that is being drained – so if you want to concentrate on the mires, go for those that are heavily drained first."

Assessing the appropriate measures requires visiting the site and considering a range of questions: "How many trees are there? Is there a lot of shrubbery? How damaged is the site? Where's the

Photo: LIFE08_NAT_S_000268/Bergslagsbild AB

This overgrown peatland site (left) was cleared and re-wetted (right), an essential step in enabling it to function as a carbon sink

groundwater level? If we don't get the groundwater level up and we take down the shrubbery you can just make matters worse," explains Ms Tenning.

The decision whether to fill in the ditches or construct a dam also depends on the material available. "If we have old banks, then there is more material available for filling in the ditch. In some cases, there is no material left and there's no way to get material so we build a dam –that's usually in an area where the ditch is 4-5 metres wide and 3-5 metres deep. You have to build a dam and the water stands still. Then nature automatically takes its course and the water table rises to ground level," says Ms Tenning.

She adds that recovery is faster when ditches are filled: "you have a lot more solid peat for sphagnum and other species to grow on. But what we tried to do is stop the negative effects and then from there nature can, on its own, return to a state where it's acting as a carbon sink."

Emissions monitoring

Although the LIFE project is not monitoring for greenhouse gases, the University of Gothenburg has calculated changes in greenhouse gas emissions from one project site in Jönköping, and Uppsala University had collected data from another site before the restoration started. The project beneficiary is hopeful that gas sampling can be repeated when the restoration work is done. "

"We have been trying to get universities involved, and they're getting there slowly now. There hasn't been any interest at all until recently," explains Ms Tenning. In fact, she says that there was not much discussion of climate change monitoring when the project was launched in 2008. "For LIFE projects to do monitoring it is necessary to be linked to a university and a researcher that knows how to do data," she adds.

Nevertheless, much data has now been gathered that show the positive effects of restoring mires and the project is using these datasets to show the results that can be expected.

Such comparative evidence for the mitigation impact of restoring peatlands helps the project in its efforts to explain to landowners that those areas that they might consider mere 'wasteland' could easily be made highly valuable. And the actions taken at the project sites demonstrate how this transformation can be achieved.

"We're progressing! We were noticing that many people had no knowledge of the mire habitats as a climate-smart habitat. But we meet the public and arrange tours of the mires to show them the restorations. And we also try to get the climate change information into our talks," says Ms Tenning.

Project number: LIFE08 NAT/S/000268

Title: Life to ad(d)mire – Restoring drained and overgrowing wetlands.

Beneficiary: Länsstyrelsen Jämtlands Län

Contact: Lisa Tenning
Email: Lisa.Tenning@lansstyrelsen.se
Website: www.lansstyrelsen.se/jamtland/Sv/djur-och-natur/skyddad-natur/life-projekt/life-to-addmire/Pages/default.aspx
Period: 01-Jan-2010 to 31-Dec-2015
Total budget: €6 813 000
LIFE contribution: €3 407 000

ENTERPRISE

LIFE helps **businesses mitigate climate change**

New business development is essential to reach EU and global climate mitigation objectives whilst contributing to the EU's innovation, jobs and growth agenda. Many enterprises, particularly in the tourism sector, have already started to implement measures to reduce their carbon footprint using LIFE funding.

The ambitious targets of the EU's 2020 Climate and Energy Package and the integrated policy framework for the period up to 2030 have triggered a legislative agenda with far-reaching consequences for Europe's businesses. The challenge is to implement this agenda in order to tackle climate change, improve energy-efficiency and increase use of renewables whilst strengthening competitiveness.

New and innovative low-emission technologies must be developed and deployed in order for the EU to become a low-emission society as envisaged by the 2050 roadmap. Such technologies will be the basis of green growth and jobs, as well as greenhouse gas (GHG) reduction: a win-win scenario. New low-emission technologies also need to be easily transferable from pilot to commercial scale. In recognition of this,

LIFE is helping tourist destinations reduce their carbon footprint

Photo: LIFE04 ENV/NL/000661

in 2014 the EU published a Communication supporting the role of SMEs in developing green technologies, including climate-related ones, and in exploring new green and climate-related business opportunities.

EU funding streams such as LIFE and Horizon 2020, as well as public-private partnerships, can provide the financial impetus needed to inspire this change.

Low-emission LIFE

One of the weaknesses of the LIFE programme has been a lack of focus on developing low-emission technologies. However, LIFE projects targeting a range of industrial sectors (including pulp and paper, tanneries, steel and textiles) have produced co-benefits in terms of GHG reductions and energy efficiencies from technologies designed with other aims in mind.

One area of enterprise where LIFE has specifically targeted climate mitigation has been tourism, providing solutions and best practice for businesses and customers (tourists) alike.

Tourism and climate change

The tourism sector has been calculated to account for some 5% of global CO_2 emissions, a figure that includes transport but does not take into account the energy used in constructing and using accommodation etc. It is also important to recognise the role of tourism-related aviation in emitting other greenhouse gases that contribute to global warming.

Different forms of sustainable and green tourism have become increasingly popular in recent years. In response to this and the growing awareness amongst tourists of how they could be contributing to climate change, the sector is looking more and more actively into exploring techniques and practices that mitigate its impact on climate change. Tourism initiatives and strategies, such as the EU sustainable tourism strategy or the Davos Process on Tourism and Climate Change (see box), are using innovative measures to reduce the industry's carbon footprint.

The overall objective of climate change mitigation strategies, policies and activities with regards to tourism is to contribute to the achievement of "carbon neutrality" in the sector. To obtain this, tourism businesses must take measures to neutralise all emissions. This includes all activities under their direct control, including travel, purchasing of goods and services and the behaviour of staff. Carbon neutrality

Photo: LIFE04 ENV/NL/000661

Transportation accounts for three-quarters of the CO_2 emissions from tourism

can be achieved by improving the way an organisation operates (e.g. through modified procurement considerations), by improving the efficiency of operations (e.g. communications and meetings) and by changing equipment (e.g. vehicle fleets and buildings).

Reducing emissions from tourism transport

Transportation is the biggest contributor by far to GHG emissions from tourism, accounting for three-quarters of the sector's CO_2 emissions. Of all modes of transport, aviation has the greatest impact: in most cases, air travel to a destination creates 60-90% of the trip's overall contribution to climate change (Gössling et al. 2005). Any strategy aimed at reducing tourism's contribution to climate change thus needs to take transport into account.

To date, there has been only one LIFE project on air transport. The Eiatne project focused on measures that policy-makers in the Nordic region could introduce to minimise the effects of emissions from

The Davos Process

The Davos Process on Tourism and Climate Change, initiated by the UNWTO in 2007, engages with tourism stakeholders, providing a clear commitment for action to progressively reduce the industry's GHG contribution and help it grow in a more sustainable manner. Actions involve mitigating GHG emissions; adapting tourism businesses and destinations to changing climate conditions; using technology to improve energy-efficiency; and securing financial resources for poor areas. (Tourism and Climate Change, UNWTO)

aircraft. This was to be done by studying and modelling the response of the atmospheric system to a range of air traffic scenarios. The emphasis was placed on potential impacts of air traffic emissions on climate change, human health and vegetation damage.

One of the findings was that flights in clean areas (such as Scandinavia) are more efficient in generating ozone than flights in more polluted regions (such as mainland Europe and the North Atlantic corridor). Furthermore, it was found that the greatest emissions produced were of NOx, a GHG precursor. In order to mitigate the effects of GHG production, levels of NOx would have to be reduced. It has been suggested that one way of cutting such emissions would be by lowering flight altitude. However, Eiatne's calculations indicate that this is not the case for the Arctic region.

Tourism doesn't only generate emissions from the movement of people; it also contributes to climate change through the movement of goods and services linked to tourism, for instance food (see ECORUTOUR box).

Another approach to reducing emissions from transport is to steer visitor flows away from tourism hotspots in certain areas in certain peak periods, thereby reducing the environmental impact and carbon footprint. The Burren Tourism project is devising a management plan for the whole Burren area of Ireland – a Natura 2000 network site – that reconciles the needs of nature conservation and tourism. By putting areas of interest into seven groups, sub-divided into high-, medium- and low-density tourism, the project is persuading visitors to go to less popular destinations at peak times, thereby spreading the economic benefits of tourism to more communities whilst lowering the carbon footprint in sites with mass appeal.

Photo: LIFE10 ENV/IT/000367

The Sustainable Cruise project is demonstrating best practice for reducing and recycling solid waste on cruise ships, including biodegradeable waste, which reduces CO_2 emissions

LIFE08 ENV/IT/000404

ECORUTOUR

The project looked at improving the environmental footprint of local tourism businesses by monitoring GHG emissions linked to all aspects of tourism transport, including food miles. "A questionnaire was designed which monitored the transport of food suppliers, external companies who provide cleaning and laundry services, journeys to and from work by employees, and tourists travelling to their destination," explains project manager Maura Mingozzi. Tools were also developed to help tourism service providers, consumers and local authorities implement and develop environmental policies. These included practical information on how to reduce CO_2 emissions in management systems. The project also held activities to encourage tourists to make more sustainable holiday choices.

Staying power – saving energy in accommodation

After transport, accommodation is the main source of CO_2 emissions from tourism - 21% of the worldwide total. Energy use is the biggest contributor to the carbon footprint of holiday accommodation. Lodging places for tourists are many and varied, including: hotels, motels, bed and breakfasts, campsites, villas, apartments and holiday homes. There are many options available for reducing energy use in tourism accommodation, most of which also offer economic benefits.

Mitigation measures usually focus on energy-efficiency for air conditioning, heating, swimming pools, showers, laundry and lighting and on the use of renewable energy to generate electricity. However, it can also comprise other measures such as food provisioning. Furthermore there are other initiatives such as participating in environmental management programmes that help in mitigating emissions linked to lodging places. Such measures often need to be supported by targeted awareness-raising campaigns to ensure large numbers of tourists consciously engage in environmentally-friendly behaviour.

A number of LIFE projects have focused on reducing the carbon footprint of tourist accommodation, with energy-efficiency the main focus. One notable example is the CARBONTOUR project (see box p.79).

LIFE STARS (+20) has a similar aim: to reduce energy consumption in lodges along the Camino de Santiago pilgrimage route. This will be achieved by measuring initial energy consumption and then implementing an action plan consisting of 20 steps to reduce GHG emissions. Actions will include introducing environmental technologies (e.g. renewable energy, eco-innovations, solar gadgets, automated lighting, water and air conditioning) and also acquainting visitors with good environmental practices to save energy, waste and emissions. It will be possible to monitor the impact of each measure on levels of consumption and emissions and its corresponding environmental cost/benefit ratio. The aim is to reduce energy consumption and CO_2 emissions by 20% (some 5 000 tonnes of CO_2) by decreasing water consumption.

The ECO-CAMPS project aimed to improve the general environmental performance of five campsites in France. It managed to reduce CO_2 emissions by cutting energy consumption – the sites introduced measures that would reduce the need for energy (e.g. better insulation and more natural light) or avoid energy being wasted (e.g. lighting that is triggered by the absence of natural light). Renewable energy sources were also tapped where appropriate, such as solar-powered water heating. In addition, the project partners worked with two manufacturers to develop a new eco-design for a chalet, which used 45% less water, 28% less energy from appliances and 60% less heating. The beneficiary estimated the overall reduction in CO_2 emissions from the project at 40 tonnes/yr.

Cruise ships also have a high environmental impact, particularly in terms of waste production. The Sustainable Cruise project is trying to reduce and recycle solid waste on cruise ships and to re-use or totally dispose of residual matter. It has adopted best practice for three waste streams (packaging, biodegradable waste and paper) and carried out a computational study of CO_2 emission reductions from energy-efficiency measures in waste management. The overall aim is to evaluate the possibility of converting CO_2 emission reductions into tradable carbon credits.

Shared responsibility

Tourists and tour operators both have an important role to play in climate mitigation and are thus important target groups for strategies on this issue. Tour operators are responsible for bundling packages that bring transport, accommodation and other tourism activities together. They can influence emissions by offering energy-efficient transport, hotels and other suppliers that are engaged in pro-environmental activities. They are also able to promote low-emission tourism packages to their customers.

Tourists, on the other hand, can influence the products tour operators and other suppliers produce and thus improve current trends. The more tourists favour environmentally-friendly tourism products, the more pressure is put on companies to work towards a climate-friendly tourism. LIFE projects working with tourists typically aim to raise consumer awareness on CO_2 mitigation and on how their choices have a positive effect on the environment and thus on climate change.

LIFE09 ENV/GR/000297

CARBONTOUR

One of the main results of CARBONTOUR is a tool that quantifies and evaluates the energy consumption and equivalent CO_2 emissions from accommodation facilities in Greece and Cyprus. "The tool could, however, easily be adapted and applied in other countries," says the CARBONTOUR tool product manager, Giorgos Konstantzos. The emissions are estimated not only in terms of total values but also as numerical indicators, namely energy use or CO_2 emissions per person per night.

The project also implemented specific energy-saving measures in various types of accommodation. According to Mr Konstantzos, "these measures showed that even with minor changes (e.g. the use of more energy-efficient light bulbs and window sensors) energy consumption and relative CO_2 emissions could be reduced by up to 15%, whilst more drastic changes could lead to a 30% decrease." Since the project finished (end-2012) the tool has been implemented in 40 hotels and more are expected to follow.

LIFE funded a new eco-design for chalets that uses 28% less energy from appliances and 60% less heating

Photo: LIFE04 ENV/FR/000321

Training for tourism operators

Two LIFE projects have also collaborated with other stakeholders, providing them with training on mitigating CO_2 emissions. Burren Tourism is teaching local tourism SMEs how they can reduce their carbon footprint by consuming less water and implementing energy-efficiency strategies. In Italy, ECORUTOUR trained staff on carbon analysis and set up a support service for local enterprises to help tourist accommodation providers answer questions about emissions-reduction measures.

Tour Link, a LIFE project that ran from 2004 to 2007, worked closely with tour operators and tourists and made valuable contributions to the aims of the EU Sustainable Tourism Strategy. The project, developed new information tools for suppliers and consumers of tourism products, delivered through three different web sites. One of these (www.its4travel.com) focused on Travelife, a system for classifying the sustainability of package holidays so that consumers could make a more informed choice and make the tourism industry more climate-friendly. Travelife scores have been included in the travel brochures of large tour operators such as Virgin and TUI. A second website (www.greentravelmarket.info) provides tourism professionals with information on current sustainable tourism products through a supplier sustainability handbook. The handbook contains guidelines for energy efficiencies in lighting, heating and cooling and the use of renewable energy to reduce GHGs - either actions for suppliers to buy from renewable energy sources or direct investment in generating renewable energy on sites. The third site (www.travelife.eu) is a web-based tool to build the capacity of tour operators to improve their sustainability. The project partners have ensured a sustainable legacy for the LIFE work through the creation of a Travelife organisation, which continues to promote sustainable practices within the travel and tourism industry.

Photo: LIFE11 ENV/IE/000922

Tourists can be drivers of climate-friendly tourism

Conclusions: more business support needed

Until now the LIFE programme has funded projects that have developed resource-efficient technologies or brought energy savings as a co-benefit, rather than explicitly aiming to develop low-emission technologies. Furthermore, there are very few projects that have helped businesses to reduce their carbon footprint; the programme instead has invested more in other types of climate mitigation projects (energy, agriculture, transport) rather than in industry and enterprise, where LIFE has focused on other environmental impacts.

The new sub-programme for Climate Action offers a unique opportunity to use LIFE funds to support the implementation of the EU's climate policy and to help bring about a shift towards a low-emission economy. In so doing it will strategically underpin the implementation of the 2020 climate and energy package and prepare the EU for the climate action challenges until 2030. These funds should be used to provide easily transferable carbon-friendly solutions to businesses and SMEs all over the EU and to develop low-emission technologies that will also take into account, from the proposal stage, potential barriers to uptake at market level.

The Sustainable Cruise project is making CO_2 emission reductions through energy-efficiency measures in waste management

Photo: LIFE10 ENV/IT/000367

ENTERPRISE

ClimaBiz – **innovative, climate-wise banking for businesses**

The ClimaBiz project has produced a pioneering model for the financial sector that estimates climate change impacts and mitigation practices for client businesses of the Piraeus Bank Group.

In order to mitigate the effects of climate change, it will be necessary to persuade the financial sector to steer more capital into low-emission activities. Helping banks and other financial institutions to feel confident about their ability to assess the risk of such lending will be a priority for LIFE Climate Action, as highlighted by Artur Runge-Metzger from DG CLIMA (see p.12-13).

A survey by Weber (2012) showed that, to date, only a few banks at a global level use quantitative indicators for the integration of environmental risks into their credit risk management, especially regarding climate change. "The main goal of ClimaBiz was to trigger the adaptation of the market to the risks and financial impacts of climate change with a focus on particularly climate-sensitive industries in Greece and other EU Member States (Bulgaria, Romania, Cyprus)," explains Dimitris Dimopoulos, project manager of LIFE ClimaBiz and Environmental Manager at Piraeus Bank

The LIFE project also aimed to inspire financial institutions in these countries to become more supportive of climate action by developing a cutting-edge Climate Risk Reduction Model (CRM). The model included a database of measures that different sectors of the economy could use to reduce greenhouse gas (GHG) emissions.

The CRM can be applied to a wide range of settings, including hospitals, factories and offices, where it can be used to calculate investment, operations and maintenance costs for each of the proposed mitigation measures. For the purposes of ClimaBiz, the beneficiary concentrated on estimating the climate risk reduction potential of hotels, since it is one of the highest impact sectors and investments in climate change mitigation measures are smaller in comparison with manufacturing, for instance.

For hoteliers, potential mitigation measures identified included the use of energy-efficient light bulbs and ceiling fans, replacing inefficient air conditioning units, adding temperature balance controls for heating and solar water heating in summer and installing building energy management systems (BEMS).

The project surveyed a total of 677 of the Piraeus Bank's business customers around Greece in order to estimate their total climate risk (€38.5 million) and carbon footprint (568 000 tonnes/yr of CO_2). Hotels made up 115 of these 677 enterprises and accounted for €15 million of that total climate risk. Using data from the survey, the ClimaBiz team was able to calculate that if each of these hotels applied most of the mitigation measures suggested in the CRM, they could reduce their carbon footprint by a combined total of 25 770 tonnes/yr of CO_2. The cost of such investments was estimated at some €16.5 million on average, with an average payback period of 4.8 years (savings of €3.4 million/yr). In addition to the economic benefits, the model suggests that the hotels would also reduce

Factoring environmental risk into credit risk management

Photo: LIFE08 ENV/GR/000552

Photo: LIFE08 ENV/GR/000552

Vrasidas Zavras (left), General Manager of Piraeus Bank, with Hans Bruyninckx, EEA Executive Director (middle) and Timo Mäkelä from DG Environment (right)

their climate risk by 22% per year and lessen their carbon footprint by 70% per year.

Advice network

During the project, Piraeus Bank employees took part in a series of workshops and e-learning sessions to enable them to use the CRM to advise customers. A total of 170 green banking advisers and 68 small business officers learned about climate risk mitigation measures in order to suggest appropriate investments. In the campaign "Climate drives business", launched in autumn 2012, trained staff then worked with more than 1 000 clients, estimating their climate risk and the costs of the solutions for its reduction. "Piraeus Bank's pivotal strategy is to support and finance companies, institutions, organisations and projects which offer added value and which benefit people and the environment by supporting deposit accounts holders and investors wishing to promote individual and corporate social responsibility in a sustainable society," says Vrasidas Zavras, the General Manager of Piraeus Bank Green Banking.

Photo: EC/Patrick Mascart

More green banking products

The beneficiary also developed a web-based tool for the Green Banking portal that it rolled out during the course of the project. This 'climabiz calculator', which can be accessed through http://www.greenbanking.gr, is a simplified version of the Climate Risk Management Model and allows the bank's business customers to get an indication of the climate risk and available climate mitigation measures for their sector in general.

The project results will be further developed and used in the coming years. In 2012, the bank began incorporating the CRM into its standard procedures so that it becomes an iintegral part of its credit policies. The model is also currently being updated so that it provides a more in-depth data assessment for the agriculture and tourism sectors.

"The incorporation of climate-related risk into clients, risk profiles would result in a much wider green business conscience among the business community in Europe and can help banks obtain a much 'healthier' client portfolio," Mr Dimopoulos explains. A wider application of tools such as the CRM could also help regional authorities calculate the total mitigation cost for the local business community in order to create appropriate climate change policies.

Furthermore, it could also be useful for the European Commission in the development of policy and operational objectives for structural funds targeted at low-emission economies.

Mr Dimopoulos believes that "businesses play a vital role in the mitigation of climate change. They can become a key player by reducing their greenhouse gas emissions. Since more stringent regulations, such as carbon taxes, are likely in our future, businesses would be wise to ramp up energy reduction and efficiency efforts, and to reduce their carbon emissions."

Project number: LIFE08 ENV/GR/000552

Title: ClimaBiz – Financial Institutions: Preparing the Market for adapting to Climate Change

Beneficiary: Pireaus Bank SA

Contact: Dimitris Dimopoulos
Email: environment@piraeusbank.gr
Website: http://www.climabiz.gr/
Period: 11-Jan-2010 to 31-Dec-2012
Total budget: €1 850 000
LIFE contribution: €924 000

Project list

The table below provides the complete list of LIFE projects related to climate change mitigation mentioned in this publication. For more information on individual projects, visit the online database at: http://ec.europa.eu/environment/life/project/projects/index.cfm

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
ACTION AT LOCAL AND NATIONAL LEVEL			
LIFE06 PREP/A/000006	EC4MACS	European Consortium for Modelling of Air Pollution and Climate Strategies	18, 19
LIFE02 ENV/UK/000147	Carra	Carbon Assessment and Reduction in Regeneration Areas	19, 20
LIFE07 ENV/IT/000451	LAKS	Local Accountability for Kyoto Goals	19, 21
LIFE08 ENV/IT/000430	FACTOR20	Forwarding ACTions On a Regional and local scale to reach UE targets of the European Climate Action Plan "20-20 by 2020"	19-21
LIFE09 ENV/IT/000200	LAIKA	Local Authorities Improving Kyoto Actions	19-21
LIFE07 ENV/FIN/000145	Julia 2030	Mitigation of and Adaptation to the Climate Change in the Helsinki Metropolitan Area - From Strategy to Implementation	19-22, 24
LIFE09 ENV/FR/000598	CLIMATE	Changing LIving Modes: Acting in our Territory for the Environment	20
LIFE99 ENV/F/000459	ADEME	European day 'In town, without my car ?'	20, 23
LIFE07 INF/FIN/000152	CCCRP	Climate Change Community Response Portal	21
LIFE09 INF/PL/000283	DOKLIP	A Good Climate For Counties	21
LIFE02 ENV/GR/000362	MedClima	Climate Alliance for Mediterranean Cities	22
LIFE04 ENV/IT/000453	ROMAPERKYOTO	Realization of Rome's Action Plan to achieve the Kyoto's Protocol objective of Green House Gas Reduction	22
LIFE07 ENV/FIN/000138	CHAMP	Climate Change Response through Managing Urban Europe-27 Platform	22
LIFE12 ENV/ES/000222	LIFE GREEN TIC	Reducing CO_2 footprint of Information and Communication Technologies	22
LIFE02 ENV/F/000289	PRIVILEGES	Cities program for greenhouse gas reduction (Chalon sur Saône)	23
LIFE08 ENV/E/000101	Las Rozas por el clima	Local Action Plan for Fighting Climate Change in Las Rozas de Madrid: Application and Evaluation of Municipal Management Methods	23
LIFE09 ENV/DK/000366	Climate Partnerships	Carbon 20 - public private partnerships for climate solutions	23
LIFE11 ENV/FR/000739	SUSTAIN-ICT	ICT for greener urban development	23
LIFE09 ENV/SE/000350	CLICC	Climate Living in Cities Concept	23, 24
LIFE10 ENV/ES/000494	People CO2Cero	Movilización y empoderamiento de ciudadanos y de agentes clave en la custodia y promoción del medio ambiente Urbano de la ciudad de Soria	24
LIFE12 INF/AT/000369	EKO-LIFE	Experimenting and communicating sustainable lifestyles to promote Energy Autonomy	24
LIFE12 INF/IT/000465	EcoLife	Ecological Lifestyles for CO_2 Reduction	24
LIFE07 ENV/GR/000282	CLIM-LOCAL2020	Developing Local Plans for Climate Mitigation by 2020	19, 25-27
RENEWABLE ENERGY AND ENERGY-EFFICIENCY			
LIFE09 ENV/ES/000450	BIOENERGY & FIRE PREV.	Contribution of forest biomass generated in the prevention of forest fires in the EU energy strategy	29
LIFE00 ENV/IT/000054	Biosit	GIS-based planning tool for greenhouse gases emission reduction through biomass exploitation	30
LIFE07 ENV/F/000178	GREEN PELLETS	Best sustainable life-cycle fittings for mixed herbaceous solid biofuels for heating to reduce GHG emissions	30
LIFE13 ENV/ES/000923	LIFE BIOBALE	Development of a cogeneration demonstration plant from biomass forest bales	30
LIFE03 ENV/S/000598	RecAsh	Regular Recycling of Wood Ash to Prevent Waste Production	30, 33
LIFE05 ENV/UK/000128	BioReGen	Biomass, remediation, re-generation: Re-using brownfields sites for renewable energy crops	31

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
LIFE07 ENV/FIN/000133	SNOWCARBO	Monitoring and assessment of carbon balance related phenomena in Finland and northern Eurasia	31
LIFE10 ENV/ES/000458	ECOGLAUCA ÉRGON	Proyecto de demostración sobre el uso de Nicotiana glauca como cultivo energético en la lucha contra el cambio climático y la erosión de suelos	31
LIFE12 ENV/ES/000913	LIFE Eucalyptus Energy	Eucalyptus Integrated Wood Processing Project	31
LIFE02 NAT/UK/008527	Bittern	Developing a strategic network of SPA reedbeds for Botaurus stellaris	32
LIFE05 NAT/PL/000101	Aquatic warbler	Conserving Acrocephalus paludicola in Poland and Germany	32
LIFE10 ENV/ES/000496	CO_2ALGAEFIX	CO_2 capture and bio-fixation through microalgal culture	32
LIFE12 BIO/LV/001130	LIFE GRASSSERVICE	Alternative use of biomass for maintenance of grassland biodiversity and ecosystem services	32
LIFE11 ENV/SE/000839	BUCEFALOS	BlUe ConcEpt For A Low nutrient/carbOn System –regional aqua resource management	32, 33
LIFE02 ENV/IT/000034	WARM-WOOD	Demonstrating the industrial viability of a medium size biomass cogeneration plant to distribute heat and electricity in a mountain rural area	33
LIFE06 ENV/IRL/000532	CleanWood	Recovery of Clean Wood from Dirty Wood	33
LIFE07 ENV/E/000829	BIOGRID	Biogas Injection into natural gas grid and use as vehicle fuel by upgrading it with a novel CO_2 capture and storage technology	33
LIFE08 ENV/SK/000240	CHEFUB	Creative high efficient and effective use of biomass	33
LIFE09 ENV/SE/000348	BIOGASSYS	Biogas Skåne – an energy system creating sustainable development by combating climate change.	33
LIFE06 ENV/E/000044	ES-WAMAR	Environmentally-friendly management of swine waste based on innovative technology: a demonstration project set in Aragón (Spain)	34
LIFE06 ENV/IT/000266	Seq-Cure	Integrated systems to enhance sequestration of carbon, producing energy crops by using organic residues	34
LIFE08 ENV/P/000237	WW4ENVIRONMENT	Integrated approach to energy and climate changes changing	34
LIFE12 ENV/ES/000332	LIFE NECOVERY	Nutrient and Energy Recovery in Wastewater Treatment Plants by Up-concentration and Adsorption processes	34
LIFE12 ENV/SE/000359	SludgeisBiofuel	Dryer for energy recovery from sewage sludge and manure	34
LIFE12 ENV/SE/000683	BIOGAS XPOSE	Maximized biogaspotential from resource innovation in the Biogas Öst region	34
LIFE13 ENV/ES/000377	LIFE ECOdigestion	Automatic control system to add organic waste in anaerobic digesters of WWTP to maximize the biogas as renewable energy	34
LIFE06 ENV/E/000054	BioSOFC	Design and demonstration of 3 CHP plants using two 5 kW solid oxide fuel cells (SOFC) working with landfill gas and biogas from anaerobic digestion	34, 35
LIFE05 ENV/D/000193	Sludge Redox	Transfer of the organic constituents of sewage sludge into a soluble form for an efficient production of biogas	35
LIFE05 ENV/DK/000141	BIOCOVER	Reduction of Greenhouse Gas Emissions from Landfills by use of Engineered Bio-covers	35
LIFE05 ENV/IT/000874	GHERL	Greenhouse effect reduction from landfill gas	35
LIFE08 ENV/B/000040	CLIM-WASTENER	Energy recovery system from landfill waste as a contribution to the fight against climate change	35
LIFE09 ENV/IT/000186	Sludge's Wealth	Ennobling of sludge for energy use and industrial	35
LIFE11 ENV/UK/000402	ACUMEN	Assessing, Capturing & Utilising Methane from Expired and Non-operational landfill	35
LIFE12 ENV/PL/000013	LIFE COGENERATION	Demo installation for electricity/heat COGENERATION with gasification of fuel based on municipal waste and sewage sludge	35
LIFE13 ENV/ES/001353	LIFE MEMORY	Membrane for ENERGY and WATER RECOVERY	35
LIFE07 ENV/E/000847	BIOCELL	Energy self-sustaining and environmental footprint reduction on wastewater treatment plants via fuel cells	35, 38

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
LIFE05 ENV/P/000369	OIL PRODIESEL	Integrated Waste Management System for the Reuse of Used Frying Oils to Produce Biodiesel for Municipality Fleet of Oeiras	36, 37
LIFE08 ENV/GR/000569	BIOFUELS-2G	Demonstration of a Sustainable & Effective 2nd Generation Biofuels Application in an Urban Environment	36, 37
LIFE11 ENV/ES/000557	EDUCO	Collection system of used cooking oils in educative centers and biodiesel production tests with cavitation technology.	36, 37
LIFE02 ENV/E/000253	ECOBUS	Collecting used cooking oils to their recycling as biofuel for diesel engines	37
LIFE02 ENV/NL/000128	BioFuel	BioFuel: biological drying and upgrading of biodegradable residual municipal wast into BioFuel for coal burned power stations	37
LIFE07 ENV/E/000820	INTEGRAL-B	Demonstration of a multi-feedstock sustainable biodiesel production scheme integrating an on-site by-products energy valorisation system	37
LIFE09 ENV/ES/000433	CITROFUEL	Demonstration project on a new process for second-generation bio fuel production: bio ethanol from citrus flesh	37
LIFE11 ENV/GR/000949	Waste2Bio	Development and demonstration of an innovative method for converting waste into bioethanol	37
LIFE13 ENV/ES/001113	LIFE BIOSEVILLE	New biofuel production technology to recover used frying oils and power the Seville's urban bus fleet.	37
LIFE13 ENV/ES/001115	LIFE+ VALPORC	Valorization of pig carcasses through their transformation into biofuels and organic fertilizers	37
LIFE02 ENV/D/000408	SuperC	Geothermal energy supply for heating and cooling of the Students' Service Center of RWTH Institute of Technology University of Aachen	38
LIFE06 ENV/D/000485	Moveable HEPP	Demonstration Plant in the Kinzig River: Moveable Hydroelectric Power Plant for Ecological River Improvements and Fish Migration Reestablishment	38
LIFE08 ENV/E/000118	GREENLYSIS	Hydrogen and oxygen production via electrolysis powered by renewable energies to reduce environmental footprint of a WWTP	38
LIFE09 ENV/NL/000426	BLUETEC	Demonstration of the technological, economic and environmental sustainability of a full-scale tidal energy device in an offshore environment	38
LIFE11 ENV/PL/000447	GeoPyrz	Demonstration of the innovative technology of the improvement of absorption of the geothermal deposit layer	38
LIFE11 ENV/SE/000838	SUNCOOL	Solar thermal collectors with a ZERO electricity heat pump & energy storage for sustainable heating and cooling	38
LIFE12 ENV/FR/000479	LIFE-PHOSTER	PHOtovoltaic STEel Roof: ready to plug BIPV roofing steel envelope based on green innovative technologies and processes	38
LIFE13 ENV/NL/000971	LIFE Solar Highways	Solar panels as integrated constructive elements in highway noise barriers	38
LIFE07 ENV/UK/000936	GRACC	Green roofs against climate change. To establish a UK green roof code to support climate change mitigation and adaptation	39
LIFE08 ENV/A/000216	RENEW BUILDING	Demonstration and Dissemination of Climate and Environmental Friendly Renovation and Building with Renewable Resources and Ecological Materials	39
LIFE11 ENV/DE/000340	DRIP	Demand Response in Industrial Production	39
LIFE11 ENV/ES/000622	The Autonomous Office	Model for a green energy autonomous office building	39
LIFE12 ENV/CY/000276	LIFE+ SmartPV	Smart net metering for promotion and cost-efficient grid-integration of PV technology	39
LIFE12 ENV/ES/000079	LIFE REUSING POSIDONIA	14 sustainable dwellings using local resources as Posidonia plants, at the Social Housing Development in Formentera	39
LIFE09 ENV/ES/000493	DOMOTIC	Demonstration Of Models for Optimisation of Technologies for Intelligent Construction	40
LIFE09 ENV/FI/000573	INSULATE	Improving energy-efficiency of housing stock : impacts on indoor environmental quality and public health in Europe	40
LIFE07 ENV/D/000222	PROGRASS	Securing the Conservation of Natura Grassland Habitats with a Distributed Bioenergy Production	32, 41-43

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
TRANSPORT			
LIFE12 ENV/FR/000480	LIFE AUTO	LIFE AUTO: Demonstration and validation of an innovative automatic fuel additives system for the diesel fuel	45
LIFE02 ENV/UK/000136	CATCH	Clean Accessible Transport for Community Health	46
LIFE06 TCY/ROS/000269	KALAIR	Kaliningrad Air Pollution induced by traffic: modeling system design, installation and validation	46
LIFE08 ENV/F/000485	ROMAIR	Implementation of an air quality modelling and forecast system in Romania	46
LIFE09 ENV/BE/000409	ATMOSYS	Policy support system for atmospheric pollution hot spots	46
LIFE09 ENV/IT/000092	OPERA	An integrated assessment methodology to plan local cost-effective air quality policies harmonized with national and European	46
LIFE02 ENV/IT/000106	RAVE	The Green Ray of Novara	47
LIFE11 ENV/IT/000015	PERHT	Parking green services for better environment in historic towns	47
LIFE05 ENV/E/000262	GESMOPOLI	Integral mobility management in industrial estates and areas (GESMOPOLI)	48
LIFE05 ENV/IT/000839	C-DISPATCH	Clean-Distribution of goods in Specimen Areas at the last mile of the intermodal Transport Chain	48
LIFE05 ENV/IT/000870	CEDM	Centre for Eco-Friendly City Freight Distribution	48
LIFE08 ENV/S/000269	CLEANTRUCK	CLEAN and energy efficient TRUCKs for urban goods distribution	48
LIFE09 ENV/IT/000063	I.MO.S.M.I.D.	Integrated MOdel for Sustainable Management of Mobility in Industrial Districts	48
LIFE12 ENV/FR/001125	LIFE+ Urbannecy	Improvement of urban environment via an innovative and economically-viable logistic platform using green vehicles	48
LIFE02 ENV/GR/000359	IMMACULATE	IMprovement of Urban Environment Quality of Air and Noise Levels by an Integrated, Cost Effective and MUlti-Level Application of Clean Vehicle Technologies	49
LIFE09 ENV/AT/000226	CEMOBIL	CO_2-neutral E-Mobility for the reduction of air pollutants (PM_{10}, $PM_{2.5}$ und NO^2) and noise in the European cities, for example Klagenfurt	49
LIFE09 ENV/ES/000507	CONNECT	Creation Of New Network for Electric Cars Technology	49
LIFE03 ENV/S/000592	Cleanowa	Cost-effective system for clean and noiseless waste collection	50
LIFE07 ENV/IT/000434	MHyBus	Methane and Hydrogen blend for public city transport bus: technical demonstrative application and strategic policy measures	50
LIFE08 ENV/IT/000425	ETRUSCAN	Under the Etruscan sun - Environmental friendly Transport to RedUce Severe Climate change ANthropic factors	50
LIFE09 ENV/IT/000216	H2POWER	H2POWER_Hydrogen in fuel gas	50
LIFE10 ENV/MT/000088	DemoEV	Demonstration of the feasibility of electric vehicles towards climate change mitigation	50
LIFE10 ENV/SE/000035	SLIDE IN	Life without oil : Slide in - energy efficient and fossil-free public transportation for a sustainable society	50
LIFE11 ENV/NL/000793	E-mobility 3 cities NL	Boosting Electromobility Amsterdam - Rotterdam - Utrecht	50
LIFE02 ENV/IT/000064	PVTRAIN	The application of innovative photovoltaic technology to the railway trains	51
LIFE03 ENV/NL/000474	LNG Tanker	LNG Tanker, Demonstrating the effective and safe use of liquid natural gas as fuel for ship engines for short-sea shipping and inland waterway transport	51
LIFE05 ENV/P/000369	OIL PRODIESEL	Integrated Waste Management System for the Reuse of Used Frying Oils to Produce Biodiesel for Municipality Fleet of Oeiras	51
LIFE06 ENV/D/000477	PARFUM	Particulates, Freight and heavy duty vehicles in Urban Environments	51
LIFE06 ENV/D/000479	WINTECC	Demonstration of an innovative wind propulsion technology for cargo vessels	51
LIFE06 ENV/D/000465	ZEM/SHIPS	Zero.Emission.Ships	51
LIFE02 ENV/E/000253	ECOBUS	Collecting used cooking oils to their recycling as biofuel for diesel engines	52
LIFE11 ENV/ES/000585	BIOLCA	Demonstration of a tool for the evaluation and improvement of the sustainability in the transport sector	52

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
LIFE99 ENV/F/000459	ADEME	European day 'In town, without my car ?'	52
LIFE13 ENV/ES/001113	LIFE BIOSEVILLE	New biofuel production technology to recover used frying oils and power the Seville's urban bus fleet.	52
LIFE10 ENV/SE/000041	HYPER BUS	Hyper Bus - Hybrid and plug-in extended range bus system	50, 53-55
		AGRICULTURE & FORESTRY	
LIFE04 ENV/FR/000319	AGRI-PERON	Development and implementation of codes of good agricultural practices to reduce point source and diffuse pollutions in the Peron catchments area	58
LIFE10 ENV/IT/000321	ZeoLIFE	Water Pollution Reduction and Water Saving Using a Natural Zeolite Cycle	58
LIFE10 ENV/IT/000347	UNIZEO	Urea-based nitrogenous fertilizers coated with zeolite : reducing drastically pullution due to nitrogen	58
LIFE11 ENV/IT/000302	IPNOA	Improved flux Prototypes for N2O emission reduction from Agriculture	58
LIFE04 ENV/IT/000454	OptiMa-N	Optimisation of nitrogen management for groundwater quality improvement and conservation	58, 60
LIFE99 ENV/S/000625	Ammonia	Towards a sustainable milk production - reducing on-farm ammonia losses	59
LIFE00 ENV/P/000829	PIGS	PIGS- Pig-Farm Integrated Management Project	59
LIFE04 ENV/FR/000337	ZNP	Zero Nuisance Piggeries	59
LIFE05 ENV/E/000302	Ecodiptera	Implementation of a management model for the ecologically sustainable treatment of pig manure in the Region of Los Serranos, Valencia-Spain	59
LIFE09 ENV/ES/000453	MANEV	Evaluation of manure management and treatment technology for environmental protection and sustainable livestock farming in Europe	59
LIFE09 ENV/IT/000214	GAS-OFF	Integrated Strategies for GHG Mitigation in dairy farms	59
LIFE10 ENV/ES/000442	UNIDIGES	Demonstrative plant for manure management of a medium size exploitation by anaerobic digestion and agronomic valorisation of the digestate	59
LIFE10 ENV/ES/000478	NITRATES	Repercussion of Agricultural Activities in Nitrate Contamination of Continental Water	59
LIFE12 ENV/CY/000544	LIFE LIVE-WASTE	Sustainable management of livestock waste for the removal/recovery of nutrients	59
LIFE12 ENV/ES/000647	LIFE+Farms for the future	Farms for the future: Innovation for sustainable manure management from farm to soil	59
LIFE12 ENV/FR/000799	LIFE Carbon Dairy	Plan carbone de la production laitière française	59
LIFE12 ENV/IT/000671	LIFE-OPTIMAL2012	OPTImised nutrients MAnagement from Livestock production in Alto Adige	59
LIFE04 ENV/HU/000372	ECOFILTER	Modern and environmental friendly composting methods of agricultural waste	60
LIFE06 ENV/E/000044	ES-WAMAR	Environmentally-friendly management of swine waste based on innovative technology: a demonstration project set in Aragón (Spain)	60
LIFE12 ENV/ES/000689	LIFE MIX_FERTILIZER	Valorization of the digestate from pig manure as new fertilizers with an organic / mineral base and gradual release	60
LIFE03 ENV/E/000085	SINERGIA	SYNERGY, Quality and respect for environment	60, 62
LIFE10 ENV/ES/000471	Crops for better soil	Profitable organic farming techniques based on traditional crops: contrasting soil degradation in the Mediterranean	60, 62
LIFE08 ENV/E/000129	LIFE+AGRICARBON	Sustainable agriculture in Carbon arithmetics	60, 62, 63
LIFE12 ENV/SE/000800	SOLMACC	Strategies for Organic- and Low-input-farming to Mitigate and Adapt to Climate Change	60, 62-64
LIFE03 ENV/UK/000617	Sowap	Soil and Surface water protection using conservation tillage in northern and central europe	61
LIFE10 ENV/BE/000699	DEMETER	Duurzaam En geïntegreerd bodembeheer om MilieuEffecten TE Reduceren (Sustainable and integrated soil management to reduce environmental effects)	61
LIFE12 ENV/IT/000578	LIFE HelpSoil	Helping enhanced soil functions and adaptation to climate change by sustainable conservation agriculture techniques	61-63
LIFE00 ENV/IT/000019	Petrignano	Integrated management systems of the Petrignano area : new models against the nitrates pollution	62

PROJECT REFERENCE	ACRONYM	TITLE	PAGE
LIFE11 ENV/GR/000942	oLIVE-CLIMA	Introduction of new olive crop management practices focused on climate change mitigation and adaptation	63
LIFE06 ENV/S/000517	BIOAGRO	Innovative method for reduction of emissions of green house gases and waste from the agriculture sector	64
LIFE09 ENV/GR/000296	Adapt2Change	Adapt agricultural production to climate change and limited water supply	64
LIFE11 ENV/PL/000444	OZERISE	Agricultural farms and smart grids integrated renewable energy sources	64
LIFE12 ENV/IT/000404	LIFE+_Climate changE-R	Reduction of greenhouse gases from agricultural systems of Emilia-Romagna	64
LIFE09 ENV/ES/000459	ECOREGA	Green (environmentally friendly) management of cattle farm waste and its repercussion on the GHG emissions	67
LIFE09 ENV/ES/000441	AgriClimateChange	Combating climate change through farming: application of a common evaluation system in the 4 largest agricultural economies of the EU	58, 60, 62-65
LIFE07 INF/E/000852	CHANGING THE CHANGE	LIFE+campaign 'Changing the change'. The Galician agriculture and forest sector facing climate change.	61, 66-67
RESTORING WETLANDS			
LIFE99 NAT/NL/006280	Fochteloërveen	Restoration programma of the Fochteloërveen raised bog	70
LIFE00 NAT/NL/007049	Korenburgerveen	Peat bog restoration programme of the Korenburgerveen	70
LIFE12 ENV/FI/000150	LIFEPeatLandUse	Quantification and valuation of ecosystem services to optimize sustainable re-use for low-productive drained peatlands	70
LIFE13 NAT/LV/000578	LIFE_Wetlands	Conservation and Management of Priority Wetland Habitats in Latvia	70
LIFE97 NAT/FIN/004095	Lapland/Ostrobothnia	Protection of aapa-mires in Lapland and Ostrobothnia	71
LIFE04 NAT/FI/000078	GreenBelt	Natural Forests and mires in the "Green Belt" of Koillismaa and Kainuu	71
LIFE08 NAT/FIN/000596	Boreal Peatland Life	Restoring the Natura 2000 network of Boreal Peatland Ecosystems "Boreal Peatland Life"	71
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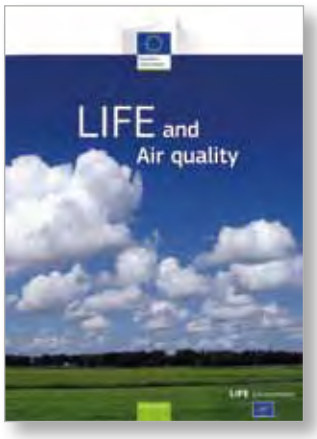

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LIFE "L'Instrument Financier pour l'Environnement" / The financial instrument for the environment

The LIFE programme is the EU's funding instrument for the environment and climate action

Period covered 2014-2020

EU funding available approximately €3.46 billion

Allocation of funds Of the €3.46 billion allocated to LIFE, €2.59 billion are for the Environment sub-programme, and €0.86 billion are for the Climate Action sub-programme. At least €2.8 billion (81% of the total budget) are earmarked for LIFE projects financed through action grants or innovative financial instruments. About €0.7 billion will go to integrated projects. At least 55% of the budgetary resources allocated to projects supported through action grants under the sub-programme for Environment will be used for projects supporting the conservation of nature and biodiversity. A maximum of €0.62 billion will be used directly by DG Environment and DG Climate Action for policy development and operating grants.

Types of projects Action Grants for the Environment and Climate Action sub-programmes are available for the following:

- "Traditional" projects – these may be best-practice, demonstration, pilot or information, awareness and dissemination projects in any of the following priority areas: LIFE Nature & Biodiversity; LIFE Environment & Resource Efficiency; LIFE Environmental Governance & Information; LIFE Climate Change Mitigation; LIFE Climate Change Adaptation; LIFE Climate Governance and Information.
- Preparatory projects – these address specific needs for the development and implementation of Union environmental or climate policy and legislation.
- Integrated projects – these implement on a large territorial scale environmental or climate plans or strategies required by specific Union environmental or climate legislation.
- Technical assistance projects – these provide financial support to help applicants prepare integrated projects.
- Capacity building projects – these provide financial support to activities required to build the capacity of Member States, including LIFE national or regional contact points, with a view to enabling Member States to participate more effectively in the LIFE programme.

Further information More information on LIFE is available at http://ec.europa.eu/life.

How to apply for LIFE funding The European Commission organises annual calls for proposals. Full details are available at http://ec.europa.eu/environment/life/funding/life.htm

Contact

European Commission – Directorate-General for the Environment – B-1049 Brussels (env-life@ec.europa.eu).
European Commission – Directorate-General for Climate Action – B-1049 Brussels (clima-life@ec.europa.eu).
European Commission – EASME – B-1049 Brussels (easme-life@ec.europa.eu).

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LIFE Publication / LIFE and Climate change mitigation

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