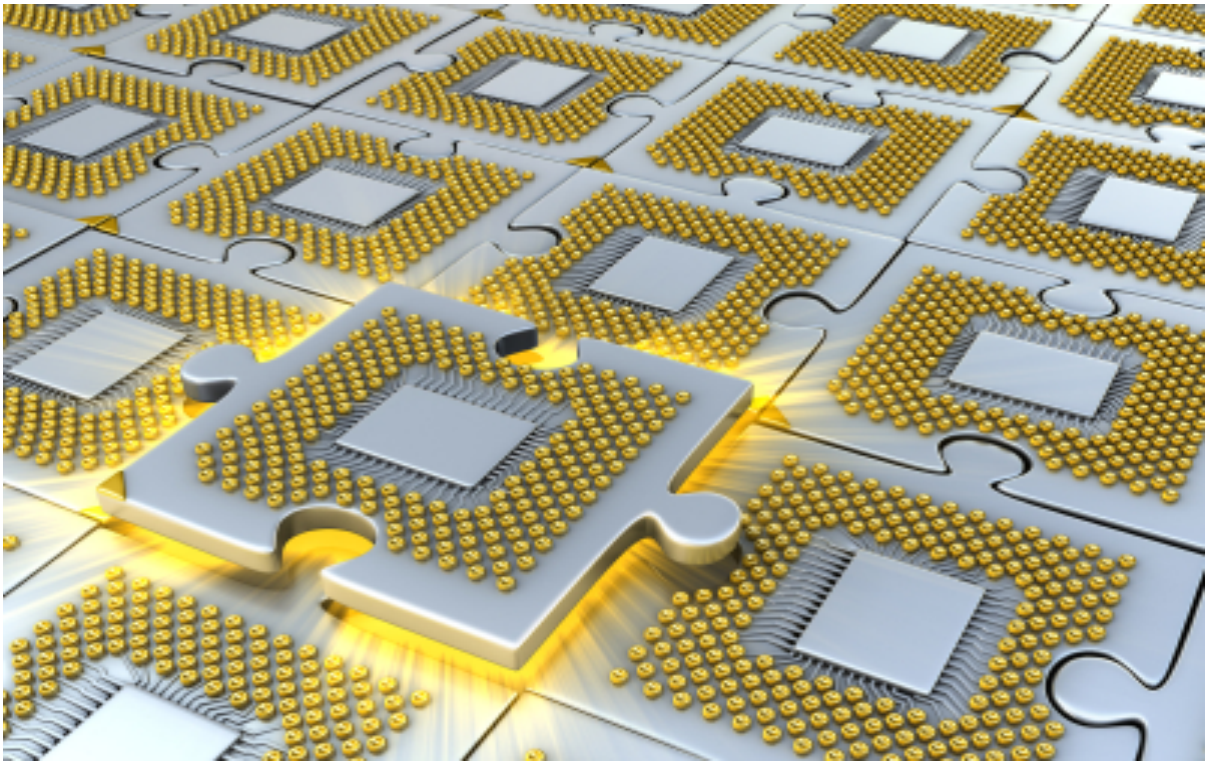
The Contribution of ICT to Energy Efficiency: Local and Regional Initiatives

Implementing energy efficiency initiatives harnessing ICT: A toolkit for local and regional authorities

March 2011



ICLEI Local Governments for Sustainability

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REGIONAL ENVIRONMENTAL CENTER

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Contents

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Contact:	Chris Fry	Tel:	+44 (0)20 7307 7155	email:	cfry@sqw.co.uk

Approved by:	Kathrin Peters Associate Director	Date:	March 2011

1: Introduction to the toolkit for local and regional authorities

Why is this toolkit important?

1.1 Energy efficiency is a key element of Europe's Climate and Energy package to meet the target of a 20% reduction in energy demand by 2020. It is seen as one of the most cost-effective ways to reduce carbon emissions and improve security of energy supply.

1.2 Information and Communication Technologies (ICT) have a crucial role to play in delivering energy efficiency and this was recognised by the European Commission in its Recommendation of 9 October 2009 'on mobilising Information and Communication Technologies to facilitate the transition to an energy-efficient, low carbon economy'. ICT solutions are already delivering the unique transformation to a knowledge society and they can also help to achieve the dual energy and climate objectives which require a transformation to a low-carbon society. There is a clear synergy emerging where economic priorities can also support social and environmental ones.

1.3 Much of the transformation to a low-carbon society needs to happen at the local and community level – where the energy is actually consumed. Local and regional authorities can influence the process and indeed should take a lead by rolling out measures and initiatives that build the momentum. To do this more effectively, they require the knowledge and tools of how ICT-based energy efficiency solutions work and where they have been successfully implemented. Due to the already pervasive nature and presence of ICT, in many cases energy efficiency is not the main objective pursued; however understanding the additional benefit which could potentially be realised of using ICT will help to increase the uptake at the local and regional levels.

1.4 It is recognised that different parts of the EU have an uneven uptake of ICT solutions, particularly with regard to their low-carbon benefits. This can be attributed to national, regional and local economic, social and cultural circumstances, including the presence (or absence) of advanced ICT technology providers and supply chains. Thus, it is beneficial for authorities to learn from each other, in order to move faster and avoid unnecessary costs and mistakes.

What does the toolkit provide?

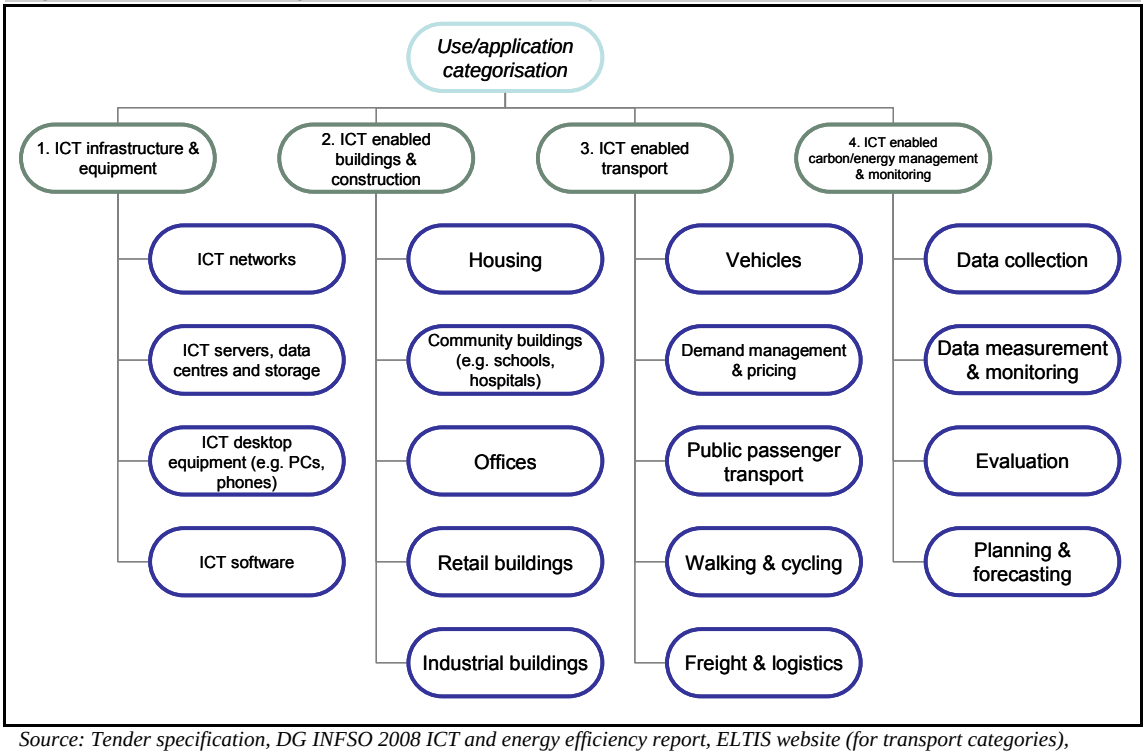
1.5 The toolkit, which is available electronically via a wiki-style website hosted within the collaborative platform at www.ict4e2b.eu and in a report publication, comprises:

- **Practical guidance** in the form of 12 narratives or 'walk throughs' to enable local and regional authorities to explore how to progress energy efficiency initiatives.
- **Specific examples (case studies)** of where local and regional authorities from across the European Union have implemented energy efficiency initiatives involving ICT.

23 case studies are presented, each one providing an in-depth description of how the initiative was developed, its successes and the lessons learnt so that other authorities can benefit from the experiences.

1.6 The toolkit focuses on energy efficiency and sustainability initiatives for topics that are likely to be relevant to most local and regional authorities in terms of their common areas of responsibility and assets. In particular the focus is upon: ICT infrastructure and equipment, ICT-enabled energy efficiency in buildings and construction, ICT-enabled energy efficiency in transport and ICT-enabled carbon/energy management and reporting. Within these broad categories the specific topics/applications covered by the toolkit are illustrated in Figure 1-1. The initiatives all utilise ICT in some way – with the ICT element varying widely depending on the situation.

Figure 1-1: The main categories and topics covered by the toolkit



Source: Tender specification, DG INFSO 2008 ICT and energy efficiency report, ELTIS website (for transport categories), project team

The practical guidance

1.7 Twelve sections of practical guidance (narratives) are presented within the toolkit, broadly grouped into two types:

- Based on *cross cutting themes.* These are likely to have relevance to authorities taking forward a wide range of energy efficiency/ICT initiatives of different kinds and at different scales.

- Based on *specific initiatives and measures*. These are most relevant to authorities considering implementing the specific type of initiative/project. They provide detailed information on the implementation/operational issues that are specific to that type of project.

1.8 Tables 1-1 and 1-2 list all of the guidance provided.

Table 1-1: Guidance on **cross cutting themes**

Section of this document	Outline description
2. Funding sources	Most energy efficiency measures involving ICT eventually 'pay for themselves' in financial terms but many will take years to achieve this pay back. This creates a barrier for authorities which have small budgets for capital expenditure and/or require a faster return on investment. One potential solution is to involve Energy Service Companies (ESCOs) that can make up front investments and then share the benefits of the energy/financial savings. Many of the most innovative initiatives can benefit from the funding and collaboration opportunities associated with international funding sources. Some authorities are experienced in identifying and accessing these sources but others are not and may not be able to proceed. Authorities are likely to benefit from practical information and experiences from other authorities regarding the relevant EU funding sources as well as other international sources such as funding opportunities under the Kyoto protocol (e.g. for certain energy efficiency projects in Central and Eastern Europe). The narrative explores the potential barriers/funding gaps and possible solutions such as ESCOs. It also identifies EU and international funding sources available to local and regional authorities for energy efficiency measures involving ICT.
3. Metrics/indicators	Insights from the case studies being prepared for this project suggest that relatively few authorities have developed a clear framework for setting objectives/indicators and monitoring the effectiveness of ICT enabled energy efficiency projects. There is ongoing activity by the ICT industry and others to develop metrics to measure the carbon impact of ICT infrastructure and equipment. The need for harmonisation is an important current driver for action in this area. The narrative describes the importance of metrics and indicators. It provides examples of possible frameworks and approaches for use in measuring the carbon/energy impact of ICT enabled energy efficiency projects as well as the latest developments in establishing common metrics for ICT infrastructure and equipment.
4. User engagement	Many energy efficiency measures involving ICT also involve engaging with and changing the attitudes and behaviours of 'users' of the building, transport system and so on. There are numerous potential challenges/pitfalls as well as approaches/techniques to engage effectively with users and change their behaviour. These can usefully be shared across authorities. Energy efficiency in residential properties, as elsewhere, can be improved through simple changes in behaviour (e.g. turning off appliances/lights, fitting low energy light bulbs). The success of other ICT-based measures can also be influenced by behaviour changes, either wholly (e.g. smart meters) or partially (e.g. boiler control and thermostat systems). Furthermore, small improvements in domestic building energy efficiency can have large impacts on a regional or EU/member state scale due to the sheer volume of residential building stock that authorities own or can influence. Many ICT-based initiatives require training of key operatives to ensure effective use of the infrastructure/hardware/software. However the importance of appropriate training can be underestimated and may not be followed through effectively beyond the initial implementation period. The narrative sets out examples of the importance of user engagement and approaches that can be used effectively to communicate and change attitudes/behaviour. It also provides examples of the relationship between ICT- based measures and behavioural change in relation to domestic housing. Finally the narrative summarises evidence of initiatives where training has had a major impact on the success of initiatives and provide examples of training curricula and delivery modes.

Section of this document	Outline description
5. Leadership, governance and public-private partnerships	The effectiveness of leadership is a key success factor in most energy efficiency initiatives. 'Leadership' often needs to be established at various levels over the life-time of an initiative - from high level (e.g. political leadership) through to setting up local 'eco-champions' to implementing aspects of the project in different parts of an authority /project elements. There are many different governance arrangements possible for energy efficiency initiatives. These include: simple management structures within an authority and conventional 'buyer-supplier' relationships; multi-partner steering groups and delivery partners; and formal public-private partnerships. The narrative explores how leadership and appropriate delegation of responsibilities can support implementation and ongoing operation of initiatives by local and regional authorities. It also describes how authorities can adopt different forms of governance arrangements including public-private partnerships for energy efficiency initiatives.
6. Appropriate use of technology	Complex technological solutions can be appropriate and tend to receive the greatest publicity - but in other situations complex ICT can also be prohibitively costly or complex to implement and maintain. There are numerous relatively simple ICT solutions that authorities could adopt to make effective energy and cost savings (e.g. spreadsheet tools for capturing energy audit data) before looking at more ambitious technological solutions. The narrative examines general issues associated with the selection of appropriate technologies, with particular emphasis on describing how simple technological solutions can achieve significant results for authorities.
7. Planning energy efficiency to 2020 and beyond	All authorities face the challenge of prioritising which energy efficiency initiatives to implement first. Some more advanced authorities are also moving on from implementing one or two standalone initiatives towards creating a long term implementation plan in support of an energy or climate change strategy to 2020 (or even 2030). Sharing ideas on how to develop a strategy and move through into plans/option selection and then implementation is likely to be helpful to many authorities. Examples of the 'menu' of options that involve ICT might also be a useful reference for authorities. The narrative explores the hierarchy and processes for energy efficiency strategies and implementation plans and describes the tools available for authorities to prioritise options/measures.
8. Managing project risks	Experiences of project failures and perceptions of risks can hold back action to implement energy efficiency measures involving ICT. Awareness of the main types of risk and knowledge of risk management techniques are likely to be valuable to authorities considering these projects. The narrative explores the value of risk management techniques and identifies practical approaches to dealing with common risks associated with ICT energy efficiency initiatives.
9. Procurement	The majority of ICT energy efficiency initiatives involve an external supplier of goods/equipment and/or services. There are various ways to procure the suppliers depending on the type and scale of the initiative (e.g. one off requests for quotations/tenders, framework contracts, performance based contracts). The narrative describes different procurement models/arrangements that are relevant to energy efficiency initiatives.

Table 1-2: Guidance on **specific initiatives and measures**

Section of this document	Outline description
10. The role of municipal energy agencies	Some local and regional authorities across Europe have set up an arm's length energy agency to provide a focal point to help to deliver energy efficiency and renewable energy programmes. The narrative pulls together success stories, experiences and details of different models for these agencies which could be helpful to other authorities considering whether to set up an energy agency.
11. Urban road user charging	Transport demand management is an important strategy to reduce congestion, CO_2 and air pollution for most European cities and many larger towns. Solutions based on or involving some ICT element are common for demand management measures from widespread measures (e.g. traffic light control) to urban road user charging schemes that require considerable investment. The narrative summarises the context of needs and potential solutions for transport demand management and focuses in particular on urban road user charging using ICT as this is a particularly relevant measure for European cities.
12. Green municipal data centres	A sensible place to start for any authority is to improve the energy efficiency of its own ICT systems and equipment. There are many measures that have successfully been adopted by authorities that are achieving a quick return on investment (e.g. purchasing lower energy consumption PCs, automatic powering down, server virtualisation and green data centres) as well as various emerging opportunities (e.g. cloud computing). The narrative summarises the reasons for addressing the energy efficiency of an authority's ICT estate and then describes the approaches available to improve the energy efficiency of data centres as a common initiative to make cost effective improvements.
13. Audit and simulation in buildings	Some of the case studies selected within this project relate to energy efficiency for buildings (including public buildings such as local authority offices, schools, hospitals). These measures can be most effective when implemented as part of a systematic process involving audits and ongoing management, supported by ICT-based monitoring and simulation tools. As noted above, authorities adopting such measures can achieve added benefits by demonstrating the potential for energy efficiency to other organisations and businesses locally. The narrative explores the opportunities to improve the energy efficiency of different types of buildings and the roles of audit, simulation and management systems based on ICT.

The case studies

1.9 The toolkit contains 23 practical examples (case studies) of energy efficiency initiatives involving ICT from cities, municipalities and regional authorities across Europe. These are listed in Table 1-3.

Table 1-3: Case studies provided in the toolkit

Case study	Case study location
Energy Savings through ICT-enabled Building Automation System and Energy Monitoring System – Aalst General Hospital	Aalst, Belgium
Awareness raising through smart metering	Amaroussion, Greece
Amsterdam Smart City	Amsterdam, The Netherlands
Political climate ambition triggers green ICT	Berlin, Germany
Pilot project to demonstrate the indirect effects of reconstructing prefabricated residential buildings to increase energy efficiency	Budapest, Hungary
Virtualising data centres	Copenhagen, Denmark

Case study	Case study location
The ECOFFICES building energy challenge	Cote d'Azur, France
Infomobility tools for fleet management	Craiova, Romania
Energy optimization of public buildings in Austria and Czech Republic	Czech Republic and Austria
Energy and environmental management in the public buildings	Częstochowa, Poland
Optimisation of waste collection routes	Daventry, UK
Mobility credits	Genoa, Italy
Centralised sleep mode for computers in Helsinki City Council's network	Helsinki, Finland
Julia 2030 project	Helsinki, Finland
Energy savings from intelligent metering and behavioural change	Leicester, UK
Sustainable schools	Malaga, Spain
ICT supported centralised Energy Management System for municipal buildings	Maribor, Slovenia
The Euro Green IT Innovation Center	Mons, Belgium
A shared energy advice service for Rennes and its surrounding districts	Rennes, France
Congestion charging	Stockholm, Sweden
Improving energy efficiency in public buildings	Tipperary, Ireland
Demand side management	Valmiera, Latvia
Demand side management for energy efficiency in buildings - SAMS	Vaxjo, Sweden

Source: SQW Project Team

2: Funding sources

Introduction

2.1 Energy efficiency has become an overriding objective policy making across the world and is being pursued by local and regional authorities, national governments and international agencies. Due to the importance attached to it, there are a wide range of funding instruments to facilitate the introduction of energy saving initiatives in general and ICT-based activities in particular.

2.2 This narrative contains information on the strategic context of global, European and national energy saving ambitions and policies and provides information of specific funding instruments, drawing on the case study experience.

The problem and objectives of this guidance

2.3 In the majority of cases, introducing energy efficiency measures at the local and regional level involves additional capital and revenue funding, a hurdle that needs to be overcome by local authorities which tend to be constrained by their budget resources. In some instances, the upfront investment generates cost savings over its life cycle and contributes to making the investment commercially viable. However, mobilising such upfront funding is not always directly within the control of the local or regional authority and to address this initial funding gap, innovative funding mechanisms have been designed to help.

2.4 This narrative provides information on available sources and mechanisms of funding for energy efficiency measures.

2.5 Key questions to be addressed in this section include:

- what funding sources can local and regional authorities consider when exploring the introduction of ICT-based energy saving technologies
- is there a role for market based instruments (MBI)
- what is the role of Energy Services Companies (ESCOs).

Objectives

2.6 The objectives of this section are for local and regional authorities to have an overview of different funding opportunities to introduce and maintain ICT-based energy saving measures.

Guidance for authorities

What funding sources can local and regional authorities consider when exploring the introduction of ICT-based energy saving technologies

The strategic context

2.7 Combating climate change is a top priority for the EU which is working hard to cut its GHG emissions substantially. The key strategic ambitions impacting on energy efficiency and sustainability are:

- *Europe 2020* which puts forward three mutually reinforcing priorities: Smart Growth (developing an economy based on knowledge and innovation); sustainable growth (promoting a more resource efficient, greener and more competitive economy; inclusive growth: fostering a high employment economy delivering social and territorial cohesion[i]

- the *European Climate Change Programme (ECCP)*; the first ECCP (2000 – 2004) was launched in June 2000 with the aim to identify, develop and implement all the necessary elements of an EU strategy to implement the Kyoto Protocol. The Second ECCP was launched in October 2005 and is designed to explore further cost effective options for reducing GHG emissions in synergy with the EU's Lisbon Strategy. [ii] The programme consists of a series of policies and measures across four domains including cross-cutting measures (including the EU's Emissions Trading Scheme – ETS), energy supply, energy demand, transport industry (including waste management), agriculture and forestry, research and development and structural and cohesion funds

- the 2006 Energy Green Paper *'A European Strategy for Sustainable, Competitive and Secure Energy'* sets the background of a new energy era which includes an urgent need for investment to replace ageing infrastructure; a need to address import dependency by making domestic energy more competitive and a concentration of reserves in few countries (Russia, Norway, Algeria); rising demand for energy – and resulting C02 emissions; rising oil and gas prices; global warming; and the absence of a fully competitive internal energy market in Europe[iii]

- *Energy 2020 - A strategy for sustainable and secure energy* was launched on 10 November 2010. The new energy strategy focuses on five priorities:

  - achieving an energy efficient Europe
  - building a truly pan-European integrated energy market
  - empowering consumers and achieving the highest level of safety and security
  - extending Europe's leadership in energy technology and innovation
  - strengthening the external dimension of the EU energy market.

2.8 Tying together funding packages is always one of the key challenges of any policy initiative. Moreover, the larger the project, the bigger the challenge. This can be particularly true for innovative energy efficiency initiatives which involve a certain degree of risk and uncertainty of outcome.

2.9 Effectively, there is no one source of funding which alone will ensure the implementation of ambitious projects. In reality, it will be essential to mix and match complementary European and national, public and private sources for a viable funding package.

European funding sources

2.10 Figure 2-1 provides a summary of European funding sources referenced in this narrative.

Figure 2-1: Summary of funding options for energy efficiency initiatives from European sources

- Consider **Cohesion Policy Funds** if you are eligible for them
  - They represent over 40% of the EU budget
  - Total fund of EUR 308 billion for the period 2007 – 2013
  - Energy has been included as a priority
  - Renewable energies: EUR 4.8 billion
  - Energy efficiency, co-generation and management: EUR 4.4 billion
  - Traditional energy & Trans-European energy networks: EUR 1.8 billion
  - Total allocation for ICT applications and services for the period 2007 – 2013 is approximately EUR 13 billion
- The **Competitiveness and Innovation Programme (CIP)** supports innovation activities (including eco-innovation)
  - Programme runs from 2007 – 2013 (EUR 3.621 million)
  - Focus on small and medium sized enterprises but municipalities can also apply – on their own or in partnership with businesses
  - Entrepreneurship and Innovation Programme (EIP) (EUR 2.166 million)
  - Information Communication Technologies Policy Support Programme (EUR 728 million)
  - Intelligent Energy Europe (IEE) (EUR 727 million) http://ec.europa.eu/energy/intelligent/call_for_proposals/doc/call_2011_en.pdf
  - Consult www.enterprise-europe-network.ec.europa.eu for further information
- Supporting measures can be funded with the help of **LIFE+** which supports technological projects with environmental benefits
  - Projects can be co-financed up to a level of 50%
- For research and development projects, consider **FP 7**
  - **CIVITAS** supports ambitious urban transport schemes
  - **CONCERTO** supports projects integrating renewable energy sources with energy efficiency techniques at the community level
- The **European Investment Bank (EIB)** provides loans for energy efficiency and renewable energy initiatives

Source: SQW – various sources

2.11 For local and regional authorities that can access them, **Cohesion Policy Funds (Structural and Cohesion Funds)** will be one of the most important sources for energy efficiency measures. These funds are designed to promote development and reduce inequalities between different regions of the EU. They represent over 40% of the EU budget, totalling EUR 308 billion for the period 2007 – 2013. Structural and Cohesion Funds have included energy as a priority for the period 2007-2013, in particular renewables and energy efficiency actions. In

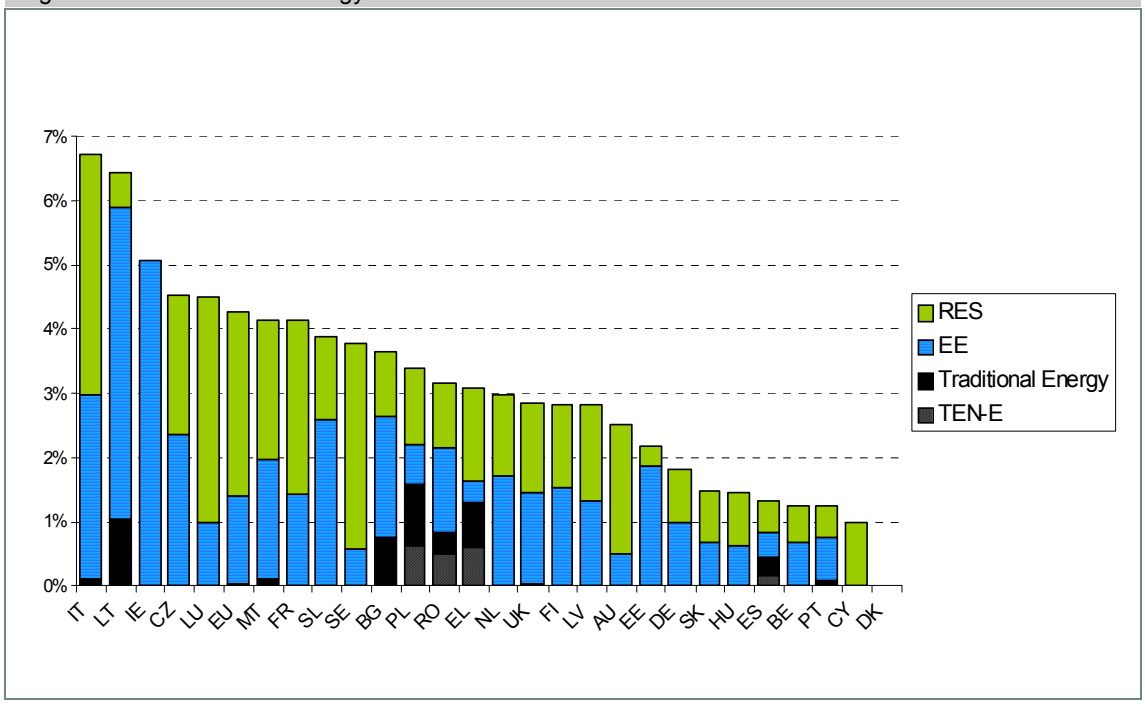
the EU as a whole, the planned support for energy activities for this period is approximately EUR 11 billion, or 3% of the total funding. It includes the following areas:

- renewable energies – EUR 4.8 billion
- energy efficiency, co-generation, energy management – EUR 4.4 billion
- traditional energy / Trans-European energy networks (TEN-E) – EUR 1.8 billion.

2.12 Relative shares allocated to energy differ between member states and are influenced by the total volume of funds available and national needs and priorities as set by each member.

2.13 Figure 2-2 summarises the allocations to the energy sector in proportion to total allocations in all EU member countries.

Figure 2-2: Allocations to energy sector as % of total allocations



Source: DG Regio

2.14 Since 2009, an amendment to the European Regional Development Fund (ERDF) Regulation has expanded its scope for supporting energy efficiency improvements and renewable energy investments in buildings in all member states. A second regulatory amendment extended the use of financial engineering instruments to energy efficiency and renewable energy in buildings, including existing housing. Buildings account for 41% of energy consumption, making this a key area for investment to achieve Europe 2020 targets. Whereas regional policy has traditionally financed energy efficiency investments only in public and commercial buildings, it is now possible to use these funds in the residential sector in all member states. Up to 4% of the national ERDF allocations may now be used for energy investments in housing that supports social cohesion. If member states would decide to re-programme accordingly, a potential EUR 8 billion could be reallocated during the current programmes.

2.15 The total allocation for ICT applications and services for the period 2007-2013 is approximately EUR 13 billion. Again, relative shares allocated to this area differ between

member states, to be seen in the light of total volume of funds available, national needs and priorities set by each member state.

2.16 The support in these fields includes grants, loans, loan guarantees and technical assistance. Based on the principle of shared management, the detailed management of programmes which receive support from the Cohesion Policy Funds is the responsibility of the member states. A list of Managing Authorities and the programmes for which they are responsible is available at: http://ec.europa.eu/regional_policy/manage/authority/authority_en.cfm.

2.17 According to the latest information from the member states, there is significant room for improvement in the implementation of projects in both the energy and the ICT fields. Therefore, regional and local authorities should be encouraged to promote the use of ICT in energy efficient measures such as smart grids, smart metering, smart lighting and smart trafficking in order to contribute to reducing carbon emissions in line with the Europe 2020 goals.

2.18 Further showing the commitment of regional policy for sustainable growth, including sustainable energy, the Commission adopted on 26 January 2011 the Communication "Regional policy contributing to sustainable growth in Europe 2020", which sets out the role for regional policy in contributing to the implementation of the Europe 2020 Strategy, and in particular to the flagship initiative 'Resource Efficient Europe'. Given the current fiscal situation in the Union, and the substantial funds still available under the current Cohesion Policy 2007-13 programming period, this Communication calls on regional policy stakeholders to act without delay, invest more in sustainable growth, and use funds more effectively. It recommends that regions and cities should accelerate investments in renewable energies and energy efficiency, seizing the new opportunities available for energy investments in buildings, and provides good practices. The Communication is available at: http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/comm_en.htm.

2.19 It should be noted that Cohesion Policy allocations potentially available for investments in ICT for energy efficiency could possibly also be reported by the Member States under other categories than the energy efficiency and the ICT categories mentioned above (e.g. categories relating to public buildings or housing infrastructure or sustainable transport categories). It is thus possible that the amounts mentioned above for energy efficiency and ECT do not give a complete picture of the funds potentially available for investments in ICT for energy efficiency.

2.20 Project examples from across the EU which may give useful information on project experiences in the field of energy efficiency are available on the Commission website http://ec.europa.eu/regional_policy/projects/stories/search.cfm?LAN=EN&pay=ALL&region=ALL&the=68&type=ALL&per=2 and

http://ec.europa.eu/regional_policy/projects/practices/search.cfm?LAN=EN&pay=ALL&region=ALL&the=68.

2.21 Other sources of funding – which cover all municipalities - are the **Competitiveness and Innovation (CIP) Programme, the LIFE Programme** and - for research projects - the **FP7 Programme**. These programmes build on achievements from a suite of older programmes including the SAVE Programme (Specific Actions for Vigorous Energy Efficiency).[iv]

2.22 The *Competitiveness and Innovation Programme (CIP)* supports innovation activities (including eco-innovation), provides better access to finance and delivers business support services in the regions. It encourages a better take-up and use of ICT technologies and helps to develop the information society. It also promotes the increased use of renewable energies and energy efficiency. The programme is primarily targeted at small and medium sized enterprises and therefore could offer interesting opportunities for private/public partnerships in the field of ICT-based energy saving initiatives.

2.23 The CIP runs from 2007 to 2013 and has an overall budget of EUR 3,621 million. It is divided into three operational programmes, each with its specific objectives, aimed at contributing to the competitiveness of enterprises and their innovative capacity. The programme consists of three parts (also called pillars):

- the Entrepreneurship and Innovation Programme (EIP) (approximately EUR 2,166 million)
- the Information Communication Technologies Policy Support programme (ICT-PSP) (approximately EUR 728 million)
- Intelligent Energy - Europe (IEE) (approximately EUR 727 million).

2.24 Each of the three pillars has an annual work programme and support measures. Overall, CIP provides the following support measures:

- better access to finance, through the financial instruments
- services to companies facilitated through the centres that comprise the Enterprise Europe Network
- grants to pilot and market replication projects in the area of ICT or eco-innovation
- grants for policy makers to networking and exchange best practices on innovation policy
- support to the elaboration of studies to analyse trends in different industrial sectors at European or global level, or SME or innovation policies in EU member states.

2.25 Further information on CIP (as well as other EU funding opportunities) is being offered by the Enterprise Europe Network which has offices in all Member States and some third countries (www.enterprise-europe-network.ec.europa.eu).

2.26 *IEE* builds on the experience gained from its predecessor, the first Intelligent Energy – Europe (2003 – 2006) Programme. This Programme has become the main EU instrument to tackle non-technological barriers to the spread of efficient use of energy and greater use of new and renewable energy sources. The Programme was originally defined in line with the Lisbon Strategy with the overall objective to contribute to secure, sustainable and competitively priced energy for Europe, by providing four actions:

- to foster energy efficiency and the rational use of energy resources
- to promote new and renewable energy sources and support energy diversification

- to promote energy efficiency and the use of new and renewable energy sources in transport
- to contribute to achieving EU targets for sustainable energy.

2.27 In 2010, Intelligent Energy – Europe covered actions in the five fields summarised in Table 2-1.

Table 2-1: Intelligent Energy - Europe: Priority Actions in 2010

Action	Support for
Energy efficiency and rational use of resources (SAVE)	• improving energy efficiency and the rational use of resources, in particular in the building and industry sectors • supporting the preparation and application of legislative measures
New and renewable energy sources (ALTENER)	• promoting new and renewable energy sources for centralised and decentralised production of electricity, heat and cooling, and bio fuels, thus supporting the diversification of energy sources • integrating new and renewable energy sources into the local environment and the energy systems • supporting the preparation and application of legislative measures
Energy in transport (STEER) to promote energy efficiency and the use of new and renewable energy sources in transport	• supporting initiatives relating to all energy aspects of transport and the diversification of fuels • promoting renewable fuels and energy efficiency in transport • supporting the preparation and application of legislative measures
Integrated Initiatives combining several fields or relating to certain EU priorities	• these may include actions integrating energy efficiency and renewable energy sources in several sectors of the economy • and/or combining various instruments, tools and actors within the same action or project

Source: Intelligent Energy – Europe: Call for proposals 2010

2.28 The Programme is managed by the Executive Agency for Competitiveness and Innovation (EACI, formerly known as the Intelligent Energy Executive Agency) (http://ec.europa.eu/eaci/). The agency employs and international team of specialists on energy, the environment, business support, multi-modal transport, communication and finance. This includes both European Commission officials as well as private sector professionals. They all share a commitment to the European way of linking competitiveness and innovation with environmental protection and a cleaner energy future.

2.29 Actions supported in the IEE framework are supposed to have a significant impact at European level, of high profile and the broadest possible relevance to European citizens and policies. In this context, preference is given to proposals of outstanding quality that present cost-effective arrangements.

2.30 Applicants must be legal entities, both private and public, established in the territory of the EU Member States, Norway. Iceland, Liechtenstein and Croatia. The IEE Programme is also

open to the Joint Research Centre of the European Commission (JRC) and international organisations, subject to certain conditions.

2.31 Examples of projects funded under this programme are all relevant to the main focus of ICT-based energy efficiency measures and include:

- training on new construction techniques that can lead to energy savings
- improvements in the effectiveness of support schemes for electricity generation from renewable energy sources
- helping Europe's cities to develop more energy-efficient and cleaner transport.

2.32 Calls for 2011 proposals were published on 18 January 2011. http://ec.europa.eu/energy/intelligent/call_for_proposals/index_en.htm.

2.33 *LIFE* is the EU's instrument supporting environmental and nature conservation projects throughout the EU, as well as in some candidate, acceding and neighbouring countries. The period 2007 to 2013 is covered by LIFE+[v]. Since 1992, LIFE has co-financed some 3,115 projects, contributing approximately Euro 2 billion to the protection of the environment.

2.34 The main LIFE+ components are summarised in Table 2-2.

Table 2-2: Life+ Components (2007 – 2013)

LIFE+ Component	Support priority
Nature and biodiversity	Supports projects that contribute to the implementation of the EU's Birds and Habitats Directives, and that contribute to the EU's goal of halting the loss of biodiversity. The maximum co-financing rate can be 75% but is normally 50%
Environment Policy and Governance	Supports technological projects that offer significant environmental benefits, for example process or efficiency improvements. This part of LIFE+ also helps projects that improve the implementation of EU environmental legislation, that build the environmental policy knowledge base, and that develop environmental information sources through monitoring (including forest monitoring). Projects can be co-financed up to a level of 50%
Information and Communication	Co-finances up to 50% projects that spread information about environmental issues. Such as climate change and conservation. This strand of LIFE+ can also support forest fire prevention awareness and training campaigns

Source: ec.europa.eu/environment/life/funding/lifeplus.htm

2.35 For Julia 2030, LIFE funding is seen as having been extremely important in developing a coherent project with challenging strategic objectives. However, even though the project managed to mobilise the required 50% match funding from partners, there was a view that it might become more difficult over time to collect the required 50% match funding because of tightening public sector budgets. Moreover, the required funding application was considered to be was considered laborious and bureaucratic. One of the big benefits for partners associated with the initiative was that the funding application was delivered centrally by the lead partner.

2.36 *FP7* is the short name for the Seventh Framework Programme for Research and Technological Development. This is the EU's main instrument for funding research in Europe and it is running from 2007 – 2013. The EC budget for the next seven years is EUR 50.5

billion and the Euratom budget for the next five years is EUR 2.7 billion. FP7 consists of four main blocks of activities:

- cooperation – collaborative research in a range of areas including ICT, energy, environment (including climate change) and transport (including aeronautics) (total budget: Euro 32 billion)
- the 'Ideas' programme implemented through the European Research Council (ERC) which is designed to boost Europe's competitiveness by helping to attract and retain the most talented scientists, supporting high risk-taking and high-impact research, and promoting scientific research in new, fast emerging fields (total budget: Euro 7.4 billion)
- the 'People' programme offers individuals the opportunity to follow a career in research. During FP7, a series of EU research funded actions will support the ongoing training, research and mobility of highly qualified scientists within Europe and the rest of the world (total budget: EUR 4.7 billion)
- the 'Capacities' programme aims to optimise the use and development of research infrastructures, while enhancing the innovative capacities of SMEs to benefit from research (total budget: EUR 1.8 billion)

2.37 There are regular calls and briefings for FP7 projects and partnerships and potential applicants should consult the relevant European websites and alert services.

2.38 Within the FP Framework Programmes, the *CIVITAS Initiative* helps cities to achieve a more sustainable, clean and energy efficient urban transport system by implementing and evaluating an ambitious and integrated set of technologies and policy-based measures. [vi]

2.39 CIVITAS - cleaner and better transport in cities - stands for CIty-VITAlity-Sustainability. With the CIVITAS Initiative, the EC aims to generate a decisive breakthrough by supporting and evaluating the implementation of ambitious integrated sustainable urban transport strategies that should make a real difference for the welfare of European citizens:

- CIVITAS I started in early 2002 and ran until 2006 (within the 5th Framework Research Programme) and involved 19 cities in four demonstration projects
- CIVITAS II started in early 2005 and ran until 2009 (within the 6th Framework Research Programme) and involved 17 cities in four demonstration projects
- CIVITAS PLUS (2008 – 2012) started in late 2008 and is running until 2012 (within the 7th Framework Research Programme) and is involving 25 cities in five demonstration projects.

2.40 CIVITAS objectives are to:

- promote and implement sustainable, clean and (energy) efficient urban transport measures
- implement integrated packages of technology and policy measures in the field of energy and transport in eight categories of measures
- build up critical mass and markets for innovation.

2.41 Horizontal support to the CIVITAS projects is provided through cross-site evaluations, European dissemination of results, an annual meeting of CIVITAS Forum members, providing the Secretariat for the Political Advisory Committee (PAC) and providing policy recommendations for long term effects of CIVITAS.

2.42 CIVITAS has played an important role in encouraging innovative energy saving actions. Infomobility tools for fleet management in Craiova in Romania is part of CIVITAS Modern which comprises the city of Craiova in Romania is working together with Brescia, Coimbra and Vitoria-Gasteiz on a packet of integrated measures in the field of sustainable transport.

2.43 CIVITAS CARAVEL involves the cities of Genoa, Burgos, Krakow and Stuttgart and their public transport operators, industrial partners and research institutions with a focus on pioneering innovative urban mobility projects such as the Mobility Credits Scheme in Genoa.

2.44 The *CONCERTO Initiative*[vii] is proactively addressing the challenges of creating a more sustainable future for Europe's energy needs. CONCERTO supports local communities in developing and demonstrating concrete strategies and actions that are both sustainable and highly energy efficient. At the latest count, there were 58 communities in 22 projects, each working ton delivery the highest possible level of self-sufficiency in energy needs. CONCERTO is part of the framework research programme supervised by DG Energy and Transport.

2.45 The focus of CONCERTO projects is primarily on demonstrating the environmental, economic and social benefits of integrating renewable energy sources together with energy efficiency techniques through a sustainable energy system operated at community level. The total funding is EUR 135 million with a maximum of EUR 6 million per project and an average project value of EUR 3 million.

2.46 The *European Investment Bank (EIB)* (www.eib.org), in partnership with the European Commission, is increasing its lending for efficiency and renewable energy projects which doubled in 2009 to EUR 1.5 billion and is expected further to increase in the future. The EIB provides a range of financing instruments from senior loans to equity for renewable energy and energy efficiency investments inside and outside the EU. The Bank has increased the volume of so-called intermediated lending, including framework loans, provided in these sectors. The EIB works through financial intermediaries in the banking sector or through specialised energy agencies or ESCOs. The EIB also provides indirect financing to renewable energy and energy efficiency projects through investment funds. The EIB also makes use of risk-sharing instruments, combining loans with grants and providing technical support. This usually involves partnering with the European Commission of national authorities. Moreover,

the Bank manages technical assistance programmes to support project preparation and operation inside and outside the EU. Managed by the EIB and funded by the Commission, *ELENA* (European Local Energy Assistance) provides technical assistance to EU Member States' local authorities for projects focusing on energy efficiency and renewable energy in buildings, urban transport and related local infrastructure.

2.47 *ELENA* is designed to facilitate the mobilisation of funds for investments in sustainable energy at the local level. The programme is financed through IEE and covers a share of the cost for technical support that is necessary to prepare, implement and finance the investment programme, such as feasibility and market studies, structuring of programmes, business plans, energy audits and preparation for tendering procedures. In short, it is designed to cover all aspects necessary to makes cities' and regions' sustainable energy programmes ready for EIB funding. *Elena* assistance may facilitate access to EIB finance from another bank. Contact with the EIB can be in any form with the preferred approach through email to elena@eib.org. For the first contact, a brief description is needed of the planned investment, the expected investment cost and the time schedule for the project plus the amount, scope and main needs to be addressed by the requested technical assistance.

Energy Services Companies (ESCOs)

2.48 Energy Services Companies (ESCOs) are commercial businesses providing a comprehensive range of energy solutions including design and implementation of energy savings projects, energy conservation, energy infrastructure outsourcing, power generation and energy supply and risk management. They can be interesting partners to local and regional authorities interested in achieving energy efficiency objectives – and indeed some authorities have set up ESCOs themselves in order to accelerate energy efficiency targets.

2.49 Generally, ESCOs operate in the following way[viii]:

- they guarantee the energy savings and/or the provision of the same level of energy service at a lower cost
- their remuneration is directly tied to the energy savings achieved
- they can finance, or assist in arranging finance, energy systems by providing a savings guarantee.

2.50 ESCOs often operate on the basis of Energy Performance Contracting (EPC) which normally involves one building as an incorporated energy consuming unit. This is a long term contractual agreement where the customer benefits from new or upgraded energy equipment and the ESCO's remuneration is directly tied to the savings achieved by reduced energy consumption. The cost of the investment is paid back by the savings and in case the ESCO fails to achieve the savings, it must itself cover the difference between the actual and the guaranteed cost. EPC is a programme of practical engineered energy efficiency measures that are implemented in buildings to deliver real energy savings by keeping total energy consumption to a minimum by way of demand side energy efficiency methods.

2.51 The key benefits of EPC include risk transfer, the ability to modernise a building's infrastructure without necessarily having the funds and accessing external expertise. In a

nutshell, EPC is completely self-financing, it includes a guarantee that transfers the financial and equipment performance risk to the ESCO. EPC tends to bring immediate improvements in that existing buildings are upgraded with modern, energy-efficient and reliable equipment.

2.52 Having been popular in the United States for about 20 years, EPCs and the involvement of ESCOs are becoming increasingly widespread in Europe.

2.53 In Budapest, municipality-owned ESCOs took over 1/3 of the financing of building renovations to be paid back from the energy savings over a period of 10 – 15 years; the use of ICT technologies which clearly demonstrate the impact of energy savings was essential in achieving the energy saving objective.

2.54 In the United Kingdom, the Greater London Authority's transport body Transport for London (as part of the Clinton Climate Initiative) used EPC for improving the energy efficiency of its buildings. An initial project of £4 million involved lighting and control replacements, upgraded building energy management controls, control of PCs during night time and in stand-by, building fabric improvements, Combined Heat and Power (CHP) Plant and solar thermal hot water system. The benefits are a 25% electrical and 20% gas reduction. Guaranteed energy savings of just under £800k and C02 reductions of 3,648 tonnes per year.

2.55 Also in the United Kingdom, a number of local authorities[ix] have established joint venture companies/ESCOs to provide energy services, often based around CHP schemes. A typical arrangement could see the local authority owning up to 20 per cent of the company, with the private sector owning the rest.

2.56 In Nyköping in Sweden, the energy usage of the community's facilities (schools, retirement homes, offices, a heating swimming pool and industrial sites) was too high and the staff had no control over lowering it. There was interest in increasing the comfort level of facilities as well as reducing their energy consumption. An ESO offered the community an EPC covering 123 of its buildings totalling an area of 257,000 square metres. Improvements included the installation of a Building Management System in all buildings, new heat pumps and solar panels, sensor-controlled lighting, heating and cooling.

2.57 eu-ESCO (www.eu-esco.org) is the European Association of Energy Services Companies. It was founded by eu.bac – the European Building Automation and Controls Association. The objective for the association is to accelerate the adoption of Energy Performance Contracting (EPC) in the public sector, helping EU member states to achieve their energy efficiency targets. The association puts particular emphasis on the modernisation of existing public buildings and contributes to the practical implementation of the European Directives on energy performance in buildings, in particular the Energy Performance in Buildings Directive (EPBD) and the End-user Energy Efficiency & Energy Services Directive (EEES).

National funding opportunities

2.58 EU member countries have their own support and funding mechanisms to encourage the introduction of energy efficient technologies. Funding for the Daventry Waste Optimisation initiative was received from the East Midlands Centre of Excellence (now the East Midlands Improvement and Efficiency Partnership), a regional association of all local authorities in the

East Midlands and the five Fire and Rescue authorities. The funding was awarded because Daventry District Council and the Northamptonshire Waste Partnership were able to demonstrate that efficiencies would be achieved through the formation of partnerships and collaborative working. The project application also made reference to an anticipated Return on Investment (ROI) which quantified the likely efficiency savings at £2.3 million, an amount which was ultimately realised.

2.59 The Euro Green IT Innovation Centre in Mons will receive EUR 750,000 of public sector funding each year for three years (from 2010 to 2012). The funding comes from the Ministry of the Economy for Wallonia, but is matched for each project by private support. While some of the organisations are contributing money, others are contributing different resources, for example, equipment, personnel and expertise. The funding sources will have an impact on the kinds of projects being funded as there has to be an interest in a project from one of the key private company partners for private match funding to be proffered. By its nature, the public private partnership is a collaborative process, so this is not necessarily perceived to be detrimental to the initiative. In any case, the public sector members of the board need to be convinced that the project will be economically beneficial to Wallonia in order to gain their support.

Leasing

2.60 Some private sector companies will enter into leasing arrangements whereby they fund the capital costs of heating systems and recoup these costs from the property owner over the lifetime of the installation. Many CHP suppliers will offer ‘equipment supplier finance’ which operates in a similar way.

The Kyoto Protocol and the potential role for market based instruments (MBI)

2.61 The United Nations Framework Convention on Climate Change (UNFCCC or FCCC) took place in Kyoto/Japan in December 1997. The *Kyoto Protocol* was adopted on 11 December 1997, committing 37 industrialised countries and the European Community to reduce greenhouse gas (GHG) emissions by an average of five per cent against 1990 levels over the five year period 2008 – 2012. The detailed rules for the implementation of the Protocol were adopted at the Conference of the Parties in Marrakesh in 2001.

2.62 Under the Protocol, countries must meet their targets primarily through national measures. However, the Kyoto Protocol offers them an additional means of meeting their targets by three market-based mechanisms: Emissions Trading (also known as the carbon market); Clean Development Mechanisms (CDM) and Joint Implementation (JI). There is increasing interest in MBI for energy saving and wider environmental considerations as outlined in the 2007 Green Paper on market-based instruments.[x] The economic rationale for MBI lies in their ability to correct market failures in what can be a cost-effective way.

2.63 At this stage, the use of MBI for energy efficiency measures at the local and regional level is relatively underused. However, this is set to change over time as carbon reduction commitment schemes are coming into force more generally.

Conclusions and recommendations for authorities

Conclusions

2.64 Many energy efficiency initiatives generate significant cost as well as energy/carbon savings. However, the savings may only be realised after many years and ICT-enabled solutions can involve significant up front capital/installation costs. There are a wide range of national and European funding sources available for supporting investment in energy efficient facilities and processes. In particular Cohesion Policy Funds (Structural and Cohesion Funds) have included energy as a priority for the period 2007-2013, in particular renewables and energy efficiency actions. In the EU as a whole, the planned support for energy activities for the period 2007-2013 is approximately EUR 11 billion, or 3 % of the total funding. A further EUR 13 billion is allocated to ICT applications and services for the same period.

2.65 For local authorities who want to hand over the risk of implementing initiatives, there are an increasing number innovative measures including ESCOs and Energy Performance Contracting which can help achieve energy efficiency improvements as well as cost savings at relatively low levels of risk to the authority. It can be expected that over time there will be an emergence of practical Market Based Instruments which will further increase opportunities to implement energy efficiency technologies with or without an ICT component.

Top five recommendations for authorities

- In the majority of cases, introducing energy efficiency measures at the local and regional level involves additional capital and revenue funding, a hurdle that needs to be overcome by local authorities which tend to be constrained by their budget resources. It is essential to examine the funding arrangements for energy efficiency initiatives at the outset.

- There are a wide range of European and national sources of funding available, most importantly amongst them the European Structural Funds. Approximately EUR 24 billion is allocated to the fields of energy and/or ICT for the period 2007-2013. The support in these fields includes grants, loans, loan guarantees and technical assistance.

- Be aware that many initiatives, apart from the smallest scale examples, will require a combined approach to funding i.e. tapping into multiple sources.

- Consider what will happen when the funding for the implementation and initial period of operation is finished. Seek to put in place appropriate transitional arrangements so that, if appropriate, an initiative can become financially sustainable in the medium to longer term.

- Consider opportunities to transfer the financial and equipment performance risks to other parties using Energy Services Companies (ESCOs) and other forms of Energy Performance Contracting. ESCOs can be useful partners to local and regional authorities – and some authorities have set up ESCOs themselves in order to accelerate the achievement of energy efficiency targets.

3: Metrics/indicators

Introduction

3.1 The potential direct and indirect effects of ICT on the energy efficiency of local and regional authorities and their communities are very wide-ranging. As a result the effects are increasingly challenging to measure and monitor.

3.2 There are a plethora of ongoing activities in Europe and worldwide to develop methods and tools to measure and/or report greenhouse gas (GHG) or carbon emissions and energy end-use/energy efficiency. These vary in terms of their scope across domains including ICT equipment, transport, buildings/construction and performance management. The methods and tools also vary by their purpose including for example: meeting targets, addressing regulatory requirements, reporting to the public and developing business cases/attracting investments for product/project development.

3.3 This section provides a guide for local and regional authorities on metrics and indicators for ICT-enabled energy efficiency initiatives and the energy efficiency of ICT equipment. It draws on the current state of development of tools and methodologies for establishing metrics as well as practical examples in recent projects from across Europe.

The problem and objectives of this guidance

The problem

3.4 The problem for local and regional authorities is twofold. Firstly, when planning energy efficiency and sustainability initiatives, authorities need to establish reliable metrics and indicators so that the degree of success can be monitored and evaluated on a practical and cost effective basis. This monitoring information is critical to inform investment and planning decisions, such as whether to continue, adjust or scale up a project or programme. To a large degree this is simply good project management practice for energy efficiency/sustainability initiatives generically, whether or not there is an ICT component to the initiative. However, individual authorities may not have much experience of planning and implementing such initiatives. There is therefore a need for guidance and sharing practice on embedding appropriate metrics and indicators into energy efficiency/sustainability initiatives in a wide range of situations where the ICT component may be minor or very extensive.

3.5 Secondly the proliferation of different monitoring approaches and the absence of robust, common metrics and indicators is a potential barrier to harnessing ICT's potential contribution to energy efficiency. This is a particular issue in relation to ICT equipment, systems and solutions that are technically complex and difficult to understand by non-specialists. This problem presents challenges to authorities, member states and EU policy makers trying to determine objectives, implement policies and programmes or compare and evaluate results of different measures. Extracts from the European Commission's Recommendation of 9.10.2009 *on mobilising Information and Communications Technologies*

to facilitate the transition to an energy-efficient, low-carbon economy sums up the issue as follows:

> *Energy use by ICT equipment and services represents about 8% of electrical power in the EU, and about 2% of carbon emissions…*
>
> *Setting ambitious targets by the ICT sector for improving the energy and environmental performance of its processes is of the utmost importance. Progress towards such targets should be measurable and verifiable. Targets should be updated as more reliable baseline data becomes available.*

Objectives

3.6 The objective of this section is to provide authorities with practical guidance (including examples of approaches and tools) for developing and applying metrics and indicators for energy efficiency initiatives involving ICT. Key questions to be addressed in this section include:

- what role do metrics and indicators have in planning and implementing local/regional energy efficiency initiatives where ICT plays an enabling role
- what resources (i.e. tools, methodologies and case studies) on metrics and indicators for energy efficiency initiatives involving ICT are available for authorities to use
- how should metrics and indicators be designed to ensure that the data required are reliable, inexpensive and making best use of available sources
- what is the current state of research and practice across the ICT industry for developing metrics and indicators to measure the energy efficiency of ICT systems, equipment and solutions.

Guidance for authorities

What roles do metrics/indicators play

3.7 It is an accepted management adage that: *You cannot manage what you cannot measure*. For a given initiative or project the choice of what to measure has a strong bearing on how effectively its performance can be managed and how clearly the results, whether intended or otherwise, of the project can be attributed.

3.8 There are various terms used to describe the measurement parameters. The preferred terms in this guidance are metrics (commonly used in the ICT sector) or indicators. Alternatives include:

- performance metrics
- performance measures
- key performance indicators (KPIs)

- balanced scorecard.

3.9 In the context of a particular project, metrics can play a number of roles at different times and for different purposes. These include:

- **in appraisal/assessment during the planning phase.** Metrics/indicators can be used as the basis of forecasting the possible outcomes of the project and comparing different options. In this application, which involves future predictions, the metric values should be accompanied with a clear description of assumptions and uncertainties that have been used in deriving them. Further information on option assessment can be found in the guidance on planning energy efficiency to 2020 and beyond

- **in monitoring and evaluation.** A monitoring and evaluation framework, including the metrics/indicators to be adopted, should be designed during the planning phase of a project. The monitoring activity then commences during the implementation of the project. An evaluation should take place at the end of the project in order to determine its success and to capture lessons learnt. For longer term, larger and/or more complex projects interim or mid term evaluations are undertaken, enabling changes and improvements to be made for subsequent phases of the project or to inform decisions whether to proceed

- **to enable benchmarking with other projects**. Authorities will often find it useful to compare the performance of a project with similar initiatives that have been or are being implemented in other European cities and municipalities. Where common or comparable metrics/indicators are selected, this benchmarking can be undertaken very effectively

- **to aggregate results in determining contributions to policy targets**. In addition to determining the general performance of an initiative and its cost effectiveness, authorities may need to determine and report the contribution that the project is making to the achievement of energy efficiency policy requirements set at an EU/international, national or regional/local scale. Robust and transparent methodologies and metrics are needed for this purpose. Further information on aggregation is provided in the section on bottom up calculation approaches.

3.10 To meet these various purposes and cover all of the relevant aspects of energy efficiency schemes, metrics/indicators may have different emphases. One typology for metrics/indicators is to distinguish between those focussing on **outcomes** (e.g. actual energy saved as a result of the intervention) as opposed to the **inputs** (e.g. expenditure on the intervention or number of partner organisations involved) or the **outputs** (e.g. number of buildings that have been treated with retrofit measures).

3.11 Other typologies have been developed with respect to different uses of metrics/indicators that may be of use to authorities in considering their indicator frameworks for energy efficiency activities. For example, the European Environment Agency assesses the state of Europe's environment using the 'DPSIR methodology'[xi]. This methodology distinguishes between indicators that identify the:

- drivers (D) and
- pressures (P), positive or negative, on the environment which affect the
- state (S) of the environment via various
- impacts (I)
- responses (R) then represent the solutions (e.g. policies, investments) for what should then be done to improve or maintain that state.

Examples of metrics for local and regional energy efficiency/sustainability initiatives where ICT plays an enabling role

Summary of metrics being used by authorities

3.12 There are many examples of local and regional authorities developing and using metrics effectively in progressing energy efficiency initiatives. There is considerable variety in the metrics chosen. As would be expected, many of the selected metrics focus on energy and/or carbon outcomes in terms of the energy/carbon consumed/emitted or the change (savings) resulting from the project. However other metrics are focussing on other areas to reflect broader objectives of an initiative and are commonly addressing inputs or outputs rather than outcomes.

3.13 Table 3-1 provides a selection of metrics that are being used by local and regional authorities across Europe to support the implementation of a wide range of energy efficiency projects that involve ICT. For each metric, the measurement units are given, the likely use (general or more specialist) is identified and case study examples are provided where more information can be found.

Table 3-1: Metrics being used by local and regional authorities in energy efficiency projects involving ICT

Area of focus	Metric (and unit)	General use or more specialist use?	See these case studies for more information
Energy/ carbon	Energy consumption per year (KWh)	General	Berlin; Helsinki; Växjö
	Energy savings/change per year (KWh)	General	Tipperary
	CO_2 emissions per year (tonnes)	General	Copenhagen; Genoa; Stockholm
	CO_2 emissions reduction/change per year (tonnes)	General	
	Energy savings associated with identified anomalies in energy consumption (KWh)	Buildings	Leicester
	Transport fuel use/reduction by type (petrol, diesel) (litres)	Transport	
	Transport fuel efficiency by type (petrol, diesel) (kilometres per litre)	Transport	
	Power Usage Effectiveness (PUE) – a ratio of the total power consumption including air conditioning/buildings infrastructure against the energy consumption of the IT (ratio)	Data centres	Berlin

Area of focus	Metric (and unit)	General use or more specialist use?	See these case studies for more information
Cost effectiveness	Cost of energy services per year (€)	General	Maribor
	Total cost savings from reduced energy use per year (€)	General	
	Cost per tonne of CO_2 saved (€)	General	
	Return on investment of energy efficiency measures/interventions per year (€)	General	Copenhagen; Maribor;
	Payback period for investments in energy efficiency measures (months and years)	General	Maribor
Changing attitudes and behaviour	Number of people trained (number of people)	General	Helsinki Julia 2030;
	Educational benefits of the project (number of lessons featuring the energy efficiency project)	School and college buildings	Malaga
	User/consumer uptake (number of users or % of overall employees/potential users)	General	Amsterdam; Maribor;
	Attitudes to energy efficiency projects amongst users/consumers, via a survey questionnaire (scoring/ranking against closed questions)	General	Amaroussion
Other	Roll out of projects/interventions (number initiated or completed)	General	Amsterdam; Mons
	ICT system 'up time' and performance against Service Level Agreements (various)	ICT systems and equipment	Copenhagen
	Project management – completion of tasks to planned time and budget (% of tasks)	General	Amsterdam
	Correct data collected and submitted (% of returns that are correct)	General	
	External publicity (number of published articles/ references to the project)	General	Amsterdam
	Web users (number of hits/unique visitors to the website per week or month)	General	Malaga
	Employment creation (number of jobs)	General	Mons
	Shift to more energy efficient modes of transport (passenger km)	Transport	Craiova; Helsinki Julia 2030
	Number of vehicles entering a controlled zone	Transport	Genoa; Stockholm
	Weather related parameters to enable 'correction' of heat consumption: temperature, humidity, wind, solar irradiation (various)	Buildings	Budapest; Côte d'Azur
	Level of collaboration (number of partners involved in implementing the project)	General	Amsterdam

3.14 Many of the metrics listed in Table 3-1 can be expressed in slightly different ways once the basic data are collected. This can facilitate a 'closer look' at how different components of the project are performing (e.g. different sites, buildings or parts of buildings). As illustrated within Table 3-1, by combining different types of data an authority can get additional insights that may assist in the interpretation and decision making (e.g. bringing cost together with energy savings to generate metrics of cost effectiveness).

3.15 There are almost endless possibilities for tailoring the metrics to measure and compare different parameters of a project. Examples of common alternative ways of expressing energy and carbon metrics are provided below:

- energy (or carbon) consumption/saving can be considered per energy source, per sector, per building, per user/population
- energy (or carbon) consumption/saving can be considered over different timescales such as per hour, day, week, month, year or per phase of project.

3.16 Some practical examples on the use of metrics by authorities and some of the key issues associated with them are described below.

Practical issues - using and analysing quantitative measures of energy use/saving

3.17 In the case study in Czestochowa the detailed monitoring for 121 school buildings focuses on two indicators. Energy use is calculated per building surface area and water use is calculated per user:

- use of every kind of energy (recalculated into kWh/m2 of the building surface/year)
- water use (m3/user/year).

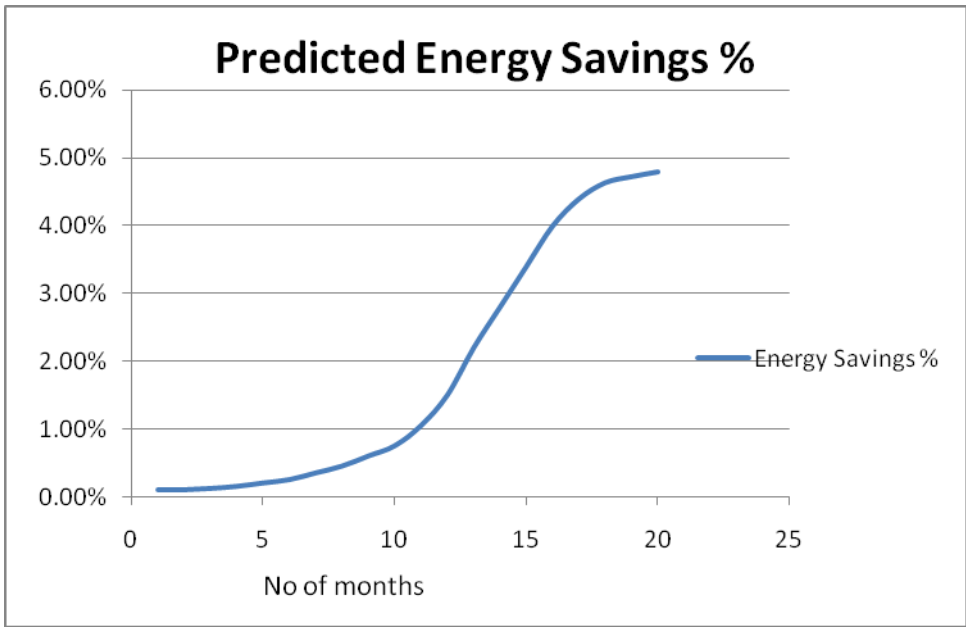
3.18 Similarly in the project to implement a centralised energy management system for public buildings in the city of Maribor, a suite of indicators was introduced including various ways of analysing energy savings resulting from the initiative. The basic measures of energy consumption/saving were compared by time period, type of energy service, building by building, building area and in terms of investment/payback.

- specific energy consumption (expressed in kWh) per user (kWh/user/y) or per square meter (kWh/m2/y) per year; or the combination of both in general per building and per specific energy service type within the buildings (i.e. heating, cooling, lighting etc.)
- annual costs of specific energy service and annual costs of total energy services per building area per year (€/m2/y) or per user per year (€/user/y)
- return on a total investment into energy retrofitting of the building by reduced/avoided costs of energy services (€/y) and simple payback periods for specific investments (building envelope, energy equipment and installations).

Practical issues - the lag time to achieve energy savings

3.19 Energy savings resulting from new initiatives are not normally instantaneous, particularly where there is a significant behavioural change element – either in terms of the expert operation of new technology or in the uptake of new practices across a wider population. In the buildings energy efficiency initiative in Växjö it was anticipated that it would take some time to engage consumers, but as this level of engagement grew, and consumers took cumulative steps in terms of behaviour change, then energy savings would start to become apparent (see Figure 3-1). This led to a general conclusion that there was a lag time before energy savings were being realised, but that these would grow faster over time, up to a theoretical maximum of around 5%.

Figure 3-1: The theoretical model showing the way in which energy savings would be realised over the project timeline.



Source: [xii]Växjö case study

Practical issues - the role of qualitative indicators

3.20 The Julia 2030 initiative in Helsinki illustrates the role that qualitative indicators can play. The aim of the project is to help the Helsinki municipalities in the Helsinki Metropolitan Area's authorities to achieve the target of 39% reduction in GHG emissions compared to 1990 levels (as set out in the Climate Strategy) but the project itself does not have a defined GHG reduction target. The project is more geared towards embedding the aims and objectives of the Climate Strategy by increasing awareness and encouraging positive behaviour change through the provision of practical tools. To achieve this purpose, qualitative indicators are used alongside quantitative ones (see Table 3-2).

Table 3-2: Key indicators for the Helsinki Julia 2030 initiative

Work strand	Quantitative	Qualitative
Public premises use	• recruit around 30-35 pilot premises • achieve 10% reduction in GHG emissions from 2009 to 2011 • train 200 Eco-supporters officers	• reduce energy consumption in the building • reduce waste • increase public transport instead of private car use • reduce copying paper consumption
Transport	No quantitative indicators set	• reduce emissions from transport • Increase walking and cycling as forms of transport
Waste flow	No quantitative indicators set	• waste prevention • reducing GHG emissions in municipal solid waste management
Public procurement	• develop guidance and criteria for 3-5 products and services	• integration of GHG emissions into the procurement decisions of local authorities

Source: SQW based on various sources

3.21 The case study in Budapest also combined qualitative and quantitative data for examining the indirect effects of energy-efficient reconstruction of prefabricated residential buildings. Monitoring equipment was set up to record: temperature values (inside air, wall, below-roof, above-cellar, outside air), humidity, noise levels, solar irradiation and wind. Qualitative information was then collected through personal interviews with residents and were summarised and presented in both qualitative (e.g. key findings) and quantitative (e.g. level of satisfaction) ways.

Practical issues – measuring operational aspects

3.22 Operational 'outputs' are commonly measured either to complement measurement of the ultimate outcomes (such as energy saved) or to serve as a proxy, for example where the impact of an initiative will occur at a later time. A focus on operational indicators was prevalent in the energy efficient buildings initiative in Amaroussion. These indicators included: the recruitment of 30 households to participate; the measurement of electricity consumption within these households for 15 days; the provision of results to each household; and the surveying of all households both before and after the metering took place. The success of the initiative was also measured in terms of whether the initiative altered attitudes towards energy efficiency measures. This was assessed through carrying out a 'before and after' survey.

3.23 In the intelligent energy metering project in Leicester, the operational effectiveness of the system was monitored in terms of:

- ability to highlight anomalies (e.g. building events, leakages or poor building management practices) in energy and water consumption data through tables and graphs
- easy notification of anomalies to a building manager

- savings of energy and water achieved through the correction of consumption anomalies.

3.24 For larger initiatives (or programmes) that involve multiple projects, a dual level approach can be useful in order to capture strategic programme level and management inputs and outputs as well as detailed projects outputs and outcomes. This approach was adopted in the Amsterdam Smart City initiative.

Table 3-3: Key metrics at the overall initiative/programme and individual project levels within the Amsterdam Smart City initiative

ASC initiative	Individual projects
Number of initiatives undertaken	CO_2 reduction in tonnes
Management tasks undertaken on time and within budget	Cost
Documented 'lessons learnt'	Electricity and gas consumption reduction
Cost	Consumer uptake of innovations
External exposure	
Number of partners	

Practical issues - metrics for supporting activities

3.25 A key aspect of the intelligent energy metering project in Leicester was the roll out of training in intelligent metering. For this purpose 'training day action sheets' were introduced to record any training activities that occurred in a participating building. These sheets monitored:

- training activity
- number and type of trainees
- date of training
- type of training.

3.26 Consumption data were then measured the week/month before and the week/month after training to help to determine whether changes in consumption could be attributed to the training and the specific training activity performed.

3.27 In the initiative to optimise energy use in schools in Malaga, as well as monitoring the energy savings, awareness raising and education was quantified in terms of the number of lessons given at schools and the number of school children attending the lessons. In terms of public awareness raising, the indicator used was the number of hits on the Municipality of Malaga's website displaying information on the renewable energy generated. Professional training in the field of sustainable energy was also measured by the number of people trained in this field by the city.

Calculation approaches for energy efficiency/carbon metrics for local and regional authorities energy efficiency/sustainability initiatives

Existing calculation tools and methodologies

3.28 Various energy and CO_2/GHG emission calculation tools and methodologies are available and already used by local and regional authorities for different purposes. Some of these tools can assist in the assessment and monitoring of particular energy efficiency projects. Furthermore, where methodologies and frameworks have been adopted by an authority, it will generally be more efficient and cost effective in terms of data collection and analysis if links can be made with the metrics for monitoring new projects.

3.29 One methodology being used by local authorities is the preparation of GHG emissions inventories. In 2010 guidance was published[xiii] to help cities and towns that are signatory's of the Covenant of Mayors in developing their Baseline Emission Inventory, i.e. to quantify the amount of CO_2 emitted due to energy consumption in the territory of the local authority. This is in line with the Covenant of Mayors' commitment to go beyond the objectives of EU energy policy in terms of reduction in CO_2 emissions through enhanced energy efficiency and cleaner energy production and use.

3.30 With the proliferation of software tools for the monitoring and management of CO_2 and other environmental parameters, directories of the available tools have also been created. For example the *Environment Tools Directory*[xiv] lists over 400 green environmental accounting software tools and techniques for measuring environmental and sustainability performance.

Bottom up calculation approaches developed for the Energy End-use Efficiency and Energy Services Directive

3.31 The EU Directive on energy end-use efficiency and energy services (ESD) set an indicative target for EU Member States to achieve a 9 % annual energy saving by 2016 from new energy services and other energy efficiency improvement measures. The Directive states (in Annex 1.1) that these energy savings should be monitored and evaluated by a combination of top-down methods, calculated from national statistics, and bottom-up methods. Bottom-up methods are most directly relevant to the monitoring of local and regional ICT/energy efficiency initiatives. The ESD defines bottom-up methods as follows:

> *A bottom up calculation method means that energy savings obtained through the implementation of a specific energy efficiency improvement measure are measured in kilo-watt hours (kWh), in Joules (J) or in kilogram oil equivalent (kgoe) and added to energy savings results from other specific energy efficiency improvement measures.*

3.32 The EMEEES project[xv] addressed measuring, monitoring and evaluation issues under the ESD and was completed in 2009. EMEEES was undertaken through collaboration between 21 European organisations to assist the European Commission to develop harmonised evaluation methods.

3.33 The EMEEES project outlines a four step process for bottom up measurement – see Table 3-4. The process starts with the calculation of annual energy savings from one final consumer or piece of equipment i.e. **unitary gross annual energy savings.** These normally need to be

calculated from the difference between the situation with an energy efficiency improvement measure and a hypothetical baseline. These savings are then added up for all consumers or equipment affected by an improvement measure. The resulting total gross annual energy savings are then corrected to avoid double counting and to account for multiplier effects.

Table 3-4: Four step bottom up calculation process

Additional analysis at this step	Step	Description	Example
	Step 1: unitary gross annual energy savings	In KWh per year per participant or unit, average or individual	How much energy is saved annually by using an A+ rated fridge instead of an A rated fridge?
+ summing across participants or units	Step 2: total gross annual energy savings	Taking into account the number of participants or units, in kWh/year	How many A+ fridges were sold (within the EEI programme)?
+ double counting, multiplier effect, +other gross-to-net correction factors (e.g., free-rider effect*)	Step 3: total ESD annual energy savings in the first year of the EEI measures	Taking into account double counting, multiplier effect, and other gross-to-net correction factors, in kWh/year	How many A+ fridges are promoted by more than one EEI programme and might be double-counted?
+ timing and lifetime (within ESD period)	Step 4: total ESD energy savings achieved in the year 2016	In kWh/year, taking account of the timing of the end-use (EEI) action and its lifetime	How many A+ fridges due to the programme are still in use in 2016?

*Note: * the free rider effect will only be relevant, if the aim of the evaluation is to calculate energy savings additional to those that energy consumers, investors, or other market actors would have achieved by themselves anyway. This effect is not mentioned in the ESD.*

Source: EMEES

3.34 EMEEES identifies a major advantage of bottom-up evaluation methods, compared to top-down approaches based on national statistics, in that they allow direct monitoring of the savings attributable to specific measures. This achieves greater accuracy and also enables the development of benchmarks and better programme/project control.

3.35 EMEEES also recognises that there is a potential drawback of bottom-up evaluation associated with the potentially high costs of data collection where a high level of accuracy is deemed necessary. It is noted that the required data for bottom up analysis can be obtained in a variety of ways by either direct measurement, analysis of energy bills, or expert calculations or estimates (ex ante or ex post; with or without on-site inspection). Further details on five data collection methods are provided in Table 3-5.

Table 3-5: Classification of bottom-up evaluation methods for energy savings

Methods for measuring or estimating unitary gross annual energy savings	**Methods for collecting number of units or participants**	**Methods for estimating gross-to-net correction factors**	**Applicable if unit is:**	**Characterisation of costs and data collection**
1. Direct measurement a) without normalisation b) with normalisation	A) Monitoring of participants and savings per participant	I) and II)	A) Monitoring of participants and savings per participant	Can be costly; suitable for large buildings or sites, or as a basis for deemed estimates
2. Analysis of energy bills or energy sales data (sample of all participants) a) without normalisation b) with normalisation	A) Monitoring of participants and savings per participant	I) and c) Comparison with control group; or d) discrete choice modelling and other in-depth billing analysis	A) Monitoring of participants and savings per participant	Can be very costly to collect and analyse, particularly d); may be the only way for information campaigns
3. Enhanced engineering estimates for methods for measuring or estimating unitary gross annual energy savings individual units (e.g. calibrated simulation)	A) Monitoring of participants number of actions and savings per participation/action	I) and II)	Participant or specific end-use action/equipment	Can be costly; however, if an energy audit or certification is done anyway, small extra cost of monitoring results
4. Mixed deemed and ex-post estimate, e.g. based on sales data, inspection of samples, monitoring of equipment purchased by participants	A) Monitoring of number of actions and savings per action	I) and II)	Specific end-use EEI action/equipment (usually)	Costs depend on level of accuracy and gross-to-net correction required; monitoring usually straightforward
5. Deemed estimate, e.g. based on sales data, inspection of samples before implementation of the facilitating measure being evaluated	A) Monitoring or number of actions and savings per action	Maybe II; always simplified; maybe inclusion of correction factors in deemed savings per unit	Specific end-use action/equipment (usually)	Costs can be quite low, monitoring of number of actions and savings per action may be combined with 'anyway' contacts

Source: http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_Final_Report.pdf

Notes

Typical methods for estimating gross-to-net correction factors (i.e. multiplier, double-counting and when calculating additional energy savings, free-rider effects) are:

I) surveys of participants (and control group and other market actors) to find out reasons for implementing end-use actions

II) monitoring of participants and end-use actions for different promotion measures to avoid double-counting

3.36 The EMEEES project also provides a series of worked examples (case applications) of the bottom-up evaluation methods for different types of energy efficiency improvement measures. A total of 20 types of measure are examined, and the most relevant to local and regional authorities considering ICT-enabled energy efficiency initiatives are:

- case application 1: energy performance of new buildings
- case application 8: non residential space heating improvement

- case application 9: lighting systems
- case application 10: central air conditioning
- case application 11: office equipment
- case application 14: vehicle energy efficiency
- case application 15: modal shifts in passenger transport
- case application 16: eco-driving
- case application 17: energy performance contracting
- case application 18: energy audits.

3.37 Individual reports on the case applications and other information from the EMEEES project can be obtained from http://www.evaluate-energy-savings.eu.

Metrics for the energy efficiency of ICT infrastructure and equipment – emerging practice

Background and definitions of direct and indirect effects

3.38 As stated in the Commission's Recommendation of 9.10.2009, ICT is recognised as an important enabler in delivering carbon reductions through greater energy efficiency. Potential savings from the adoption of ICT-enabled low carbon solutions are estimated to be around 15% of total emissions, a figure that would set the EU well on the way to achieving its 2020 targets.

3.39 However, almost all ICT processes, systems and devices depend on electricity to function, and in most EU Member States, generating electricity has a significant carbon footprint. As a major user of electricity, ICT is responsible for around 2-3% of global carbon emissions. This means that the carbon impact of the ICT itself – known as the 'direct effects' - should always be taken into account when evaluating the carbon reductions that have been achieved through ICT-enabled technologies and solutions.

3.40 ICT is what is known as a derived demand. This means that people use ICT not for the joy of playing with strings of 0s and 1s, but to do something else. Travel is another derived demand, because people usually travel in order to get somewhere, not just for the joy of sitting in a car or train. Because ICT is a derived demand then the effects of using ICT should always be taken into account when calculating its energy impacts. By effects we mean the carbon impact of whatever it was used for.

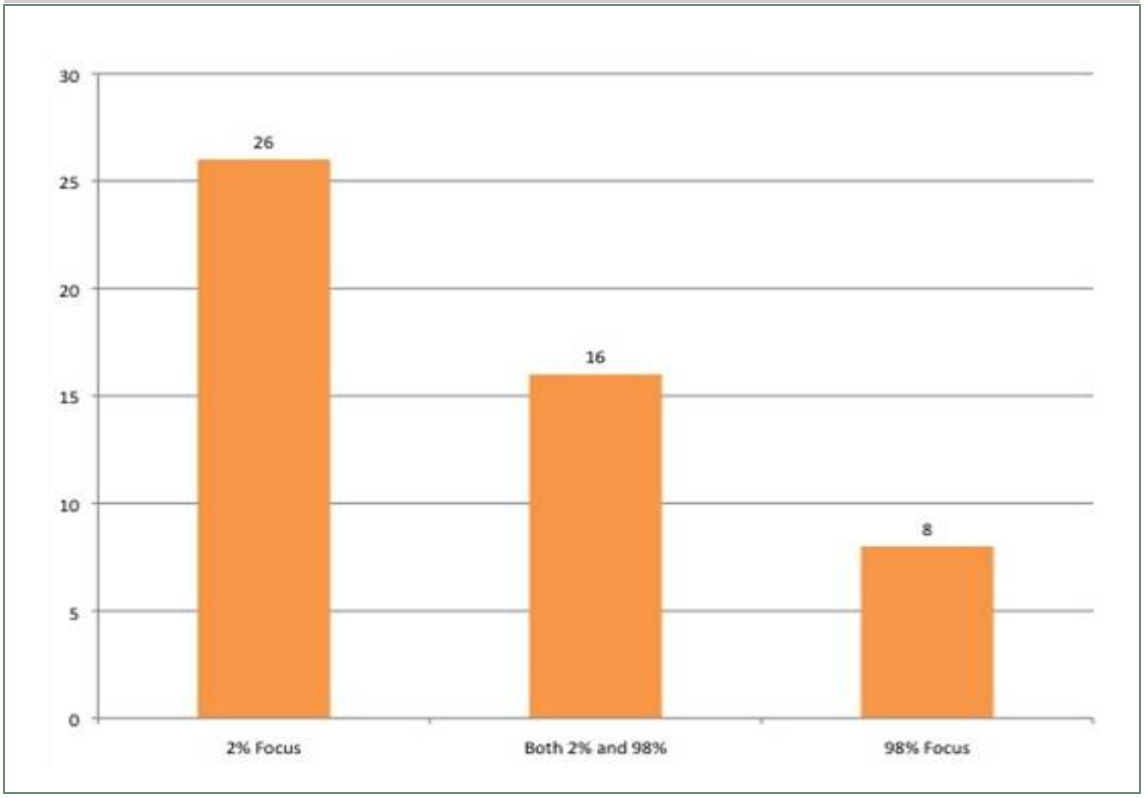
3.41 When calculating the carbon impacts of ICT it is important to take into account both direct and indirect effects. Examples of direct effects include the energy used by devices, networks and support systems. Indirect effects might be reduction in travel by using teleconferencing or reduction in heating energy used for a building by implementing a building management system. Effects can be positive or negative. A number of third party reports, including the

GeSI 2020 report, calculate that the intelligent use of ICT could deliver a 15% reduction in globally emissions, a reduction that far exceeds ICT's 2% footprint.

3.42 ICT-enabled low carbon technologies include a wide range of environmental offerings such as (to name but a few) virtual conferencing and collaboration tools, satellite broadcasting systems, intelligent transport systems including transport telematics, logistics and satellite navigation tools, building and energy management systems, photovoltaics, in-silico modelling, testing and CAD (computer aided design) and carbon auditing and accounting systems. ICT is in fact increasingly being categorised as part of the environmental goods and services sector[xvi]

3.43 However, not all policy frameworks see ICT in this way. Until recently the majority of government and industry initiatives and studies to evaluate the carbon impacts of ICT only looked at the direct impacts of ICT. Since ICT is thought to contribute around 2% of global carbon emissions, this essentially means that the scope for ICT-enabled emissions reductions across the other 98% of the global economy is being ignored. Figure 3-2 shows the results of an OECD analysis of such initiatives.

Figure 3-2: OECD Survey of 50 government initiatives to evaluate the carbon impact of ICT in 22 countries, the EU and China. Note that the focus is predominantly on the direct effects of ICT rather than the enabling effects.



Source: OECD 2009

Energy/CO_2 methodologies under development by the ICT industry

3.44 Recently a few organisations, particularly industry consortia, have started to develop methodologies to evaluate the enabling effects of ICT. In other words, methodologies and approaches that assist in calculating, or at least estimating, the net effect of ICT after taking into account both its direct and indirect effects, whether positive or negative.

3.45 Some of these approaches are taking a top-level view, where, rather than establishing a detailed methodology, they set out guidelines or frameworks instead. The GeSI Methodology for Evaluating the Carbon Impact of ICT is one such and its intention is to simplify what could otherwise be an impossibly complex process in a way that allows elements that are insignificant to be excluded, focusing the process on those factors that do have an impact on the final result.

3.46 At the time of writing, there are no fully developed, systematic, recognised and publicly available methodologies specifically for calculating the carbon footprint of ICT. There are, however, widely accepted general methodologies for calculating the embedded carbon in a product or service, such as PAS 2050. These could be adapted for ICT and steps are already in place to do just this. The International Telecommunications Union is exploring ways to evaluate the carbon impact of ICT and the UK Carbon Trust is working on evaluating the carbon impact of IT services.

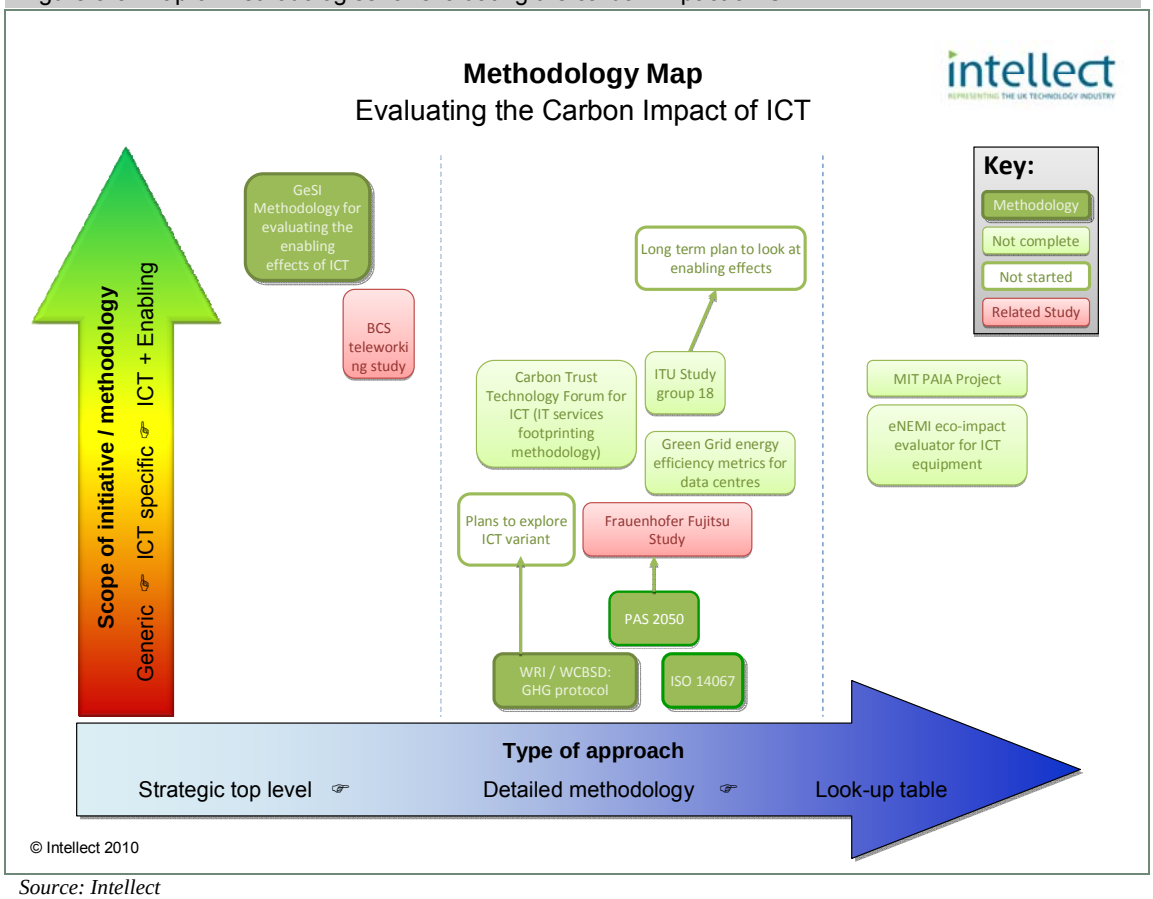
3.47 Recent initiatives by several large industry-academic consortia are developing databases or look-up tables that will allow users to establish ballpark figures for the carbon footprints of their ICT equipment by establishing typical profiles for a range of products under a range of usage conditions.

3.48 Figure 3-3 is a simplified 'map' of some of the most prominent methodologies currently in use or in development. The figure differentiates methodologies by their type on the x-axis – whether high level guidance, detailed step by step processes or look-up tables. On the y-axis it also differentiates them according to the way that they address ICT – starting with general methodologies that are not specific to ICT, methodologies specific to ICT but limited to direct effects and methodologies that take into account the enabling effects of ICT and which therefore deliver a more coherent and holistic picture.

3.49 As is evident from Figure 3-3, there are as yet no detailed methodologies to calculate either the direct effects of ICT or the enabling effects, although it is anticipated that several complementary approaches will be at least at testing stage by 2012.

3.50 The proliferation of different measurement approaches could create further challenges and consistency problems. The need for coherence in the development and adoption of ICT carbon metrics and methodologies is therefore considered by many as being an urgent issue to address – see for example the European Commission's Recommendation of 9.10.2009 *on mobilising Information and Communications Technologies to facilitate the transition to an energy-efficient, low-carbon economy.*

Figure 3-3: Map of methodologies for evaluating the carbon impact of ICT



Source: Intellect

Possible future developments in energy/ CO_2 methodologies

3.51 One important initiative that aims to facilitate the development of a methodology to evaluate the carbon impact of ICT is the ICT4EE Forum, a joint activity between the European Commission and the ICT industry[xvii]. Activity is split between three working groups, one of which has the objective of measuring the energy efficiency of ICT processes, including the development of methodologies, targets, reporting, auditing and verification frameworks. By 2011 that working group aims to:

- develop a measurement methodology
- agree protocols for standardised disclosure of energy consumption of ICT processes (taking into account existing methods such as GHG Protocol guidelines and other reduction methods, projects and processes)
- share verifiable data around energy measurement and performance of processes in the ICT industry.

3.52 It is important not to underestimate the complexity of evaluating the carbon impact of ICT. Even calculating the embodied carbon in devices is extremely burdensome - computing devices are astonishingly complex; they incorporate a range of components that may come from varying sources, with complicated, dynamic supply chains that may exceed 2,000 separate organisations. Yet calculating the embodied carbon of a device is simple relative to that for the provision of an ICT service where a whole range of other factors and variables

have to be taken into account, such as the proportion of network infrastructure attributable. This complexity is then multiplied further if the effects of using the device or service are also taken into account (which of course they should be). With this in mind, it is not surprising that we do not yet have a fully developed methodology that can provide a systematic approach to calculating the true carbon impact of ICT.

3.53 The current pattern is that different approaches are being developed in parallel, with some at more advanced stages than others. Knowledge about these parallel approaches is being shared and the result so far seems to be that the different activities are tending to be complementary. For instance the Carbon Trust's work on IT services is complementary to the International Telecommunications Union's work on embodied carbon in ICT. On the methodology map, few approaches sit exactly together, although it is evident that most of the current effort is focused on the development of detailed methodologies to establish the direct carbon effects of ICT, and much less activity is delivering real transparency about the more substantial, enabling effects.

3.54 Current progress could be described as a wall, which is made up of many different building blocks, or bricks some of which are overlapping. A degree of overlap will be helpful for benchmarking and verification – for instance if a PAS 2050 style approach achieves a similar answer to a lookup table that uses a different method of calculation consistently over a range of products, then both approaches are strengthened.

Conclusions and recommendations for authorities

Conclusions

3.55 Energy efficiency and sustainability initiatives have a wide range of potential outcomes in energy, cost and other terms. The use of practical metrics and indicators and supporting methodologies are critical to the effective management of these projects. Local and regional authorities are often involved in monitoring energy and CO_2 at various levels across their own assets and the wider community for various purposes (e.g. local greenhouse gas emissions inventories). At a project level the adoption of metrics/indicators and methodologies that align with such frameworks can be beneficial. Alternatively there are numerous examples of the metrics/indicators used by other authorities implementing similar initiatives across Europe, enabling the benchmarking of performance if the same metrics are chosen.

3.56 In terms of the energy and CO_2 impact of ICT equipment and infrastructure, although a finalised, fully developed, authenticated and validated methodology does not yet exist, it looks likely that it will become a reality within the next few years. A harmonised approach to this development of energy/CO_2 metrics for ICT equipment and infrastructure is advocated by the European Commission – see the Recommendation of 9.10.2009 *on mobilising Information and Communications Technologies to facilitate the transition to an energy-efficient, low-carbon economy.*

3.57 The existence of a methodology for measuring the energy/CO_2 of ICT equipment and infrastructure will be extremely important for the ICT sector, and in turn for authorities that are using ICT-based solutions, because it will enable the development of much more robust

carbon calculations of the impact of ICT. The industry will be able to model potential applications and also evaluate, or re-evaluate, existing ones. It is known that the intelligent use of ICT can deliver very significant carbon reductions across the wider economy, but the actual impact of ICT is not yet known with any certainty. These methodologies will provide that certainty, or at least go a long way towards it.

Top five recommendations for authorities

- Put in place metrics/indicators at an early stage of developing your energy efficiency initiatives. That way you will achieve greater clarity in terms of investment and forward planning to help ensure that ICT-enabled low carbon technologies are applied appropriately.
- To gain a broad perspective regarding the impacts of an initiative, consider selecting metrics that measure different aspects. For example select some that measure outcomes (e.g. actual energy saved as a result of the intervention) as well as others that measure inputs (e.g. expenditure or the number of partner organisations involved) and outputs (e.g. number of buildings treated with retrofit measures).
- Select metrics that cover areas such as energy/carbon consumption/saving (e.g. by energy source, per sector, per user and over different timescales), cost effectiveness and changes in user attitudes and behaviour.
- Pay attention to the practical considerations associated with establishing suitable metrics/indicators. For example the lag time between implementing an initiative and achieving the full energy savings, the measurement of supporting aspects (e.g. the roll out of training) and qualitative as well as quantitative approaches.
- Make use of and consider linking the metrics to existing tools and methodologies. For example local greenhouse gas emission inventories (e.g. Guidance for Covenant of Mayors signatory cities[xviii]) and the bottom up calculation approaches developed for the Energy End Use Efficiency and Energy Services Directive (see the EMEEES project [xix]).

Sources of further information

European Environment Agency: http://www.eea.europa.eu/

Evaluate Energy Savings website (from the EMEEES Project): http://www.evaluate-energy-savings.eu

ICT for Energy Efficiency (ICT4EE) Forum:
http://ec.europa.eu/information_society/activities/sustainable_growth/docs/ict4ee_forum/ict4ee_forum_roadmap.pdf

4: User Engagement

Introduction

4.1 The effective implementation of any innovative energy saving initiative significantly benefits from the active engagement of all stakeholders in the process. A group which is often surprisingly under-involved in planning and implementation are the users themselves. However, this is the group which will ultimately decide the success of the scheme.

4.2 This chapter provides guidance on how users can be involved in the planning and implementation processes of such projects.

The problem and objectives of this guidance

4.3 The introduction of new technologies, systems or processes into an organisation or community almost inevitably requires some form of change in the behaviour of 'users'. Workers in an office with a new heating and lighting system, for example, may have to get used to a different colour of light, to stricter rules on opening windows, or to controlling heating/cooling levels through an IT system. Residents in a town with a new congestion charge may well have to learn to use a new online electronic system for paying or receiving travel credits, and may also need to change their travel behaviour.

4.4 Most people are nervous about change to some degree, and any new initiative will likely encounter some form of reluctance and resistance from users. Whether rational or not, such resistance may well have a major influence on the final success of the initiative. Effective communication why a change is being made, how it will affect the users, and making sure their opinions are taken into account within the process, is critical to success and therefore needs to be taken into account in the planning process.

4.5 Key questions and issues to be addressed in this section include:

- how to engage users in finding the optimal solution to a problem
- how to use communication and awareness raising when introducing energy efficiency initiatives
- the importance of training programmes to increase acceptance and uptake
- the necessity to involve all relevant partners
- the role that can be played by project champions
- the value of positive feedback through effective monitoring and evaluation
- wider research on behaviour change – an emerging field.

Objectives

4.6 The objectives of this section are to alert local and regional authorities to the benefits stemming from effective user engagement and provide examples of how effective engagement can be achieved. The section considers the life cycle of a project from the formulation of the project concept, its design, introduction, inception and implementation to monitoring and evaluation. It considers different user and stakeholder communities who need to be brought on board for the project to be successful in meeting its objectives.

Guidance for authorities

How to engage users in identifying the best solution

4.7 It is not only important to engage users to ensure acceptance of new solutions. Users can also contribute substantially to the design and development of these solutions themselves. They are likely to know best what functionality is required, and may well have ideas to contribute for potential improvements.

4.8 The earlier you involve users in the process, the more likely you are to gain acceptance, and the more likely you will be to understand and meet their specific needs, requirements and concerns.

4.9 Consider holding consultation workshops at the beginning of the process designed both to clarify user requirements and to collect good ideas and concerns. A follow-up workshop can be held after the development of the concept.

4.10 Before introducing a mobility credits system to reduce traffic congestion in Genoa a long consultation process was undertaken involving the local business associations of the affected business sectors (principally town centre economic operators, and freight carriers). These groups met once per month throughout the development of the scheme to ensure all needs were taken into account.

4.11 The projects piloted under the Amsterdam Smart City initiative were specifically conceived as a series of platforms for testing innovative, sustainable energy solutions across the city. The success of the initiative in developing workable solutions is attributed significantly to the involvement of users at each stage of the project, multiple feedback loops and knowledge sharing through a series of events and intensive communication and dissemination process.

4.12 In the Provence-Alpes-Côte d'Azur, workers at the Centre Scientifique et Technique du Bâtiment (CSBT) are competing in teams to reduce energy usage in their offices, in a project funded by the region and ERDF. By creating a competition, the ECOFFICES energy challenge, the partners believe that participants will find energy saving activities more engaging and that it will encourage them to go further than if it was only company policy to save energy. At the end of the challenge, the winning team will get a prize as an added incentive. Sensors to monitor both energy consumption and different actions (like opening windows or switching lights on and off) are being monitored as part of the competition and provided on the basis of real-time information.

How to use communication and awareness raising when introducing energy efficiency initiatives

4.13 Effective communication on what is being planned, why it is needed, when it will happen, and what it means for individual users is essential to ensure commitment to the project and encourage target individuals and groups to participate. In particular, it is important that organisations planning to introduce energy efficiency measures are aware of the need to:

- explain the reason for the initiative and the need for change as clearly and convincingly as possible
- find attractive and interesting was to present information to the users
- consider setting up complementary awareness raising activities on energy efficiency to address barriers and obstacles.

4.14 The way in which information is presented is important in encouraging effective engagement. For example, the use of graphical illustrations, or interactive online tools which allow a comparison of the energy consumption impacts of different types of behaviour of technology, can be effective tools to interest users. It may also be beneficial to hold awareness raising seminars on energy efficiency for the target users, in order to provide context to the initiative and further encourage commitment.

4.15 However, communication needs to be timed and targeted well, keeping in mind the specific needs of each individual project, to achieve optimum impact. There are some examples amongst the case studies where it has been considered wise to wait to have some results to report before establishing a widespread promotion and marketing campaign. In others, interest and ownership was to be created from the very beginning for maximum impact.

4.16 To support the sustainable schools initiative in Malaga, in addition to planning energy efficient technical solutions to, for example, lighting systems, a broad programme of energy efficiency awareness raising seminars was carried out in schools across the city. This was designed to help understand the reason behind the initiative, but also to use this to encourage more energy efficient behaviour within the community as a whole.

4.17 Regular communication was extremely important in the SAMS project in Växjö concerned with improving energy efficiency in buildings. The focus of the project was to change the behaviour of users on the basis of smart meters that had already been installed in households. By promoting an online management tool, users could not only visualise their own energy use but through an interactive element compare their consumption with users in their own neighbourhood and other parts of the city. The project involved a wide range of communication tools including a SAMS website which provided an open forum for people to exchange ideas, pick up information and discuss energy maters. Some features of the smart metering technology and the website encourage innovative use. For instance, the SAMS website includes maps that show how domestic electricity use varies across the city. The patterns vary by neighbourhood and this prompts people to explore reasons for such differences and adjust their behaviour.

4.18 For the smart metering initiative in Amaroussion the results of a survey of typical household energy consumption was presented on the project website, providing a number of graphs and charts which clearly illustrated the identified patterns, and helped to demonstrate where improvements could be made. The website also presented advice on how to reduce energy consumption alongside these illustrations.

Training and introduction

4.19 In many cases the energy efficiency benefits of new technological solutions will only be realised if they are used effectively. Energy saving modes on IT equipment, for example, will only work if they are not disabled by users or IT co-ordinators. Congestion charge schemes will not work unless clear instructions are provided on how to use them. Often such training activities can be complemented by more general awareness raising initiatives as described above.

4.20 Major changes need to be managed carefully. In any project implementation, it is almost impossible to remove all risks and uncertainties. Introducing new systems in stages, or considering first implementing smaller scale pilots, can help to ensure that problems arising are managed effectively without risking the whole scheme.

4.21 Many energy efficiency initiatives include specific components designed to familiarise users with the new technology through general awareness raising, training or one-to-one mentoring activities. In particular, the following aspects are important:

- make sure users are provided with appropriate training on the new solutions
- plan the switch-over to the new system carefully to minimise disruption
- consider small-scale pilots before wider introduction
- ensure opportunities for reviewing and providing feedback.

4.22 A big challenge for the Daventry waste collection optimisation initiative was to gain acceptance from the Council-employed waste collectors who would eventually have to travel on the new routes. These individuals had extensive on the ground knowledge which they did not want to see superseded by the computerised solutions. The waste managers, supervisors and drivers initially had sceptical responses to the introduction of the software, with some welcoming it more than others. In order to combat scepticism, both the ICT supplier as well as the participating municipalities found it important to engage these employees at the earliest possible stage in the process to get them interested and willing to contribute to the process.

4.23 In the event, the software supplier spent time with the waste managers and collectors for live demonstrations of the system, to examine individual routes and to invite comments on the feasibility of the plan and the accuracy of the data. If a route did not make sense to the waste collectors, or did not reflect where the bins were actually accessed, the routes were tweaked to take this ‘insider knowledge’ into account. For new routes, the GIS officer works with the service manager in the waste department to ensure that the routes continue to make sense from a practical point of view. Another barrier was that the route instructions were

unnecessarily detailed; this superfluous information was scaled back after the project had started and led to the software being considered much more helpful and user friendly.

4.24 There was a slow and gradual implementation of the energy saving systems for Helsinki City Council's computers. Trials were started in 2008 and over a period of around two years, obstacles and problems were evaluated through technical tests and consultations and alternative technologies were assessed. Some departments (such as hospitals and social care departments) were excluded from the sleep mode because the trials had identified user issues in a high stress environment. When the technology was ultimately fully rolled out in 2010, there were few problems in user acceptance and technical functionality.

4.25 The Intelligent Metering project in Leicester includes a training component as an integral part of the project. The training has been used as a means of engaging participants in thinking about the way they use energy and how their consumption habits can be changed. Intelligent metering provides a medium to view and interpret consumption data from which appropriate behavioural changes can be initiated. A great deal of attention was given to the design of the training sessions to enable, engage, incentivise and catalyse the participants' shift to more sustainable consumption patterns. Each training session followed a standardised approach but also included bespoke elements for the particular requirements of schools and other local authority buildings. A variety of training materials were made available to complement training manuals which included sticker/posters, best practice guides and PowerPoint presentations, all designed to maximise the chances of long term behavioural changes stemming from the training.

4.26 As part of the introduction of the Maribor Centralised Energy Management System, there have been extensive activities to raise awareness amongst the users of the municipal buildings. Heads of administrative units, headmasters of schools and the directors of the municipally funded institutions in the fields of health, culture and sports were introduced to the basics of energy efficiency and energy efficient behaviour in buildings and trained to use different motivation tools for users of 'their' buildings to achieve energy savings through appropriate behavioural changes.

4.27 The Stockholm Congestion Tax was introduced in 2007 after a six month trial period (from January to July 2006), followed by a referendum in September 2007. The trial was introduced by the Swedish National Road Administration and Stockholm City, in a climate of considerable hostility against a congestion tax, in order to test the system and ascertain the benefits flowing from it as well as providing an opportunity for users to experience it first hand as a basis for decision making in the next stage.

4.28 The trial experience was exceptionally well received by traffic users for a number of reasons including a well functioning and simple system and costs which were considered to be fair and affordable. Altogether, the trial was considered successful in meeting the scheme's objectives and following a referendum in September 2006, it was implemented permanently in 2007. The introduction of the scheme was supported by a range of investments and measures including a new bypass road to help traffic flow outside the city centre.

4.29 The trial period and the referendum allowed people to experience the effects of the congestion tax and gave them a voice in the final decision. Implementing the trial **before** the referendum

was seen as the key factor; other schemes had been rejected because users had not experienced the benefits of the scheme. In Stockholm's case, it helped that there were a range of accompanying measures such better bus services, a new park and ride facility, an extension of commuter rail services and the new bypass road.

4.30 Smart Metering in Amaroussion was piloted in 30 households and the main focus of the initiative was to understand user patterns, raise awareness of the benefits from smart meters and understand resistance factors. The information thus gathered can be used in introducing smart meters more generally, addressing obstacles and concerns early on.

Involvement of partners

4.31 Energy saving projects tend to be partnership initiatives, often bringing together different types of organisations, all with their own objectives and competencies working towards the same goal. There is merit in engaging partners early, thereby creating widespread 'ownership' of the project aims and building commitment amongst many to make it work. It is essential to involve all important stakeholders within the implementation process.

4.32 The Amsterdam Smart City Initiative is managed by two partners, a private sector company (the utility company Alliander) and Amsterdam Innovation Motor, a municipal organisation. In addition to these two leaders, there are a large number of other organisations involved, both at the strategic and the operational level. To keep all project participants on board and aligned to achieving the project objectives, it has proved helpful to have a clearly defined governance structure and regular communication channels between all strategic and project partners.

4.33 The success so far of Julia 2030 in Helsinki is considered to be intimately linked with bringing on board decision makers from a wide range of relevant organisations. The ground work for this was done during the strategy development phase when the lead partner consulted and engaged leaders across all organisations that were considered to play an important role in achieving the high level project objectives. Because these individuals were brought in early, they were eager to be part of the project and more importantly had the authority to commit resources to it even at a time when public budgets were under pressure.

4.34 On the other hand, an important learning lesson from Julia 2030 was that at a practical level, it can be challenging to fit the different working relationships and styles of partners together. Project managers need to appreciate that timetables and communication styles between organisations vary which can impact on project progress. Frequent central communication as well as encouraging partners to provide regular updates was considered essential for the success of the project.

4.35 Partnership working in the course of introducing Mobility Credits in Genoa was seen as one of the key benefits of the project. Given the multiple stakeholder groups involved in the negotiation process leading to the final design of the project, regular monthly meetings were organised between the City Council and the various stakeholder groups to ensure adequate participation, transparency and consensus. Additionally, one-to-one meetings were organised between the project sponsors and particular stakeholder groups or partners.

Use of project champions

4.36 Given the obstacles that need overcoming in introducing and implementing energy efficiency initiatives, it can be helpful to enlist a group of facilitators or champions that carry the message to the grass roots.

4.37 A key part of Julia 2030 in Helsinki is the training of eco-support staff to act as champions at their places of work and motivate and guide their colleagues to make climate change friendly choices. The officers are individuals who have volunteered to take on this responsibility alongside their normal work duties. In most cases, they have had no particular education or expertise in environmental affairs but receive their training as part of the project.

Monitoring and evaluation

4.38 Collecting data on actual cost and GHG savings is an essential element of the introduction of energy saving technologies. In the buildings sector, for example, the energy performance calculated at the design stage is often considerably better than the actual performance measured once the building is being used, for a variety of reasons.

4.39 It is therefore crucially important to put in place effective systems for monitoring actual against planned performance, and methods for evaluating this performance.

4.40 Assessment of qualitative aspects such as user acceptance and comfort are also helpful in evaluating the reasons for relative success or failure.

4.41 Having a mechanism built into contracts with suppliers to monitor performance and evaluate the reasons for any discrepancy with planned performance can be a useful approach.

4.42 The IT Department implementing the energy saving systems for Helsinki City Council generates reports on savings on a kilowatt per hour basis and these data are then converted to both monetary and CO_2 emissions savings. The reports were initially produced on a daily basis to get a better picture of the energy use patterns. In the long run, reports will be provided on a monthly basis and summarised in an annual report. The IT Department considers the data collection aspect of the project of central importance because it has enabled it to show each individual organisation within the authority the scale of their computer energy use and how reducing it can provide important financial savings. Having this kind of factual evidence has made it easy to argue with the responsible senior manager that reducing energy is worth the effort and has also facilitated the setting of appropriate targets.

Wider research on behaviour change and energy efficiency research

4.43 Behaviour change and energy efficiency improvements are emerging research questions. Addressed both by the academic sector as well as by utility companies across the world.

4.44 A comprehensive research project on energy and behaviour at various levels of decision making has been undertaken by the California Institute for Energy and the Environment. The results of the research first published in January 2010 are structured into nine topics (also called white papers) as summarised in Table 4-1

Table 4-1: California Institute for Energy and Environment: Overview of Research White Papers

White paper	Key questions
Pursuing energy efficient behaviour in a regulatory environment: Motivating policy makers, programme administrators and programme implementers	The white paper examines how policy makers and programme administrators can be motivated to pursue behavioural change in a regulatory environment. The three primary goals of the report include: • Identifying common perceptions of behaviour change strategies • Identifying contexts in which programme administrators, implementers and others have been – or are likely to be – motivated to pursue behaviour change as a means of reducing energy consumption • Specifying effective policy options to motivate policy makers, programme administrators an programme implementers to pursue behaviour change as a means of enhancing energy and carbon savings
The climate imperative and innovative behaviour: Encouraging greater advances in the production of energy-efficient technologies and services	This white paper examines why a large array of innovative institutions, behaviours, technologies and services is needed to ensure energy efficiency outcomes
Using experiments to foster innovation and improve the effectiveness of energy efficiency programmes	This white paper argues that realistic small scale experimental versions of key programme components (including messages, delivery channels, social network effects etc) should be completed prior to any full scale pilot testing
Behavioural assumptions in energy efficiency potential studies	This white paper considers the behavioural assumptions in energy efficiency potential studies and options for modifying and supplementing these assumptions, using recent California energy efficiency studies as the main example
Behavioural assumptions underlying California Residential Sector Energy Efficiency Programmes	This white paper explores the ways in which residential consumers are addressed by California utility-managed energy efficiency programmes and offers suggestions for improvements
Behavioural changes underlying energy efficiency programmes for businesses	This white paper describes the behavioural assumptions underlying utility sponsored energy efficiency programmes offered to businesses in California.

Source: California Institute for Energy and Environment

Conclusions and recommendations for authorities

Conclusions

4.45 Close user engagement and effective collaboration with project partners throughout the whole life cycle of energy efficiency measures are essential to achieving energy efficiency results. Understanding the 'human factor' is essential in designing and implementing energy efficiency initiatives. Only by enthusing individuals to change their attitudes and behaviour and enabling them to use new technologies appropriately can environmental results be achieved.

Top five recommendations for authorities

- Involve the operators and users of the technology as early as possible. The sooner users are involved the more likely you are to gain acceptance, and the more likely you will be to understand and meet their specific needs, requirements and concerns.

- Set up different types of training and awareness raising to address the needs of different groups. The energy efficiency benefits of new ICT solutions will only be realised if they are used effectively and this can require detailed training for the primary operators of the new equipment. Training activities should be complemented by more general awareness raising initiatives for other participants.

- Consider the best way to present information to communicate it most effectively to users. For example, the use of graphical illustrations, or interactive online tools which allow a comparison of the energy consumption impacts of different types of behaviour of technology, can be effective ways of generating interest.

- Consider enrolling a group of facilitators or 'champions' to carry the message to the grass roots level. Champions can help to embed a sense of ownership and enthusiasm for an initiative across different groups.

- Put in place appropriate monitoring arrangements for projects and include the monitoring of qualitative aspects such as user acceptance and comfort. This approach should help to explain the reasons for successes/failures and changes in performance.

5: Leadership, governance and public-private partnerships

Introduction

5.1 The promotion of energy efficiency at the local and regional level is facilitated by strong long term leadership on part of the key promoters. This narrative provides background on the ingredients for effective long term leadership and draws out relevant information from practical examples across Europe.

The problem and objectives of this guidance

5.2 New initiatives and policies to support energy efficiency and energy savings often encounter a wide range of obstacles on the part of institutions, individuals, households and businesses, the very people and organisations whose behaviour they are supposed to change. Such obstacles are the result of a number of factors:

- perceived inconvenience associated with the new measures
- insufficient belief that they will be effective
- differences in approach and promotion between key sponsors
- immature technology which has fewer benefits than expected.

5.3 In order to succeed, it is essential for energy efficiency initiatives to be based on strong long term leadership to address obstacles arising in the implementation cycle. Effective leadership can be helped by reaching out into other communities of interest and creating governance models that integrate other types of organisations such as businesses and the voluntary sector.

5.4 Key issues to be addressed in this section include:

- how to arrive at a clear vision as to what can and should be achieved
- how to convert the vision into a practical and effective plans
- how to ensure alignment with policy agendas at different levels
- the importance of mustering convincing evidence
- the role of effective monitoring and evaluation process to adjust policies and make necessary changes
- partnership processes at various levels to implement processes more effectively, learn from what others have achieved and receive support from peers in difficult times
- governance models including public/private partnerships

- user engagement (separate narrative) helps to create commitment and support at all levels.

5.5 The objectives of this section are to provide an overview of the components of effective long term leadership.

Guidance for authorities

How to arrive at clear vision as to what can and should be achieved

5.6 A clear vision on what can and should be achieved on part of the organisation moving the process forward is essential. This applies both for leaders in the public and civic sphere as well as for corporate players, community groups and NGOs. In some cases, the leadership is exerted just by the lead body while in others there is a partnership of organisations with complementary objectives (see heading on partnership below).

5.7 Strong leadership tends to be grounded in a strategic commitment to the pursuit of energy efficiency, either driven by a political consensus that this is necessary course of action to achieve long term sustainability, a corporate view that this course of action is essential for commercial reasons or both.

5.8 Case study examples which demonstrate a clearly formulated vision include:

- Amsterdam Smart City which is implemented through a partnership between Alliander, one of the biggest utilities companies in the Netherlands, and Amsterdam Innovation Motor, a foundation focusing on promoting innovation across different sectors and activities. While promoters had to work hard to align objectives, the strong strategic commitment on part of both partners meant that issues could be overcome and ultimately the strong partnership achieved significant impacts pursuing a number of projects and involving a wide range of beneficiaries (individuals, businesses, school children, residents)

- a pilot project to demonstrate the effects of reconstructing prefabricated residential buildings in Budapest was implemented against the backdrop of very strong commitment on part of the national government for whom the 'Panel Programme' is one of the key investment areas of the Kyoto Protocol. This commitment influenced the local players, in particular the lead municipality, who were confident that what they were doing was in the national as well as local interest

- Copenhagen has a Climate Vision initiative through which the city plans to cut its GHG emissions by 20% by 2015. The city strategy is set within a highly proactive energy efficiency policy at the national level with Denmark being committed to going beyond the European 2020 targets in terms of energy savings and energy efficiency. Our case study Virtualising Data Centres, is only one example of a host of initiatives by which the Municipality of Copenhagen is cutting its $C0_2$ emissions by a minimum of 20% by 2015 in order to work toward achieving its ambitious strategic objectives

- the Helsinki 'Metropolitan Area Climate Strategy to the Year 2030', developed in partnership between the municipalities located in the Helsinki Metropolitan Area, sets a common vision and aims to introduce GHG emission cuts across plans and objectives of all its partner organisations; this includes visions for building design, procurement, transport and other local authority activities. The collaboration during the strategy development process demonstrated that there was an increasing appetite for energy efficiency actions which subsequently meant that the negotiations to implement Julia 2030, featured as one of our case studies, was facilitated significantly and other projects and initiatives are in various stages of development and implementation

- the City of Stockholm has a very strong policy agenda targeted at climate change alleviation, closely aligned to an equally determined national policy. The aim is to cut per capita carbon dioxide emissions to three tonnes by 2015 and to be independent of fossil fuels by 2050. Early in 2006, the Swedish National Road Administration (SNRA) and Stockholm City announced a trial congestion charge; the trial period ran from January to July 2006 and was considered successful in meeting the schemes objectives and following a referendum in September 2006, it was implemented permanently in 2007. The introduction of the scheme was supported by a range of investments and measures including a new bypass road to help traffic flow outside the city centre (also see user engagement narrative). The Stockholm Congestion charge is an interesting example of a supportive relationship between the central and the municipal levels; the initial policy directive and the capital funding was provided by the national government while the benefits of the scheme are concentrated in Stockholm and indeed any financial returns are ring fenced for investment in the capital

- local and regional authorities can also demonstrate leadership in this area by signing up to the Covenant of Mayors, a European Commission initiative seeking to bring together Europe's most pioneering local authorities. The covenant formally commits authorities to going beyond the EU climate change, energy efficiency and renewable energy targets for 2020, and necessitates the creation and implementation of a Sustainable Energy Action Plan within each authority (for more information, see guidance on 'planning energy efficiency implementation to 2020 and beyond'). A high number of local authorities in and around the city of Rennes, France, for example, have signed (50 of the 150-odd total French signatories), which is helping to galvanise council politicians and employees alike to action.

How to convert the vision into practical and effective plans

5.9 Even within a strong over-arching vision, there are inevitably different – and sometimes conflicting – policy goals that need aligning and reconciling and high level aims need to be translated into lower level objectives and activities. It is therefore essential for the vision to be translated into targets and a clear course of action.

5.10 The Municipality of Amaroussion has formulated a comprehensive plan to increase energy efficiency with a particular focus on improving the green credentials of municipal and

residential buildings. The municipality has been assisted in its endeavours through its participation in the EU Eco Management & Audit Scheme (EMAS)[xx] since June 2005 which has provided it with reference points and suggestions with respect to climate protection and energy efficiency.

5.11 Amsterdam Smart City is mapped out into four main phases, starting from 'visioning' to 'roadmapping', leading on to project definition and then full scale project roll out and evaluation. The initiative is designed to scan a wide range of possible project opportunities, involving many stakeholders and beneficiaries, but then narrowing down on those projects that appear most effective in achieving energy efficiency and sustainability objectives.

5.12 Energy efficiency agreements signed between the central government and municipality levels in Finland require energy efficiency action plans, highlighting the areas where energy savings can be expected to be achieved. Large municipalities or cities (such as Helsinki) sign a bilateral agreement with central government while smaller ones are part of an energy programme which assists them in exploring options and making choices.

5.13 In the case of the Daventry waste collection optimisation initiative, partnership working to manage municipal waste had been in place in Northamptonshire since 1996. However, it was only in 2005 that more formal arrangements were put in place with the establishment of the Northamptonshire Waste Partnership Shadow Board. The move to action was supported by an added emphasis on addressing public sector financial constraints and the drive to find innovative solutions to project funding.

How to ensure alignment with policy agendas at different levels

5.14 The closer the alignment between local, regional and national policy goals, the more likely it is that local and regional action will be taken and be embedded into an environment which leads to effective achievement of objectives.

5.15 For example, at the national level, Finland has been proactively looking at energy efficiency since the early 1990s. The Ministry of Trade and Industry (now Ministry of Employment and Economy) has supported comprehensive studies of energy consumption (energy audits) in buildings and production processes since 1992. Local authorities are aware that any actions they are taking with respect to increasing energy efficiency are embedded in a supportive and conducive context.

5.16 Similar national commitment has been important for energy efficiency actions in Budapest/Hungary – where municipal actions are embedded into three national programmes that support the energetic renewal of residential buildings; Copenhagen/Denmark – which has a very strong climate change policy agenda.

5.17 The energy efficiency activities in Maribor/Slovenia are backed by the 1999 Energy Act. In 2004, the provision of the first National Energy Programme demanded from municipalities to provide Local Energy Concepts (LECs) as a precondition to access financial support for investment in certain energy activities and in October 2008 Regulations on Efficient Use of Energy in Buildings further committed local authorities to take actions.

The importance of mustering convincing evidence

5.18 Evidence on the impacts of energy efficiency initiatives is important to build confidence and conviction for those who are introducing the scheme at the policy and promotion level as well as individual citizens, consumers or businesses who are affected by those decisions.

5.19 The smart metering initiative in Amaroussion commenced with a volunteering cohort of 30 households who had smart meters installed in their homes providing them with a graphical overview of their daily energy consumption and with simple information about the potential impact of simple energy saving technologies. When surveyed about their change of behaviour, an overwhelming majority stated that they felt that their attitudes towards energy saving technologies had changed and that they would further wish to improve their habits toward energy saving and renewable energies.

5.20 Amsterdam Smart City provides a platform for testing and evaluating 15 different approaches to improving energy efficiency, working with a number of public and private partners and continuously measuring the effectiveness and impact of each of the individual projects. All initiatives should be economically sustainable investments and their benefits are tested in local, small-scale projects. These projects are realised by bringing public and private partners together. The initiatives that prove to be the most effective can then be implemented on a larger scale.

5.21 Project sponsors consider the spread of projects an important aspect of the success of the initiative because it reduces risk. Moreover, the aim of the initiative is not necessarily to achieve 'perfect' projects and solutions first time round but to learn lessons; failure is anticipated and as long as it provides valuable insights, it is welcome. Given the number of projects being pursued as part of the project, it is expected that there will be a significant base of evidence to decide which approach yields best results.

5.22 The Budapest pilot project to improve the energy efficiency of residential buildings involved two buildings of the same type (a sample building and a control building) and activities surrounding the project included data collection and analysis, media relations and development of findings and policy recommendations. The main deliverable of the project was a detailed guidebook which included a thorough description of the research and recommendations.

5.23 The Stockholm Congestion Tax was first trialled by the Swedish National Road Administration (SNRA) and Stockholm City Council in early 2006 on the basis of a system roughly similar to those used in Singapore, London and Oslo working on the basis of a polluter pay principle. An initial trial to test the scheme ran from January to July 2006 and was considered to be successful. After a referendum in September 2006, the tax was implemented permanently in 2007. The scheme includes both automatic number plate recognition as well as automatic charging, widely considered as improvements on non-integrated schemes. The scheme has completely altered what was previously perceived as an unstoppable and unsustainable growth in traffic and traffic levels in the city have now stabilised below their pre-trial levels. The success of the scheme is attributed in large parts to being trialled effectively, giving users a chance to input on the schemes eventual design, and

The role of effective monitoring and evaluation processes

5.24 There is a broad appreciation that expertise in the field of energy efficiency and energy savings is rapidly emerging and that knowledge needs to be captured effectively in order to draw conclusions for actions. This approach is very much in the centre of a wide range of national and European activities. The CIVITAS Initiative goes as far as calling cities 'living laboratories for learning and evaluating'[xxi] and it is within the spirit of learning and understanding that many of our case studies are embedded.

5.25 The case study of the Aalst General Hospital shows the importance of continuously working on and further improving the properties of ICT-based systems. Having first carried out an energy audit and established the Building Automation System (BAS) in 2005, the performances of the system is continuously monitored and improved further.

5.26 The Smart Metering initiative in Amaroussion was designed as a pilot project in order to learn about household behaviour and shape future activities and the focus of the project was on understanding whether the initiative altered attitudes towards energy efficiency measures, assessed through carrying out 'before and after' surveys amongst the pilot cohort of households.

5.27 The Amsterdam Smart City Initiative is particularly focused on finding out which of the many different projects that are encouraged through the initiative are actually effective and which – while useful from a learning perspective – are less valid. Evaluation metrics cover both the initiative (in terms of the number of projects undertaken, the management of tasks on time and within budget, documented 'lessons learned', external exposure and number of partners) as well as individual project metrics such as GHG reductions, cost and consumer uptake of innovations.

5.28 The Budapest pilot project to demonstrate the effects of building refurbishment arose from an appreciation that there was a lack of data to prove the effectiveness of building refurbishment measures. The project therefore focused on collecting data from a refurbished building and a non refurbished control building. These measurements confirmed the original assumption and where channelled back to national policy makers. At the core of the initiative were data collection activities which used ICT to gather, analyse and present data.

5.29 Measuring energy and cost savings were a key component of the Copenhagen Data Centres project. It is estimated that the project achieved power savings – and proportional GHG emissions reductions – of around 70% and cost reductions of 40%. Moreover, the IT team reported that the new infrastructure is much easier to manage and creates a better working environment for the server support staff.

5.30 Waste collection optimisation in Daventry was introduced after extensive feasibility explorations using GIS route optimisation software. In total, four different scenarios were modelled with different levels of cross-municipality integration, which showed there was a business case for three out of the four options. Piloting of the preferred option was then undertaken in Daventry and the full scheme was subsequently rolled out to Daventry's neighbouring municipalities.

5.31 An interesting finding emerges from the centralised energy management system in Maribor/Slovenia. The fact that energy use is measured and monitored at the place where a specific energy service is provided results in considerable and measurable energy savings, since users will in most cases stop energy wasting behaviour such as overheating rooms, non-repairing of leaking hot water supplies etc. It therefore seems to be legitimate to argue that energy use in rooms and buildings which are part of an energy management scheme is likely to be more efficient than in buildings and rooms where this is not the case.

Partnership processes at various levels

5.32 Effective partnership processes are essential for achieving energy efficiency targets in the medium to long term. Such partnerships can be between different municipalities, public and private sector players and pan-European consortia.

5.33 An interesting example for a public private initiative is Amsterdam Smart City which is a unique collaboration between the inhabitants of Amsterdam, businesses and governments in order to illustrate how energy can be saved, now and in the future. The project was initiated by Alliander, one of the country's largest Distribution System Operators (DSOs) and the Amsterdam Innovation Motor, a consortium of public and private partners concerned with encouraging innovation across all aspects of life in Amsterdam. The broad partnership carrying this initiative is essential for its approach of finding out what works well – and what is less successful. The partnership creates a large learning environment to test innovative sustainability projects.

5.34 The Energy Future project in the cross border region of Austria and the Czech Republic demonstrates the potential of municipalities from different countries working together to share experience and competence. In this particular case study, Austria is already a leading player with respect to energy efficiency in buildings and Czech municipalities are benefitting from the accumulated experience. The implementation is also helped by established energy agencies on both sides of the border (see Energy Agency narrative).

5.35 Collaboration between different municipalities was essential for the Daventry waste collection optimisation initiative because small local authorities on their own would not have had sufficient resources to afford expensive software on their own. Using the Northamptonshire Waste Partnership as the delivery vehicle, economies of scale and cost savings could be achieved. For example, only one software license was necessary to implement the initiative across a number of municipalities. It was also considered important that the partnership arrangements were clearly structured, with defined roles and responsibilities such as a project board and a project team.

5.36 The ICT-supported energy management system in Maribor/Slovenia has involved 15 neighbouring municipalities, brought together with the help of the local energy agency, in first exploring and then addressing the scope for energy savings.

5.37 In the case of the Stockholm congestion charge, the City of Stockholm, the Swedish National Road Administration and the Stockholm Transport Authority worked together very closely, setting up a joint project team that operated like a single unit. This proved essential for the progress of the success of the project which involved a large number of decisions across many

different spheres and had there been delegation back to the individual host authority for each issue, the ambitious project timing would not have been achieved.

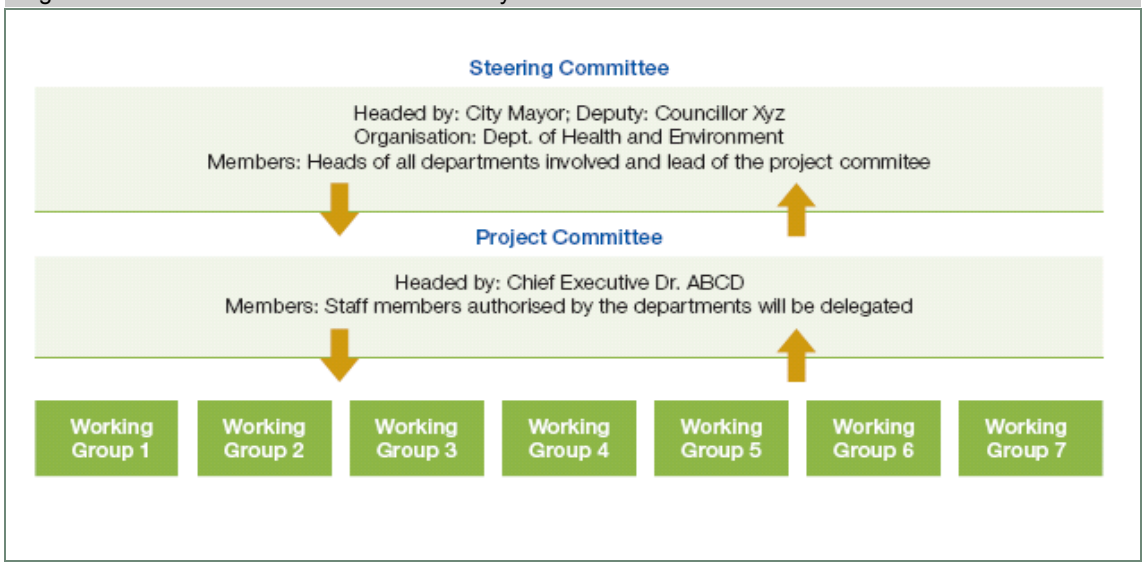
5.38 Partnership processes are also important between leaders of different initiatives, including at the pan European level. Designing and implementing energy efficiency actions, by their very nature, can be fraught with concerns and sensitivities, given the overriding objective to change behaviour and introduce innovation. It can be lonely at the top and having national and European consortia of leaders engaged in similar processes, overcoming obstacles of a comparable nature, can be of great comfort and support.

Governance models

5.39 The governance models for planning and coordinating energy efficiency initiatives need to recognise the multi-faceted nature of these schemes and how important it is to bring on board key promoters and wider stakeholders in a coherent structure. 'A lack of coordination between the various policies, local authority departments and external organisations has been a considerable shortcoming in the energy or transport planning of many local authorities.'[xxii]

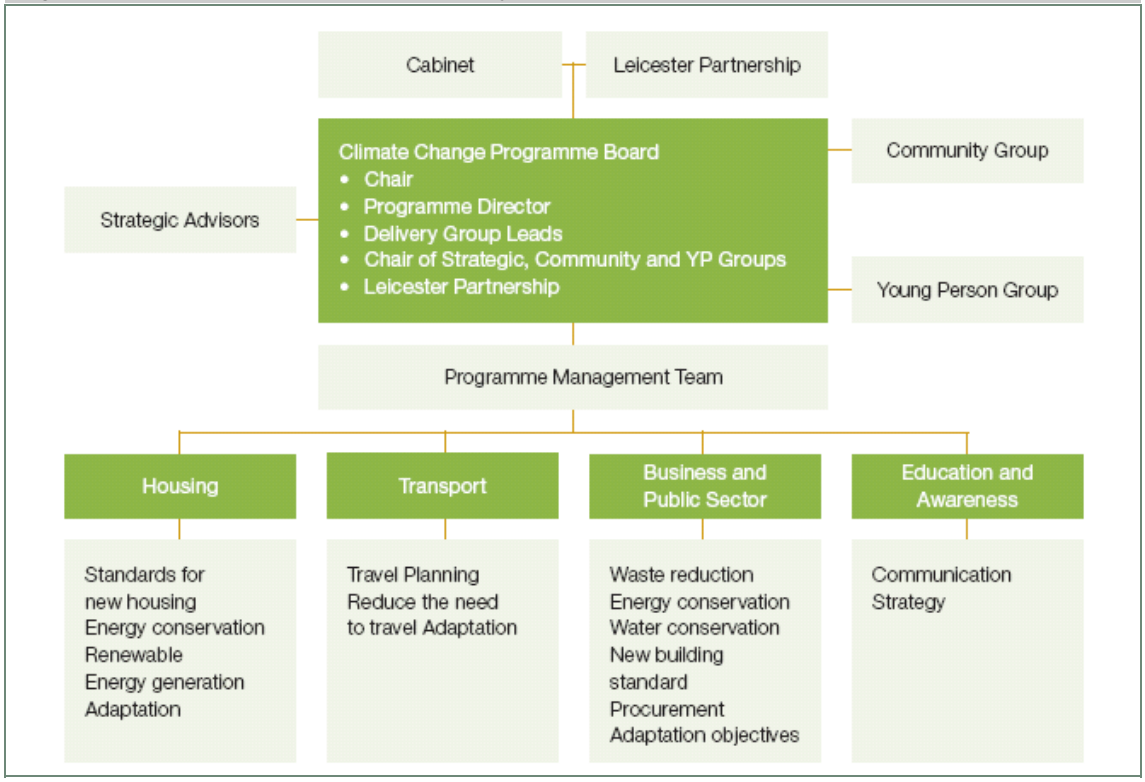
5.40 There are different governance models to ensure joint up and purposeful actions. Two examples are provided in Figure 5-1 and Figure 5-2.

Figure 5-1: Administrative Structure of the City of Munich



Source: Covenant of Mayors: How to Develop a Sustainable Energy Action Plan (2010)

Figure 5-2: Administrative Structure of the City of Leicester



Source: Covenant of Mayors: How to Develop a Sustainable Energy Action Plan (2010)

User engagement

5.41 User engagement is addressed in detail in another section of this toolkit, but it should be stressed within this leadership section that effective user engagement at the point of conceiving, designing, running and evaluating any energy efficiency initiative is an important condition for its success.

Conclusions and recommendations for authorities

Conclusions

5.42 Based on the experience of local and regional authorities across Europe it is clear that strong leadership plays a central role in the success of energy efficiency initiatives. Effective leadership is required over the long term to help to address obstacles that will inevitably arise during the project implementation cycle.

5.43 Energy efficiency initiatives involving ICT solutions are often multi-faceted and therefore need to involve a wide range of funders, promoters, users and other stakeholders. The governance models for planning and coordinating the initiatives need to provide a coherent leadership and management structure to reflect these aspects. It can also be advantageous and cost effective to collaborate and form partnerships with other municipalities/regions when implementing ICT and energy efficiency initiatives.

Top five recommendations for authorities

- Secure the support of senior leaders in your local/regional authority by aligning the initiative to current priorities. General statements of endorsement can be helpful but ultimately more active senior support will be more effective.
- Develop and promote a clear vision that will inspire others to play their role in making the initiative work. Translate this vision into effective and practical plans for the initiative delivery team to follow.
- Organise governance structures (e.g. steering committees, advisory roles, working groups) to align with the initiative's vision and to tie it in to the policy agenda at different levels.
- Establish effective communication channels and use them on an ongoing basis. There may be a wide range of partners to be brought in initially and to be kept engaged and committed throughout the life of the initiative, even once the initial burst of enthusiasm has subsided.
- Generate strong evidence of success to help to persuade doubtful supporters/stakeholders. Monitoring and evaluation can provide feedback loops that reinforce the message and build momentum.

6: Appropriate use of technology

Introduction

6.1 Complex technological solutions can be appropriate and tend to receive the greatest publicity - but they can also be prohibitively costly at the investment stage and expensive to maintain. There are numerous relatively simple ICT solutions that authorities could adopt to make effective energy and cost savings (e.g. spreadsheet tools for capturing energy audit data) before looking at more ambitious technological solutions.

6.2 The narrative will examine general issues associated with the selection of appropriate technologies[1], with particular emphasis on describing how simple solutions can achieve significant results for authorities.

The problem and objectives of this guidance

The problem

6.3 Local and regional authorities often face a situation where they will need to decide which technology to use in an energy efficiency measure or project. However, those decisions are difficult and complex because they can have long lasting and wide ranging impacts on the project and the authority as a whole.

6.4 Often technology-based projects end up being more complex and expensive than necessary. There can be a tendency to go for a highly complicated technology with diverse and complex functionality to achieve optimum energy efficiency results and wider recognition benefits. However, such complex solutions often come with a price premium. In addition to the direct cost of ICT hardware and software, additional costs can be incurred due to the need for more extensive maintenance, use of external experts and training of staff. The rapid development in ICT means that the cost of many simple solutions, such as spreadsheets or internet-based tools, is decreasing and more users have the potential to access these as part of their standard working environment. This presents opportunities for authorities to develop simpler projects with lower investment and running costs which provide good results whilst being more practical and cheaper to implement and manage.

6.5 There are various issues local and regional authorities may face when choosing appropriate technologies, including the following:

- reasons for considering simple technologies
- how to identify appropriate technologies
- what issues to consider to ensure technologies are appropriate over time

[1] The term 'appropriate technologies' in this narrative refers to technologies which are appropriate for the context and use. It does not refer to the concept of 'appropriate technologies' used elsewhere to describe simple technologies suitable for use in developing nations or less developed rural areas.

- considering the 'human factor'
- testing fitness for purpose in practice.

Objectives

6.6 The objective of this narrative is to help local and regional authorities to make appropriate technology choices for energy efficiency initiatives relating to ICT infrastructure and ICT-enabled buildings, transport and energy management. It discusses reasons why local authorities should consider simple technologies as a good alternative for complex solutions in ICT-based energy efficiency initiatives. It also provides pointers on what local and regional authorities should consider when selecting technologies to make sure they are appropriate.

Guidance for authorities

Reasons for considering simple technologies

6.7 Local and regional authorities sometimes struggle with the idea of introducing technology-based projects because they are perceived to be costly, technically complex and challenging. However, many of the case studies have shown examples of local and regional authorities using simple ICT-based solutions to achieve high energy savings whilst being still reasonable in cost and management terms.

Costs

6.8 Local and regional authorities often struggle to fund ICT-based energy efficiency initiatives and the costs can be a barrier to set up such projects. Simple technologies are often cheaper – or indeed come at no additional cost if they are part of the general ICT package already used. Examples of such simple technologies with potential in energy efficiency initiatives include use of spreadsheets, simple databases or internet-based tools.

6.9 In the Budapest case study the costs of the reconstruction project for prefabricated residential buildings played an important role in the municipality's decision as they were unable to cover all project costs and external funding had to be sourced in addition to own sources. The authority ended up using standard software applications because a more expensive system would have been prohibitive for the initiative. These tools were perfectly suitable for the analysis required and due to the simple and cost-effective nature of the project there are good chances it will be replicated elsewhere in Hungary.

6.10 A similar approach was used in Amaroussion, Greece where the authority analysed and visually presented the electricity consumption data collected through the smart meters using Microsoft Excel spreadsheets. Even though the tool was simple, the clear graphical presentation of results was considered successful in this project and it helped to raise awareness and encourage behavioural shift.

Large number of users

6.11 Projects expected to involve many users can benefit from simple technologies to reduce barriers to access. This is true for large collaborative projects involving many partners all requiring access to the technologies; it is equally important when it is hoped that the technology solution will be used by large numbers of unknown users such as the members of the general public for transport projects or residents for construction projects.

6.12 The Julia 2030 project used web-based carbon calculators for the collection and reporting of carbon emissions data from the participating sites. Using a simple tool online made sure that all of the 500 eco-supporters based in different types of municipality-run organisations across the partnering municipalities were able to access it without additional costs or necessity of installing new software on computers with differing settings. The preliminary results of the project have shown that the technology has worked well; when necessary, the tool was improved based on feedback from the eco-supporters. New transport carbon emissions calculators were integrated into an existing journey planning website with a large number of known users and this ensured that the tool was available to the wider audience.

Ease of use and user-friendliness

6.13 Users can get frustrated by complex technical features, particularly if they cannot understand or use them properly. In the Rennes energy advice service case study, because the automatically produced reports on local authority energy usage from the software were highly detailed and technical, further analysis had to be undertaken manually by energy advisors who provided much shorter documents containing headline figures and trends in consumption and spending, along with recommendations for each local authority. The next version of the software is being developed to be much easier to use and will contain a report analysis capability so that the energy advisors can devote more of their time to actual advisory work.

6.14 Even seemingly minor hindrances can deter users, as shown in the Växjö case study. When using the online tool for monitoring their energy use, the residents had to log in and use data from their bill. This was not onerous but customers were put off by this procedure and the number of individuals logging on and using the system was initially low; half way through the project only around 1,200 out of 30,000 metered households logged on. However, once logged on and using the system, the level of engagement improved dramatically because the tool itself was intuitive and easy to use.

Linking with other technologies

6.15 Complex solutions might make it more difficult to integrate the technologies to the wider technology environment or combine them with other systems. A good example of how simple technologies can facilitate linking with other technologies is the case study of Tipperary. The authority used modern but fairly simple energy management technologies. Due to the simple nature of the technology they were able to power down equipment by linking the computing and building facilities technologies so when the burglar alarm was switched on (i.e. when the last person left the building) this action triggered the automatic switching off of all the power sockets (other than those required for critical 24 hour services). This ensured that the

powering down was done with minimal disturbance to staff working in the building whilst still achieving a good level of energy savings.

Potential for scaling up and replicability

6.16 With simple technologies, scaling up can be less complicated than with complex solutions because in many cases the technologies are already part of the standard ICT working environment in most local and regional authorities (e.g. the internet or spreadsheets) or the cost or access barriers to adopting them are low (e.g. open source software).

6.17 Initiatives using particularly simple or common technologies have shown that there are virtually no limits to increasing the number of users. For instance, the initiatives in place in Växjö and the Julia 2030 project, which are using mainly internet-based tools, have nearly unlimited potential to allow more users to use the technology without extra costs or adjustment to the tool itself.

6.18 The potential for scaling a solution from a local to national level can have the added benefit that it allows local authorities to collaborate and support each other more easily. The case study of Valmiera described how a unique but simple software application Ekomaja[2], developed initially for auditing and optimising energy efficiency measures in three pre-selected blocks of flats in Valmiera, has had high replicability potential for the whole of Latvia. The simple nature of the technology and good functionality has attracted interest from other authorities and the authority in Valmiera has shared experiences to benefit other authorities.

How to identify appropriate technologies

Focusing on the problem

6.19 In selecting a technology there is a danger to get distracted by the vast number of available options and begin the decision making process by examining the different types of functionality they offer rather than by what is actually needed to address the identified problem. The starting point for any decision should be the identification of the problem and what is needed to address it rather than what solutions are available. Identifying the problem and evidencing the need for a technology-based solution are considered to be key determinants in successfully selecting an appropriate technology[xxiii xxiv].

6.20 Sometimes the technology itself offers the solution to a problem whilst at other times the technology is just a means to an end. This difference can be exemplified by contrasting the two case studies of Helsinki City and Rennes. Helsinki City needed to find a way of centrally switching its computers to sleep mode after office hours so that they use less energy. Using ICT was seen to be the most efficient way of achieving this and a software-based solution was identified to solve this issue. In Rennes, where the local authorities needed to analyse local energy data and implement changes in managing the municipal buildings, fleet management and lighting, the implementation of an energy data database alone would not have been sufficient because the authorities did not have adequate internal expertise or resources to

[2] www.ekomaja.lt

analyse energy data. Hence, the local energy agency set up a joint energy advice service to analyse energy and water consumption data provided by the local authorities using a bespoke computer program created with this usage in mind by ADEME, the French Environment and Energy Management Agency.

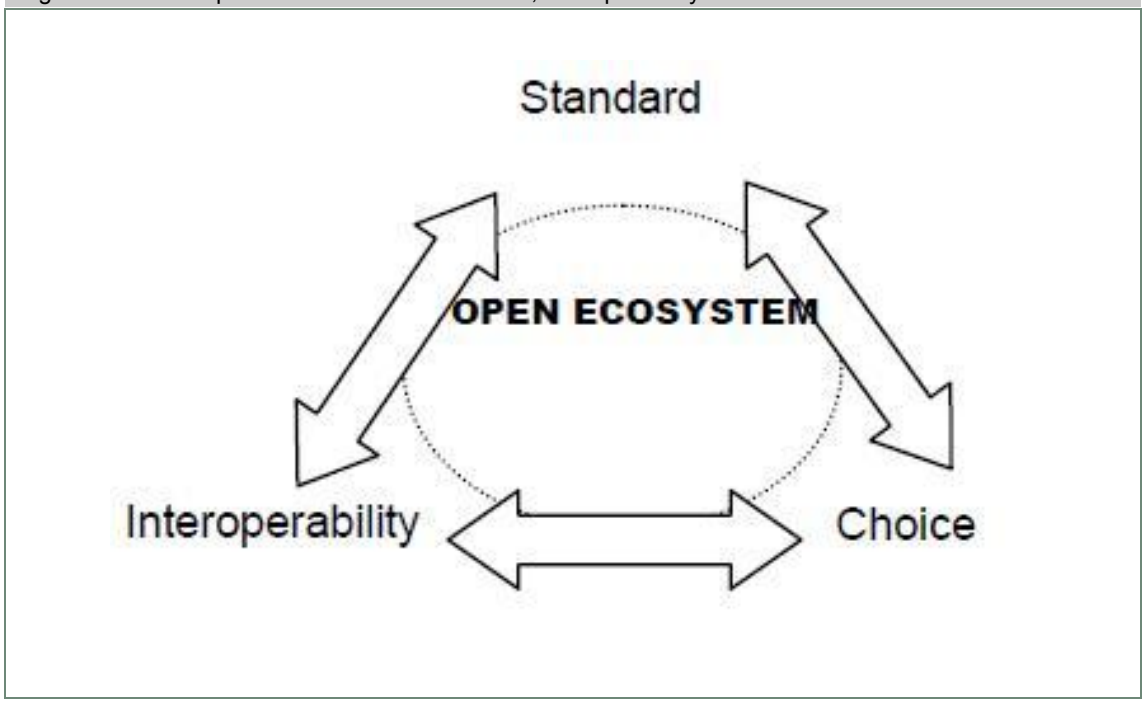
Selecting technologies which are fit for purpose

6.21 There are very few tools available for local and regional authorities for assessing technologies and their fitness for purpose. Most of the available guidance relates to arranging effective procurement processes which are discussed in the procurement narrative. However, there are some issues to consider when considering whether a given technology is fit for purpose.

6.22 **Interoperable technologies,** defined as the 'ability of two or more networks, systems, devices, applications or components to exchange information between them and use the information so exchanged'[xxv]. This is a particular issue for ICT technologies where suppliers often try to protect their own market share by introducing unique features or structures that act as barriers for changing to other solutions or technology approaches later. It is important to avoid 'technology lock-in' whereby a solution or a technology might lead down a given technology path which creates barriers for later switching to another one. [xxvi xxvii] Hence, the greatest benefits of interoperability for local and regional authorities are greater flexibility and control as the users are not limited to specific technologies and do not need to replace equipment which will not communicate with each other.

6.23 Standardisation and open standards are seen to be key enablers of interoperability (See Figure 6-1).

Figure 6-1: Interdependence between standards, interoperability and enhanced user choice.



Source: EICTA (2006). White Paper on Standardisation and Interoperability. p.6
http://www.digitaleurope.org/fileadmin/user_upload/document/document1166544474.pdf

6.24 Based on the European Union definition to be open, the standard must:

- be adopted and maintained by a not-for-profit organisation and its ongoing development must occur on the basis of decision making procedure open to all interested parties (consensus or majority decisions)
- be published and the standard specification document must be available either freely or at a nominal charge
- the intellectual property of the standard – or parts of it - must be made irrevocably available on a royalty-free basis
- there must be no constraints on the re-use of the standard.

6.25 Open Source Software (OSS) facilitates open standards and promotes open and democratic debate around the specifications, making them both more robust and interoperable. Open source development has become more common in recent years, partly due to lower costs arising from less intellectual property right protection.

6.26 From a local and regional authority point of view, the European Information & Communications Technology Association (EICTA) encourages public sector users to support public procurement policies which promote interoperability and solutions compliant with open standards.

6.27 The case study of Rennes exemplifies in practice how interoperability can be a concern for local and regional as well as national authorities. The national Energy Agency in France ADEME, its regional offices in Brittany and Poitou-Charentes regions and a software provider collaboratively developed statistical analysis software (Déclic) to capture and analyse all information relevant to energy and water usage and spending by the local authorities. Following trials in Rennes and some other areas, other regions have started to use this software. A second version of the software with increased user friendliness and added features is now being developed, with plans to disseminate it to authorities across France. However, as the launch of the second version has been delayed by nearly one year, there is a danger that other, non-compatible software will be developed and taken up by some authorities. Having various tools for the same purpose is seen to hinder ADEME's objective of data collection and analysis of municipality energy consumption across France through Déclic, because the data may be inconsistent. The regional and local authorities will also be impacted as they are unable to get more reliable national benchmarks for judging their performance.

6.28 **Multiuse technologies**. During the decision-making process it can be useful to examine whether a technology or solution has other potential uses in the same or different contexts. This is especially important when authorities are struggling with limited resources. The case study of City of Helsinki demonstrated how discussions with suppliers revealed a new functionality in an existing solution which helped to achieve cost savings in the long run. Following a seminar and discussions with their main supplier, the IT department within the City of Helsinki decided to abandon a solution they had bought to switch their computers centrally on sleep mode because a new version of one of their existing software offered the same functionality. It was not financially sensible for the authority to pay additional licence

and maintenance costs for another solution when they could achieve the same outcome by upgrading their current solution to a newer version.

6.29 The case study documenting route optimisation software in organising waste collection in Daventry also showed how useful it is to consider if an ICT solution purchased for energy savings in one area can be leveraged in other areas. Daventry District Council identified how the route optimisation software used for waste collection can be applied in increasing efficiency of street cleaning, winter gritting and checking addresses for council tax collection. Moreover, it could also be used as a decision support tool in procurement processes to assess bids, by comparing costs and carbon emissions of the refuse collection routes that would be necessary for various locations of waste treatment or disposal facilities proposed by different bidders.

6.30 Local and regional authorities might have to balance their energy efficiency project needs with **wider economic development needs** including the impact of their procurement decisions on local, regional and national suppliers. There are a range of ways authorities can ensure that their energy efficiency projects have wider economic and environmental impacts.

6.31 In Mons the regional authority has set up a Euro Green IT Innovation Center as a public-private partnership to encourage the creation and deployment of energy efficient ICT technologies and technologies that enable increased energy efficiency and sustainability in the region. In terms of governance arrangements the public sector representatives have more votes in the public-private partnership to ensure that the technologies supported through the initiative yield wider public benefits. Similarly, Malaga's Municipal Energy Agency has engaged predominantly local suppliers in the sustainable schools initiative which has helped to ensure the local economy gains benefits beyond the energy savings.

Considering the 'human factor'

6.32 Many of the case studies have demonstrated how important it is to consider the 'human factor' at all stages of the project implementation cycle. The cost implications of selecting technology solutions which are not implemented or accepted by their users are significant. These costs relate both to direct and indirect costs, including costs of set up and training but also costs caused by potential complications or ineffective use of the technology.

6.33 The technology users mentioned in the case studies can be broadly divided into the following groups:

- **authority employees** – a diverse group of technology users with varying levels of ICT skills, capacity and technology use experience. In Rennes, users of the statistical software were trained Energy advisors who had relevant academic qualifications and internal training for the purpose using the software. In Julia 2030, the eco-supporters promoting grass-root behaviour change in the local authorities were employees coming from a range of municipality run organisations, including hospitals, schools and day care centres who voluntarily took on this additional responsibility. Most of them had no previous experience of handling energy and other consumption data, and their data processing skills varied greatly

- **field operatives –** who may or may not have previous experience of using technologies. However, some of the case studies have shown how important it is to engage with field operatives who either use the technology on the ground or are highly affected by it. This is important firstly to ensure the users are engaged and positive about the technology but secondly to ensure that the technology is used to its fullest potential. In Maribor, the operatives using the central energy management systems in the municipal buildings were provided with both technical as well as motivational training to ensure that they remain engaged and competent in using the tool during a long implementation phase. The Daventry initiative showed how user engagement can be used to complement the technology and its functionality. The software provider collaborated with the waste collection managers and workers whose working routes were determined by the mapping software to ensure the suggested routes were realistic. The refuse collectors had the practical knowledge of collecting waste from these locations. Based on their experience they would know if the mapping software had inaccurate data or if the routes were not optimal in practice

- **residents and the general public** - a heterogeneous group of technology users with varying degrees of capacity and technology user experience. There have already been many policy initiatives to ensure that ICT technologies are accessible by people of all ages and abilities[xxviii] and local and regional authorities should acknowledge that user-friendliness and ease of use needs to be a key part of the design of an ICT-based energy saving project. In Julia 2030, transport-related carbon calculators directed at residents have been made accessible through the internet, which is seen as the most accessible form of technology by a majority of residents. These calculators are designed to be very simple to use and visually easy to understand. They have been positively received and are intensively used.

6.34 Considering the wide range of technology users and the differing degrees of technical capabilities and experience they have, the authorities are challenged to find different ways to ensure that the technology selected is in line with the skills and capabilities of the intended users. Amongst the best ways of achieving this goal are:

- **formal training:** the provision of formal training for technology users is the most obvious and effective way of ensuring that the users have the required skills to use the technology in an appropriate manner. Various case studies, including Julia 2030 and Maribor, have noted training as an integral part of process of implementing a technology. Leicester Energy Agency provided training to the users of smart meters in public buildings in four countries to encourage use of the metering, beyond simple monitoring of data, towards useful analysis and a subsequent change in energy consumption habits. The training sessions were designed to enable, engage, incentivise and catalyse the participants' behavioural shift to more sustainable consumption behaviour. The technology in combination with the training resulted in behavioural changes in all areas of metering (heating, electricity and water) and in all partner countries

- **communication and awareness raising:** whilst training might be the most effective way of ensuring appropriate use of technology, it is also the most resource intensive

and therefore most appropriate for targeting small groups of core technology users. In the case of large groups of technology users, broader communication and awareness raising activities may be more appropriate to keep users engaged and to help them get the most out of the technology. The case study of the SAMS initiative in Växjö, Sweden encouraged households to reduce their demand for electricity on the basis of a web-based Online Monitoring Tool (OMT), allowing them to view, understand and manage their energy consumption. To ensure the tool was used, the authority organised an extensive communication and awareness raising strategy which involved mass communication through websites and forums, adverts on radio programmes, newspapers, magazines and on buses, videos at cinemas, flyers, exhibitions and car stickers. The marketing alerted potential users to the available tools so they could make their own decision about using it

- **using ICT products which are accessible to all potential users:** In line with the policy drive for equal opportunity in accessing technologies, local and regional authorities have to consider ways to ensure the technologies they use and promote are available and accessible by people of all abilities and ages. This can become a particularly important issue when wanting to engage a wide cross-section of the general public in the use of ICT. 'eAccessibility: Access for All' is a concept promoted by the European Commission which embraces the idea that mainstream ICT products must be developed in a manner that are accessible to all, regardless of age and ability levels.[xxix] Some countries in Europe have made notable progress in supporting eAccessibility; for example Denmark[xxx] and Ireland[xxxi] are known to be promoting the use of nationally developed public procurement toolkits to foster the use of e-accessible goods and services in their public administrations.

Testing fitness for purpose in practice

6.35 One of the key lessons from the case study of using congestion charging technology in Stockholm, Sweden is that in order to get public support for a particular energy efficiency technology, the technology needs to function as envisaged and be reliable. However, often the functionality and reliability can only be established once the technology is trialled and tested in practice.

6.36 Some of the case studies have highlighted how trialling and piloting can be good practice in large technology implementation projects. In Stockholm, the testing of technology resulted in the support of the residents who otherwise might have been suspicious or even resisted the full implementation of the scheme. Because the trial worked well and showed a high level of reliability, the referendum received a positive result. The case study of City of Helsinki illustrated the technical benefits of piloting. The compatibility issues of using a network card approach to reducing the energy use of computers only arose when the technology was tested on various computer models with different types of network cards. The piloting led to explore other, less hardware-reliant. Further solutions were first trialled on a small scale and then gradually rolled out to ensure fit with the ICT environment.

6.37 The case study of Amsterdam Smart City is an example of a project fully geared to test the fitness for purpose of various new technologies. The project tests smart technologies, each as

a separate project, on a small scale in a real life setting and explores their contribution to reducing the city's carbon emissions. Technologies successful in this project can then be scaled up and used elsewhere in larger projects. The pilot project results can be used to build a credible business case in further projects.

Conclusions and recommendations for authorities

Conclusions

6.38 ICT-based energy efficiency projects do not have to be complex to be effective. In many cases, simple solutions seem to work best. The case studies have shown that this is especially true on occasions where the authorities are constrained by costs, where there are a large number of expected users or when there might a need to link it with other technologies or scale the technology up at a later stage.

6.39 The starting point of any project should be the identification of the problem and what type of solution is required. The evaluation of different options should focus on the fitness for purpose. Aspects that can define what is fit for purpose can include the interoperability of the technology, and the extent to which it is multiuse by nature or how a particular solution might generate wider economic benefits which are prioritised by the authority.

6.40 Considering the 'human factor' in deciding on a technology is also important as it impacts on the way in which the technology is used. Training, awareness raising or adopting technologies which are accessible to all by design are strategies which can be used to ensure that the technology selected is in line with the skills and capabilities of the intended users. Various case studies have shown that testing and gradual implementation are important for successful ICT based energy efficiency initiatives. Piloting not only allows any final technical difficulties to be spotted without causing large scale disruption but it can also be useful for obtaining buy-in from users or other stakeholders.

Top five recommendations for authorities

- Always start a project by identifying what the problem is and outlining why and how the technology is going to help to address the energy efficiency issue or problem. It is important to create a solid case for investment prior to committing any resources.
- Do not get blinded by complex technologies with wide ranging functionality. Consider simpler technologies which may be part of the general ICT package already used in local and regional authorities. This is especially useful if the authority is constrained by costs, faced by a large number of expected users or when there might a need to link it with other technologies or scale the technology up at a later stage.
- When considering fitness for purpose, take into account interoperability, extent to which the technology can be applied to multiple purposes or whether a particular option provides wider economic benefits which are important for the authority.
- The 'human factor' of any technology should be considered in both selecting technologies but also in implementing ICT projects. Where the skills of the users are

not in line with the technology, training or awareness raising should be used. When accessibility to users of all abilities is a concern, the authority should consider adopting ICT solutions which are recognised to be e-accessible.

- Test and roll out new technologies gradually. This can be especially useful when buy-in from users or stakeholders is required for the implementation to run smoothly.

7: Planning energy efficiency implementation to 2020 and beyond

Introduction

7.1 All authorities face the dilemma of prioritising which energy efficiency initiatives to implement first. Many are also seeking to move on from implementing one or two stand alone initiatives towards creating a long term implementation plan to deliver energy efficiency and/or climate change goals to 2020, 2030 or beyond. This guidance will outline the processes for developing energy efficiency strategies and implementation plans and describe the tools available for authorities to prioritise projects.

The problem and objectives of this guidance

Problem

7.2 Climate change, sustainability and energy efficiency policy objectives and quantitative targets (e.g. CO_2 reduction) are now established at a European scale as well as for most Member States. Regional and local authorities have an important role in the delivery of those objectives within their communities and for their own organisations/assets but need to consider what will be the most effective approach before embarking on implementing ad hoc projects. Without some attention to strategy formulation and planning, supported by quantitative information on the main sources of CO_2 emissions/energy consumption, scarce resources (financial budgets and staff) might be spent on projects that perform poorly and only make a minor contribution to the longer term objectives.

Objectives

7.3 This guidance will help authorities seeking to address the following questions:

- what is involved in developing and implementing a coordinated plan to reach energy saving targets in 2020 (and beyond)
- what role do greenhouse gas/carbon emissions inventories play in developing a plan
- how should authorities prioritise between all of the potential initiatives and projects to meet energy efficiency goals
- what practical tools, guidance and experiences on developing and implementing energy plans from other authorities are available to learn from.

Guidance for authorities

Local and regional mechanisms for energy efficiency strategy formulation and planning

7.4 Action to improve energy efficiency at a local and regional level is commonly driven by the achievement of European Union energy and climate policies. However, the linkages between policy objectives and the implementation of local initiatives will vary between different Member States where there are different public administration structures and arrangements at the national, regional and local levels.

7.5 Many authorities have established and adopted strategies and plans at a local or regional scale. These vary considerably in terms of their scope (e.g. energy efficiency and/or renewable energy generation, climate mitigation and/or adaptation), focus (e.g. sectoral coverage, public/community/private realms) and time horizons (e.g. three years, five years, to 2020, to 2030 or beyond). Some are required by legislative provisions and are formally adopted whereas others are voluntary in nature and have a role to support and influence other statutory plans (e.g. land use plans).

7.6 For example, the City of Amsterdam's 2040 Energy Policy sets ambitious targets to make the transition to sustainable energy use, with subsequent effects on CO_2 emissions in the area. Amsterdam is seeking: reduce 75% of CO_2 emissions by 2040; reduce 40% of CO_2-emissions by 2025 (compared to 1990); and to make the municipal organisation carbon free in 2015. It is adopting a threefold approach:

- energy savings
- sustainable energy
- energy efficiency.

7.7 Other initiatives at the municipality include:

- climate neutrality in new build public buildings by 2015
- electric transformation (infrastructure/cars)
- local sustainable heat
- wind and solar photovoltaic renewable energy production in the city
- greening of IT.

7.8 In Maribor, Slovenia, the Local Energy Concept of the Municipality of Maribor was initiated in 2007. In February 2009 the Local Energy Concept was approved by the City Council. Its aim is to improve energy efficiency in the municipality by 1% a year from 2009 to 2018 and to achieve a 25% share of renewable energy in the primary energy balance of the municipality by 2025. It contains the following objectives:

- to reduce energy consumption in municipal public buildings: average annual demand for heating in elementary schools should not exceed 110 kWh/m^2 and 160 kWh/m^2 in kindergartens

- to replace the use of fossil fuels in public municipal buildings with renewable energy sources
- to set clear and comprehensive responsibilities for the field of energy in the municipality
- to improve energy efficiency in the housing/buildings/household sector
- to increase the share of renewable energy in the housing/building sector
- to promote renewable energy and energy saving in the business sector
- to increase awareness of all users in the municipality on energy conservation, efficient use of energy and renewable energy
- to reduce the use of electric power in the municipality
- to promote the generation of 'green electric power' in the municipality
- to introduce energy and environmental criteria in transport management in the municipality.

7.9 The State of Berlin's approach is underpinned by an energy savings law that was in place by 1990 to contribute locally to climate protection and guarantee a sustainable energy supply. Four years later, Berlin committed itself to reduce its CO_2 emissions by 25% by 2010 compared to 1990 levels. In order to achieve this goal, the Senate of Berlin decided on an energy programme with a wide variety of instruments. The recent State Energy Programme 2006-2010 focused mainly on the increase of energy efficiency, renewable energy use and energy savings with the intention to provide an effective energy and climate protection policy.

7.10 Berlin reached its 25% CO_2 emission reduction goal in 2005. New targets were subsequently formulated and Berlin is now aiming for a 40% CO_2 reduction compared to 1990 levels by 2020; it also wants to halve its per-capita emissions by 2030. In its climate policy work programme from July 2008, the Senate of Berlin confirmed the importance of involving stakeholders through climate protection agreements that commit social and economic stakeholders on a voluntary basis, appreciating that climate and energy policy requires actions from all sectors.

7.11 Some local and regional authorities are also making use of other environmental mechanisms in managing climate protection and energy efficiency actions. For example, the Municipality of Amaroussion has been registered under EMAS (Eco-Management & Audit Scheme) since June 2005. EMAS constituted a good reference point as well as a commitment for activities related to climate protection and energy efficiency for ensuring the continuous improvement of environmental performance of the municipality. In particular, the municipality has been awarded with the 1st National EMAS Award 2009 for the application of green procurement in its supply chain. Since February 2010, the municipality has been certified according to the requirements of ISO 14001:2007.

Sustainable Energy Action Plans

7.12 Many European towns, cities and regions have voluntarily committed to reducing their CO_2 emissions beyond the EU-wide 20 % target by signing up to the Covenant of Mayors. The Covenant of Mayors commitment is achieved through the implementation of Sustainable Energy Action Plans (SEAPs).

7.13 As defined in the 'How to develop a Sustainable Energy Action Plan - Guidebook'[xxxii] (the SEAP Guidebook), a Sustainable Energy Action Plan:

> *is a key document that shows how the Covenant signatory will reach its commitment by 2020. It uses the results of the Baseline Emission Inventory to identify the best fields of action and opportunities for reaching the local authority's CO_2 reduction target. It defines concrete reduction measures, together with time frames and assigned responsibilities, which translate the long-term strategy into action. Signatories commit themselves to submitting their SEAPs within the year following adhesion. The SEAP should not be regarded as a fixed and rigid document, as circumstances change, and, as the ongoing actions provide results and experience, it may be useful/necessary to revise the plan on a regular basis.*

7.14 There is a growing body of experience amongst local and regional authorities in preparing SEAPs. A logical, phased process involving a number of key actors is advocated in the SEAP Guidebook – see Table 7-1. As well as the SEAP Guidebook there is a SEAP template and supporting instructions are that are available in the Covenant of Mayors website library[xxxiii].

Table 7-1: The Sustainable Energy Action Plan process – main steps and roles of the key actors

Step	**Role of the Actors**		
	Municipal council or equivalent body	**Local administration**	**Stakeholders**
PHASE: Initiation			
Political commitment and signing of the Covenant	Make the initial commitment. Sign the Covenant of Mayors. Provide the necessary impulse to the local administration to start the process.	Encourage the political authorities to take action. Inform them about the benefits (and about the necessary resources).	Make pressure on political authorities to take action (if necessary).
Adapt city administrative structures	Allocate sufficient human resources and make sure adequate administrative structures are in place		
Build support from stakeholders	Provide the necessary impulse for stakeholders' participation. Show that you consider their participation and support as important.	Identify the main stakeholders, decide what channels of communication / participation you want to use. Inform them about the process that is going to start, and collect their views.	Express their views, explain their potential role in SEAPs.

Step	Role of the Actors		
	Municipal council or equivalent body	**Local administration**	**Stakeholders**
PHASE: Planning phase			
Assessment of the current framework: Where are we?	Make sure the necessary resources are in place for the planning phase.	Conduct the initial assessment, collect the necessary data, and elaborate the CO_2 baseline emission inventory. Make sure the stakeholders are properly involved.	Provide valuable inputs and data, share the knowledge.
Establishment of the vision: Where do we want to go?	Support the elaboration of the vision. Make sure it is ambitious enough. Approve the vision (if applicable).	Establish a vision and objectives that support the vision. Make sure it is shared by the main stakeholders and by the political authorities.	Participate in the definition of the vision, express their view on the city's future.
Elaboration of the plan: How do we get there?	Support the elaboration of the plan. Define the priorities, in line with the vision previously defined.	Elaborate the plan: define policies and measures in line with the vision and the objectives, establish budget and financing, timing, indicators, responsibilities. Keep the political authorities informed, and involve stakeholders. Make partnerships with key stakeholders (if necessary).	Participate in the elaboration of the plan. Provide input, feedback.
Plan approval and submission	Approve the plan and the necessary budgets.	Submit the SEAP via the CoMo website. Communicate about the plan.	Make pressure on political authorities to approve the plan (if necessary).
PHASE: Implementation phase			
Implementation	Provide long term political support to the SEAP process.	Coordinate the implementation plan. Make sure each stakeholder is aware of its role in the implementation.	Each stakeholder implements the measures that are under its responsibility.
	Make sure that the energy and climate policy is integrated in the every day life of the local administration.	Implement the measures that are under responsibility of the local authority. Be exemplary. Communicate about your actions.	Make pressure / encourage the local administration to implement the measures under its responsibility (if necessary).
	Show interest in the plan implementation, encourage stakeholders to act, show the example.	Motivate the stakeholders to act (information campaigns). Inform them properly about the resources available for EE and RES.	Changes in behaviour, EE and RES action, general support to SEAP implementation.
	Networking with other CoM signatories, exchanging experience and best practices, establishing synergies and encouraging their involvement in the Covenant of Mayors.		Encourage other stakeholders to act.

Step	Role of the Actors		
	Municipal council or equivalent body	**Local administration**	**Stakeholders**
PHASE: Monitoring and reporting phase			
Monitoring	Ask to be informed regularly about the advancement of the plan.	Proceed to a regular monitoring of the plan: advancement of the actions and evaluation of their impact.	Provide the necessary inputs and data.
Reporting and submission of the implementation report	Approve the report (if applicable).	Report periodically to the political authorities and to the stakeholders about the advancement of the plan. Communicate about the results. Every second year submit an implementation report via the CoMo website.	Provide comments on the report and report on the measures under their responsibility.
Review	Ensure that plan updates occur at regular intervals.	Periodically update the plan according to the experience and the results obtained. Involve political authorities and stakeholders.	Participate in plan update.

Source: [xxxiv]

7.15 The preparation of a SEAP or an equivalent strategic plan is an activity that involves setting out long term goals/objectives and an accompanying strategy as well as a plan of action to achieve the strategy through a series of actions/ measures/ initiatives/ projects (referred to as initiatives in this guidance). Whilst all SEAPs should run until at least 2020, different authorities will adopt different time horizons for their plans depending on local institutional arrangements and other circumstances. For longer term plans (e.g. longer than ten years into the future) it is appreciated that it will probably not be possible for authorities to plan specific projects in detail beyond the first period of the plan (e.g. three to five years).

7.16 The City of Malaga is an example of an authority that has committed to reducing its carbon dioxide emissions by a minimum of 20% by 2020 after signing up to the Covenant of Mayors. It has a shorter term target of reaching 11% savings in electricity by 2012, defined in the Regional Sustainability Energy Plan for Andalucia (2007-2013) (in Spanish, Plan Andaluz de Sostenibilidad Energética). In early 2011 Malaga's Sustainable Energy Action Plan was in the process of being approved by the City Council. The City of Malaga is also a signatory of the European Green Digital Charter[xxxv] , launched at the end of 2009 to encourage cities to link their ICT activities to energy efficiency for buildings, transport and energy.

7.17 As in Malaga, the Covenant of Mayors is seen as an important new driver of change within le Pays de Rennes in France where around 90% of the local districts have signed up to the Covenant, along with Rennes Métropole. Since its official launch in 2009, around 50 of a total of approximately 150 French authority signatories come from the Rennes area. In addition to the Covenant, various other documents are influential:

- Le plan climat énergie territorial de Rennes Métropole (2010) – adopted in October 2010, this plan describes how Rennes Métropole is intending to engage local

authorities in increasing energy efficiency and renewable energy, including continued support of the shared energy service

- Le Schéma de Cohérence Territorial (SCoT) – a policy and planning framework for infrastructure covering the whole of the Pays de Rennes territory which came into effect in 2008. The SCoT includes a presumption in favour of energy efficiency and renewable energy in new developments
- Programme Local de l'Habitat (PLH) – sets out the social and commercial housing strategy for the Rennes Métropole area, with a undertaking to construct new social housing
- Plan de Déplacements Urbains (PDU) – the urban transport strategy for Rennes Métropole.

7.18 This illustrates that the Covenant of Mayors can provide additional impetus for action. In Rennes, the authorities that have signed the Covenant have committed to go further than obliged.

The role of emissions inventories

7.19 A critical step in planning and prioritising energy efficiency initiatives is understanding and quantifying the main sources of emissions within a city or region. Within the SEAP Guidebook, a Baseline Emission Inventory (BEI) is seen as:

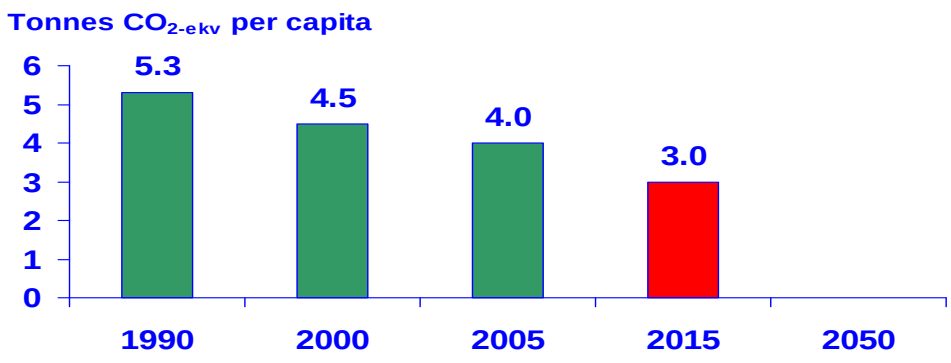
> *a prerequisite to SEAP elaboration, as it will provide knowledge of the nature of the entities emitting CO_2 on the municipality's territory, and will thus help select the appropriate actions. Inventories conducted in later years will allow determining if the actions provide sufficient CO_2 reductions and if further actions are necessary.*

7.20 Part 2 of the SEAP Guidebook provides detailed advice for authorities on how to undertake a BEI for CO_2 emissions and, where appropriate, other GHG emissions. The advice includes defining the boundaries and scope, selecting emission factors, how to collect activity data and the calculation, reporting and documentation arrangements.

7.21 There are many other tools available to authorities for measuring carbon and other GHG emissions although care should be taken to adopt recognised and standardised approaches wherever possible. The Environment Tools Directory[xxxvi] provides a listing of more than 450 carbon accounting tools and identifies the underlying methodologies that they adopt (e.g. Intergovernmental Panel on Climate Change guidance to countries on compiling GHG emissions inventories and the EMEP/European Environment Agency air pollution emissions inventory guidebook).

7.22 Once emissions have been quantified, targets for reductions can be communicated in different ways. For example the City of Stockholm adopts a 'per capita' approach and publicises its overall objective to reduce per capita carbon dioxide emissions over time, to 3 tonnes by 2015 (see Figure 7-1).

Figure 7-1: Chart showing reduction in per capita emissions since 1990 and future targets



Source: City of Stockholm

Considerations in developing a vision, objectives/targets and strategy

7.23 An emissions inventory is intended to help an authority to understand the baseline situation today. By contrast, a well formulated vision is intended to set out the authority's aspirations for the future on a relatively long term basis. Quantified objectives/targets and strategies sit alongside and further elaborate upon the vision, for example by establishing interim goals or milestones (see also the guidance on metrics and indicators).

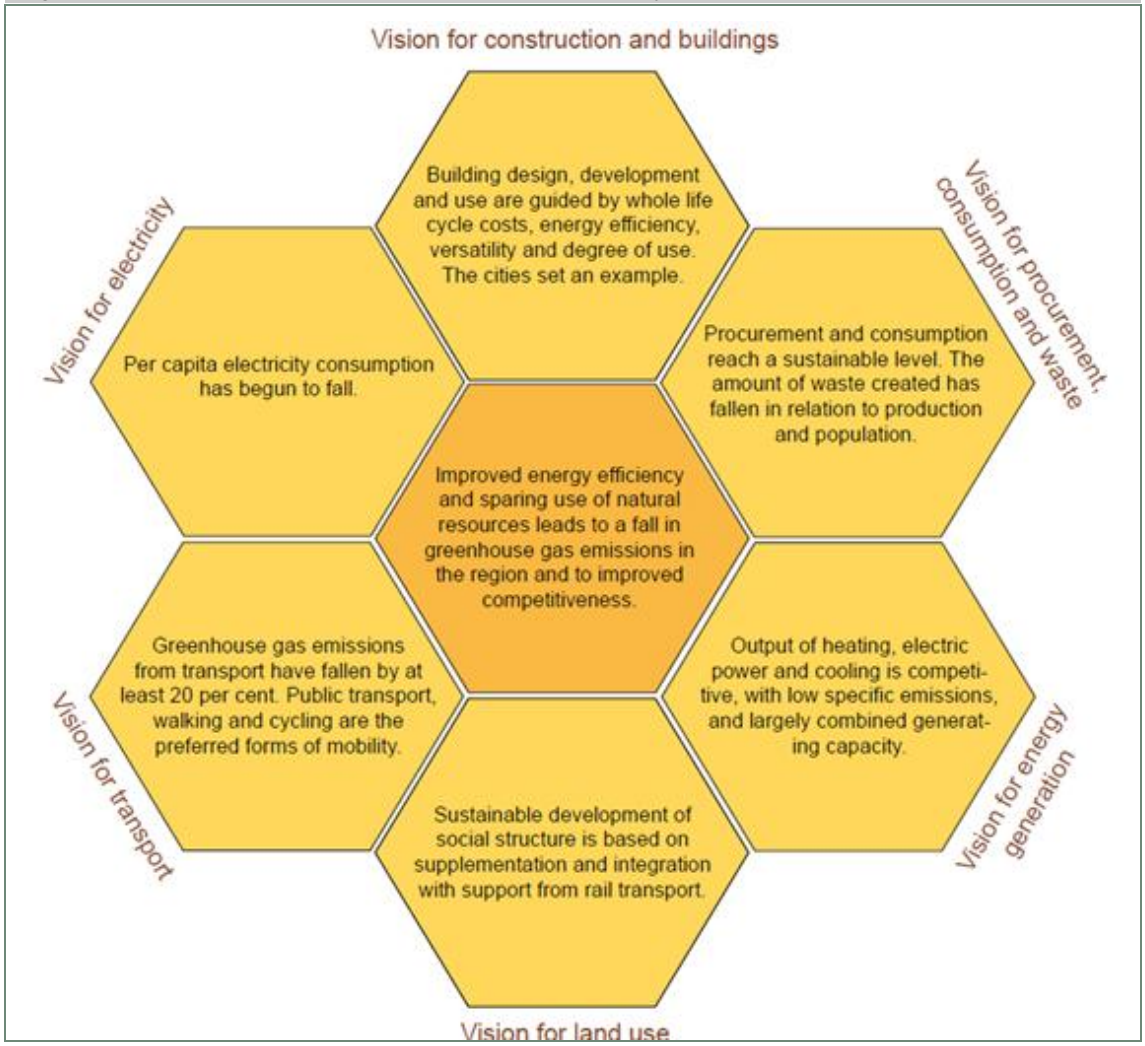
7.24 Further information is contained in the SEAP Guidebook but there is no single blueprint for the development of a sustainable energy vision, objectives or strategy that will be appropriate for every local and regional authority.

7.25 One illustrative example is the process adopted in the Helsinki Metropolitan Area Climate Strategy. The purpose of the Strategy[xxxvii] is to set a common vision and appreciation of operating policies to reduce GHG emissions in the Helsinki Metropolitan Area. It aims to ensure that GHG emission cuts become a consistent element in the objectives and plans of the various municipalities in the metropolitan area. The strategy focuses primarily on instruments that fall within the purview of city municipalities and can be realised through operations and guidance measures.

7.26 The strategy outlines a vision of reduced GHG emissions and improved regional competitiveness deriving from energy efficiency and sparing use of natural resources. It outlines the key target for the area to be a 39% reduction in the per capita GHG emissions of the 1990 level by 2030 which equals to 4.3 tonnes CO_2 per capita.

7.27 The strategy also identifies six sectoral visions as key areas for emissions reductions. The visions have been compiled in collaboration with a wide range of stakeholders from the public and private sectors, including sector specialists (see Figure 7-2).

Figure 7-2: Helsinki Metropolitan Area climate vision for the year 2030



Source: YTV (2008). Helsinki Metropolitan Area Climate Strategy to the Year 2030, p.17

Selecting and prioritising initiatives

7.28 There are an ever growing number of ICT-enabled initiatives that can be adopted by local and regional authorities to make a contribution to energy efficiency and other sustainability objectives. A diverse range of case study examples from across Europe are available within this toolkit. As a result, once some momentum starts to build for an authority (e.g. around a new vision, objectives and external commitments), it may be tempting to try to initiate a large number of innovative projects covering a wide range of issues and stakeholders. However, in order to deliver effectively and maintain buy in from stakeholders, a realistic and practical approach is advocated.

7.29 Adopting a practical approach was seen as a key success factor for the Julia 2030 initiative in Helsinki. The process of developing the Helsinki Metropolitan Area Climate Strategy was laborious and at times frustrating as it was difficult for the partners to see the progress that had been made. To keep the motivation of the partners, Julia 2030 needed to bring concrete actions to achieve results and be practical about what the municipalities had power and influence to do. Therefore, the project concentrated on working in areas where municipalities can make changes including reducing the municipality's own emissions, identifying future

direction for policy and action, and providing tools for residents and businesses to do their share.

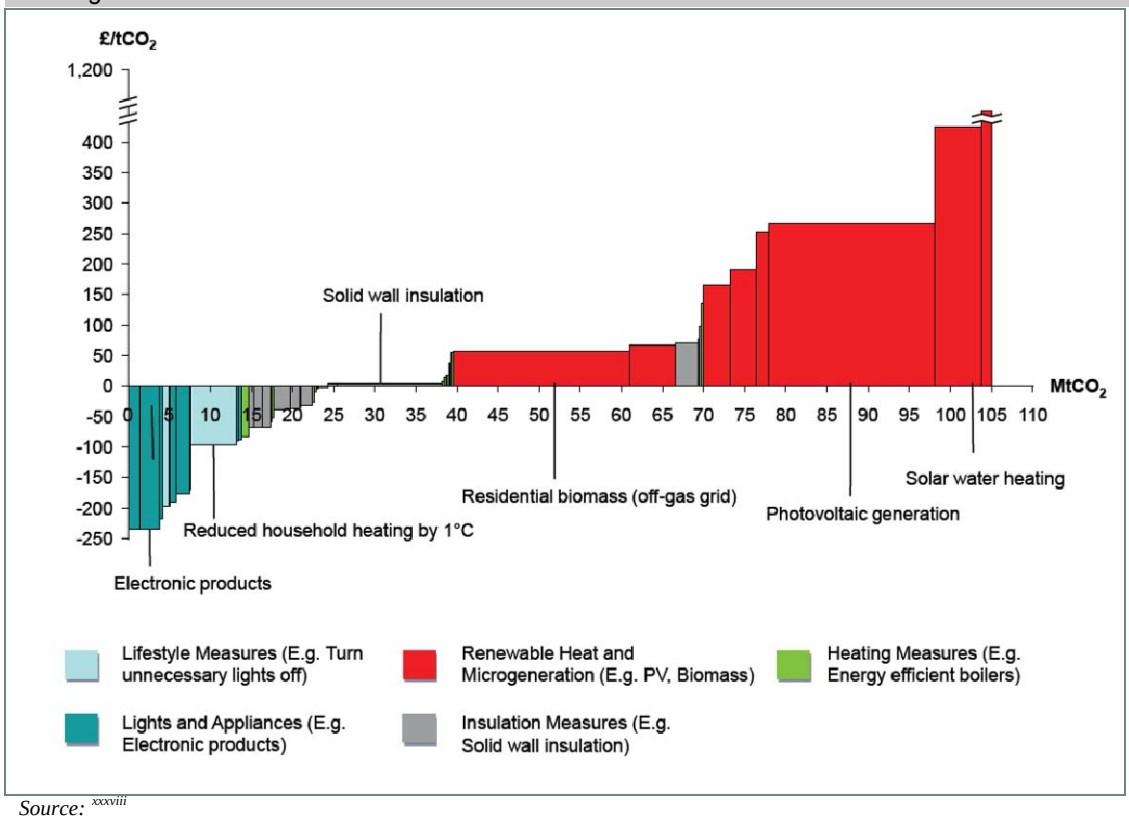
7.30 For a project of Julia 2030's size and complexity, it was also important to set up timelines which are realistic, appreciating that progress does take time. Three years is considered to be the optimal duration. A shorter timeline might mean that the project does not have enough time truly to embed the activity in the municipalities whilst a longer timeline might make it more difficult to plan due to political and financial uncertainty.

7.31 Finally there was a focus on practical and useful carbon tools to support the action. The tools used established and known technology (the internet) available and accessible to all partners at no additional cost. The choice of tools was also influenced by an acknowledgement that users vary in terms of their technical skills and consequently have to be as simple and user friendly as possible. The technical tools were also bundled with practical training for the users.

7.32 Another consideration is how best to select the initiatives that will be most effective in energy/CO_2 reduction terms and that will also be cost effective given capital and revenue funding constraints. There are various tools and methodologies that authorities should consider to assist in appraising, comparing and prioritising the different options available to them. These include:

- predictions of energy/CO_2 saving potential: at its simplest level, quantified estimations normally expressed over the lifetime of the initiative or on an annual basis
- Marginal Abatement Cost (MAC) analysis: to examine the cost per tonne of carbon saved for different initiatives, at a country scale or regionally/locally/within an organisation. This analysis can produce a visual representation in the form of a Marginal Abatement Cost Curves such as the one shown in Figure 7-3. An advantage of a MAC curve is that users can compare potential initiatives both in terms of cost effectiveness and CO_2 reduction in a single graph
- Cost Benefit Analysis: to compare the total expected costs against the total expected benefits of the intervention, usually in monetary terms
- analysis of the rate of return or payback period: to determine in monetary terms the level of return on the initial investment or the time required for the return on an investment to 'repay' the sum.

Figure 7-3: Marginal Abatement Cost Curve – example of the UK's technical potential for the residential buildings sector to 2020



Source: [xxxviii]

Conclusions and recommendations for authorities

Conclusions

7.33 Local and regional authorities may be able to identify some suitable energy efficiency and sustainability initiatives on an intuitive and ad hoc basis. However, without some strategic planning supported by information on the main areas of energy consumption/CO_2 emission sources, there is a real danger that the initiatives selected are not the most appropriate or cost effective. Ultimately this will hamper progress towards long term goals.

7.34 The scope and planning timeframes for energy efficiency will vary between cities and municipalities of different scales who will be working within different budgets and other constraints. Nevertheless, sharing experiences as well as processes/tools can help authorities to avoid common pitfalls. The Sustainable Energy Action Plan Guidebook[xxxix] provides a useful framework for authorities looking to develop a successful plan.

Top five recommendations for authorities

- Take a long term approach and learn to devise projects as a complementary and coherent group to be delivered in a logical sequence. This includes the implementation of ICT enabled and other energy efficiency projects.
- Build support from stakeholders and seek to secure a long-term political commitment. Be aware that conflicting stakeholders' interests deserve special attention.

- Put in place the appropriate financial and other resources. Ensure proper management arrangements are in place during implementation and make sure that your staff has adequate skills, and if necessary offer training.
- Do a proper CO_2 emissions inventory as this is vital to understanding where actions and initiatives are most needed. Establish CO_2 monitoring and reporting mechanisms with appropriate ICT to enable them.
- Actively search for and take advantage of case studies, experiences and lessons learnt from implementing energy efficiency plans in other cities.

Sources of further information

7.35 Covenant of Mayors, (2010), How to develop a Sustainable Energy Action Plan – Guidebook, http://www.eumayors.eu/mm/staging/library/seap_gl/docs/001_Complete_version.pdf

8: Managing project risks

Introduction

8.1 Experiences of project failures and perceptions of risks can hold back action to implement energy efficiency and sustainability initiatives involving ICT. Awareness of the main types of risk and knowledge of risk management techniques are likely to be valuable to authorities considering whether and how to take forward energy efficiency projects.

The problem and objectives of this guidance

The problem

8.2 Project risk can be defined as *the likelihood of an event occurring that is detrimental to project success* [xl] . In common with other types of projects, the risks associated with regional or local energy efficiency initiatives will generally tend to increase with the scale and complexity of the initiative or for specific reasons associated with the project's context or nature (e.g. organisations working together for the first time or the use of an innovative technology solution).

8.3 Risks can be connected with any area of uncertainty that represent a potential threat or an opportunity to a project[xli]. Project decisions are taken based on the best information at the time, but outcomes are never absolutely predictable. Some degree of risk is inevitable for a project to achieve its objectives and to make the most of opportunities that might accrue. So managing risk does not mean 'playing it safe' on every count. Most attention to risks will be to avoid or reduce the likelihood of events that might cause your project to be thrown seriously off course.

8.4 The identification and consideration of risk is considered by many to be an integral part of managing projects and the successful delivery of change but the management of risks may be overlooked, particularly for smaller scale projects that do not involve physical engineering activities (e.g. behavioural change activities).

8.5 Where risks are not effectively managed the negative consequences for an authority and its project stakeholders can be wide ranging in terms of finances/resources as well as potentially safety/welfare and pollution. Demonstrating an appropriate awareness and management of risk is also a prerequisite for receiving external funding from most sources. For example, funding applications under the Intelligent Energy Europe programme require risk management and contingency planning to be addressed within an applicant's description of the 'management' work package for all submissions[xlii]. Similarly risk management is recognised in guidelines for other European Commission funded projects.[xliii]

Objectives

8.6 The objective of this guidance is to help authorities to ensure that ICT-based energy efficiency initiatives meet their objectives and deliver practical, sustainable solutions. It seeks to address the following questions:

- what are the common risks facing regional and local authorities associated with ICT-based energy efficiency initiatives
- how have other authorities addressed these common risks and what can be learnt from their experiences
- what tools and techniques are available to help authorities to best manage uncertainties and unforeseen events/developments when implementing ICT-based energy efficiency measures.

Guidance for authorities

Organisational level risks and project level risks

8.7 When planning a particular energy efficiency initiative, an authority's main focus will be on risks that are directly associated with that project (i.e. project level risks). However risks to a regional or local authority can be associated with any aspects of the broad operations of the organisation or enterprise as well as within the context-specific projects. There is often a relationship between the two such as where a major ongoing risk to an organisation needs to be addressed by a new project which involves taking on new risks, perhaps on a temporary basis.

8.8 This kind of trade off between ongoing authority risks and project risks is illustrated by the project to virtualise data centres in Copenhagen. In that case there was an ongoing risk of disruption to public service delivery because 25,000 end users were using IT infrastructure that was not fully reliable. The virtualisation project was then relatively risky to deliver due to the need for a completely smooth transition to the new system with no down time or hitches (i.e. a large, new system had to work perfectly from the start). In the event, the project risk was worthwhile to achieve the significantly improved reliability of the IT platform.

Common types of risk for ICT-enabled energy efficiency projects

8.9 ICT can play a small role in a very wide range of energy efficiency and sustainability initiatives for transport, planning/buildings and other service provision. Implementation of such projects can also be unique in different authorities and communities due to the particular legal, organisational, cultural and environmental contexts as well as the scale/extent of the project. As a consequence the range of potential risks that can occur is almost endless, particularly given that different types of risk can interact with each other to cause additional consequences. However, there are some common types of risk that have been experienced in other ICT-based energy efficiency initiatives that provide a good place to start in considering which issues might apply to a new project. Five common risks are explored below. Each of

these risks, if they transpire, can result in financial and other resource implications such as escalating costs. Financial consequences are therefore not identified as a separate risk category in the following list.

Risk 1: The intended benefits of the initiative are not realised

8.10 Energy efficiency initiatives will often have a central aim to achieve a certain outcome in terms of the direct reduction of energy consumption or CO_2 emissions. A wide range of other benefits may also be anticipated and possibly used to justify the decisions to proceed with the project. If the stated benefits of even a small project are not achieved, the authority's progress towards energy efficiency goals can be significantly set back through the loss of confidence amongst decision makers and funders of the project.

8.11 Financial benefits are often anticipated from energy efficiency projects through cost savings associated with reduced energy consumption, lower running and maintenance costs of assets and equipment. Further savings potential can also come from lower human resource costs through associated operational efficiency savings in the way that services are delivered. Whilst significant financial benefits can be achieved from energy efficiency projects, sometimes in a very short payback period, a realistic appreciation of the potential for cost savings does need to be carefully thought through in order to meet and exceed expectations. When assessing the potential savings, an holistic approach is advocated so that cost savings in one area (e.g. lower running costs of equipment) are not just offset by increased costs elsewhere (e.g. the number of skilled staff needed to operate the new systems).

8.12 Where the expected energy or CO_2 savings are not being achieved by a project, and this is identified relatively early, authorities may have opportunities to seek to re-focus the initiative to improve performance in future years. Alternatively attention and resources might be shifted to other projects. However, this may not be possible if the initiative is due to provide an immediate and critical contribution to the achievement of energy reduction or CO_2 policy targets at the local, regional or national scale. This highlights the importance of authorities taking a long term, phased approach to setting and meeting energy efficiency goals. Through this approach an authority can identify, prioritise and implement a portfolio of projects so that their impact and cost effectiveness are maximised. For more information see the guidance on strategic planning for energy efficiency implementation to 2020 and beyond.

8.13 Energy efficiency projects often seek to achieve benefits in terms of raising awareness of sustainability issues and/or involve an element of changing attitudes and behaviours in order to realise the direct energy savings. A particular risk for such projects is associated with the time taken to embed behavioural changes. This was an issue for the project in Växjö which aimed to reduce domestic electricity use in buildings by 5% across the city through demand side management. The initial project timeframe was 17 months which was not long enough to achieve behavioural change across the whole of a large population. 'Early adopters' were successfully engaged but it was found that a longer period was going to be needed to get a critical mass involved, and longer still before the 'tail-enders were really engaged. Similarly, in the relatively short duration of the intelligent energy efficiency buildings project in Amaroussion, it was very challenging to try to assess the actual long term benefits of the initiative in terms of the whether the advice on energy efficiency measures was followed.

8.14 With larger capital investment projects there may be a concerted effort needed over a longer period to achieve the optimum scale of benefits, with the associated risk that commitment tails off as members of the project team get involved in other duties. A response to this issue was needed in the Aalst General Hospital Group project to implement a Building Automation System (BAS) and Energy Monitoring and Control System (EMC) over a ten year period. With more systems in place it became apparent that dedicated staff resources with clear responsibilities were needed to work with the systems on a full time basis further to develop and maintain the systems to a optimum standard.

Risk 2: Delays and project timetable over-running

8.15 Risks of delays, resulting in projects not achieving the intended timetable, are common and quite often will only have minor, temporary consequences. However in some situations, even minor delays can undermine the overall success of the project and de-rail opportunities to take forward similar initiatives in the future. The consequences of delays can also be compounded, for example where there are knock-on effects on other risk areas such as cost escalation or on other external projects/programmes. For example in the shared energy advice service project in Rennes, the benefits to the initiative of introducing a new version of the standard energy monitoring software that had historically been used (e.g. freeing up energy advisor time so that they could concentrate on more specialist advice) were held back due to delays in developing the new software. This presented a further, more strategic, risk that different local energy agencies across France would be prompted to opt for different software, ultimately leading to incompatibilities and inconsistencies in the format for reporting energy efficiency improvements on a national basis.

8.16 Risks of delay are by no means unique to ICT-based energy efficiency initiatives, but as illustrated in Figure 8-1, there are some common causes of delay associated with projects involving ICT.

Figure 8-1: Top 11 causes of delays in Information Technology projects

1. Expansion of functionality
The expansion of functionality is a phenomenon in which new functionalities continue to be conceived and requested as the project proceeds. The software can never be completed in this way.

2. Gold plating
Gold plating is a phenomenon in which programmers and designers try to make many details of the software or design too elaborate. Much time is spent improving details, even though the improvements were not requested by the customer or client. The details often add little to the desired result.

3. Neglecting quality control
Time pressure can sometimes cause programmers or project teams to be tempted to skip testing. This frequently causes more delays than it prevents. The time that elapses before an error is discovered in the software is associated with an exponential increase in the time that is needed to repair it.

4. Overly optimistic schedules
Overly optimistic schedules place considerable pressure on the project team. The team will initially attempt to reach the (unrealistic) deadlines. These attempts lead to sloppy work and more errors, which cause further delays. In this regard, be particularly wary of schedules that are imposed from above. The desire to complete a project (more) quickly sometimes arises for primarily strategic reasons; if it is not feasible, however, it should not be attempted. The project will not proceed more quickly and the product will ultimately suffer.

5. Working on too many projects at the same time
Dividing work across many different projects (or other tasks) causes waiting times that lead to many delays in projects.

6. Poor design
The absence (or poor realisation) of designs leads to delays, as it requires many revisions at later stages.

7. The 'one-solution-fits-all' syndrome
Using the right software for a project is important. Some software platforms are more suited to particular applications than others are. Thinking that the use of particular software will greatly improve productivity, however, is also a trap.

8. Research-oriented projects
Projects in which software must be made and research must be conducted are difficult to manage. Research is accompanied by high levels of uncertainty. When or if progress will be achieved in research is unclear. When software development is dependent upon the results of research, the former frequently comes to a standstill.

9. Mediocre personnel
Insufficiently qualified personnel can cause project delays. Technically substantive knowledge of the subject of the project plays a role, as do knowledge and skills in working together to play the game of the project.

10. Customers fail to fulfill agreements
Customers are not always aware that they are expected to make a considerable contribution to the realisation of a project. When customers do not react in a timely manner to areas in which they must be involved, projects can come to a standstill. Worse yet, the team may proceed further without consulting the customer, which can lead to later conflicts.

11. Tension between customers and developers
The tension that can arise between customers and developers (e.g. because the project is not proceeding quickly enough) can cause additional delays, as it disturbs the necessary base of trust and the working atmosphere.

Source: [xliv]

8.17 An example of the source of delay risks in practice is in the Amsterdam Smart City initiative which provides a test bed for innovative products and services, often showcasing new technologies that take time to develop. The initiative has been extended by six months to enable project teams to try to establish and work to realistic periods for overcoming uncertainties and challenges associated with new technology development/application and to ensure that useful data and information can be collected.

8.18 Another potential source of delay in some ICT-enabled energy efficiency improvement projects is the time required to assemble and input baseline data into software tools. For example in the Daventry route optimisation initiative this process was complicated by the fact that the data were available in different formats in the various authorities involved in the initiative. Whilst some of the authorities already had some form of Geographic Information System software, including Daventry that had been using GPS tracking software since 2000, other councils relied on more manual methods to determine routes for waste collection. The time taken to complete this step therefore slowed down the process of data input and collection within the project.

Risk 3: Failure or shortcomings of technologies

8.19 There are particular issues associated with the actual technologies used in energy efficiency and other projects and this is explored in more detail in the guidance on the simplicity and selection of technology solutions. The ICT sector has recognised the need to work with its clients to manage this risk. For example Intellect, the trade association for the UK technology sectors, has introduced an 'IT Supplier Code of Best Practice' which contains commitments for the industry to contribute to a more mature procurement environment for IT solutions. Commitment 7 relates to risk management and states: "We will rigorously identify, analyse and manage risks and we will seek to agree solutions with the customer that offer the best ownership and risk mitigation strategy"[xlv]. This commitment specifically recognises risks associated with novel technologies, "where risk is created by virtue of the scale or novelty of a solution for which there is no reliable benchmark for estimation, we will, if appropriate, recommend a modular or incremental approach to reduce risk."

8.20 Where the uncertainties over technologies and/or the consequences of failure are very significant, another approach is to pilot two technologies in parallel. This approach was taken in the Stockholm congestion charging scheme pilot. At the time there was a high degree of uncertainty over the automatic number plate recognition technology for identifying vehicles entering and leaving the congestion charge. This led the scheme to be designed also to involve in-car transponder units. During the pilot phase for the scheme, the automatic number plate recognition technology was proven to be sufficiently reliable and accurate so that the on-board units were no longer needed, saving significant ongoing costs in operating the permanent scheme.

8.21 The likelihood of success of introducing new ICT technologies for energy efficiency can also be influenced by the ICT infrastructure, equipment and software that are already in place. For example in Helsinki City Council's initiative to introduce energy saving systems for its 20,000 computers, the trialling of different technologies made the IT Department more aware of the constraints of their current IT stock. The initial 'wake-on-lan' technology did not work due to the City Council using a whole range of different types of desktop computer models. Fortunately, they were able to investigate and found other options which were less computer model specific.

Risk 4: Misalignment of partners' expectations

8.22 Many local and regional authority energy efficiency initiatives will involve external public and private sector organisations – either as a supplier of services/technologies or in some kind of more complex partnership arrangement. Working with external partners has significant benefits in terms of accessing the best expertise/solutions and sharing responsibilities and costs. Aligning the objectives and expectations of all parties can however be challenging and, if not achieved in the early stages of a project, can jeopardise the success of an initiative down the line during the detailed implementation phases of a project.

8.23 On a practical level, 'cultural' differences between partners in terms of working arrangements, communication styles and decision/action timeframes can present a risk to progress. This was recognised in the Helsinki Julia 2030 project to reduce GHG emissions across public sector services in six municipalities. Although the partnership working was very successful, in some of the work strands it took time to refine the tools to take into account the differences between the contexts of different municipalities. For example, in the work strand concerned with public premises, the development process of the carbon calculators has required many iterations as the calculators have been amended to take into account different systems being used in different types of premises. Frequent communication from the central project team as well as encouraging partners to provide regular updates on their progress and issues that they are facing are seen as two mechanisms to avoid this risk escalating to an unproductive point.

8.24 Differences in strategic objectives, particularly between public and private sector organisations, should also be recognised up front and reflected in designing an energy efficiency project and its supporting processes. For example the Euro Green IT Innovation Center in Mons is intended to be a 'win-win' initiative for both the public and private sectors alike by encouraging the creation and deployment of energy efficient ICT technologies and

ICT-enabled technologies for energy efficiency in the Walloon Region of Belgium. However, it was also recognised that the benefits to private sector partners could potentially outweigh the benefits to the region. This risk was mitigated by having a majority of public sector directors on the board to ensure that the aims to create jobs, promote SMEs and generate technology transfer remain paramount in deciding which pilot projects to support.

8.25 A difference in the primary interests and expectations amongst project stakeholders does not necessarily have to represent a conflict. However, there may be a need to clarify and communicate multiple/parallel benefits. For example in the Amsterdam Smart City initiative it was sometimes the case that the clients and consumers of particular projects did not have the same degree of interest in energy and sustainability as the core partners of the initiative. Therefore efforts were made to overcome this by highlighting the financial benefits of these innovations for the various stakeholders, rather than the associated carbon or energy savings.

Risk 5: Changes to people/institutions and/or policy goals

8.26 Despite the best efforts to align projects to the latest policy environment and establish collaborative teams to deliver them, things can change once a project is underway. Such risks are not entirely foreseeable but authorities can take preparatory actions in the early stages of an initiative so that the consequences are not so severe. For example, through upfront research and discussion with relevant stakeholders, the timescales for expected new energy efficiency policy development and the political cycles (e.g. local council elections) can be mapped out to see if they coincide with the project's own implementation timetable.

8.27 Alternatively, some change in scope or focus of an initiative may be something that can be accommodated as a managed change once the project is underway. For example, in Malaga's initiative to optimise energy use in public building, the first year of the initiative (Sustainable Schools I) included a water reduction/saving element. This aspect was discontinued in the second year when the entire focus of the initiative shifted to energy efficiency and renewable energies. The slight change in focus made the initiative fit in more with the competencies and general topic focus of the municipal energy agency which was managing the initiative. It was also established that the actions concerning water saving could be taken up by a different municipal department in the future.

8.28 The role of particular individuals can be critical in terms of the particular expertise that they might bring to a project and/or because of their effectiveness and influence as a champion of the initiative (see the detailed guidance on leadership). Changes in key staff occurred within the wider 'MODERN' project during the implementation of the initiative in Craiova to introduce infomobility tools for fleet management in the city; the leaders of other programme elements left the team and their responsibilities were transferred to the leader of the fleet infomobility tools initiative. While this presented a temporary challenge, it was effectively overcome in such a way that the implementation of the initiative was not adversely affected overall.

8.29 The consequences of possible staff changes can also be reduced by taking action up front. In building a project delivery team, particularly for projects over a longer duration, it is important to share responsibilities and to put deputies and/or 'succession plans' for key individuals so that the project can continue successfully even if a key individual changes jobs

or becomes unavailable. The efficient continuity of projects following changes in staff can also be assisted through the use of knowledge management processes and tools within the initiative (e.g. online collaborative project sites for electronic document sharing).

Tools and approaches to managing project risks effectively

Project risk assessment and management

8.30 Risk assessment and risk management can be applied to the planning and implementation of projects including energy efficiency and sustainability initiatives. They are defined as follows:

- **risk assessment** is the process of identifying potential risks, quantifying their likelihood of occurrence and assessing their likely impact on the project[xlvi]
- **risk management** is the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events.[xlvii]

8.31 Formalised risk assessment and risk management are supported by 'ISO 31000' which is intended to be a family of standards relating to risk management codified by the International Organization for Standardization. ISO 31000:2009 provides principles and generic guidelines on risk management for practitioners and companies and seeks to replace the myriad of existing standards and methodologies that have differed between industries, topics and regions.

8.32 When taking forward particular projects and initiatives, risk assessment and risk management are commonly seen as part of the process of project management. Project management in turn can be supported by formalised processes and tools such as PRINCE2 which, originally designed for IT projects, is now one of the most widely used project management approaches more generally (see Figure 8-2).

Figure 8-2: The PRINCE2 project management method

PRINCE® (Projects in Controlled Environments) is a widely used project management method that navigates through all the essentials for running a successful project. Since its introduction in 1989 as a UK government standard for IT project management, PRINCE has been taken on by both the public and commercial sectors and is now recognised as a de facto standard for project management. PRINCE is a flexible method and although originally designed for the management of IT projects is now aimed at all other types of projects too.

The latest version of the PRINCE method is PRINCE2 which was driven by user-based improvements, project management specialists and a review panel of 150 public and private sector organisations. This end result is a generic best practice tool which is flexible enough to be tailored to your organisation and used successfully for all types of projects.

Source: [xlviii]

Project risk registers/risk logs

8.33 In very small projects, the management of risk may be an informal process and the project manager may simply record the risks and any proposed actions to deal with them as part of the project documentation. Risk registers, also known as risk logs, are commonly used in the initial assessment, ongoing tracking and communication of risks and mitigation actions within

other projects. Risk registers list all of the identified risks and the results of their analysis and evaluation.

8.34 Risk registers are often presented as a table or spreadsheet and typically include information on the following (i.e. these points become the column headings of the table) [xlix]:

- risk identification number (unique within the register)
- risk type (where indication helps in planning responses)
- risk owner/raised by (person)
- date identified
- date last updated
- description
- cost if it materialises
- probability (likelihood)
- impact (consequences)
- proximity
- possible response actions (including mitigation actions)
- chosen action
- target date
- action owner/custodian (if differs from risk owner)
- closure date
- cross references to plans and associated risks.

8.35 To provide an immediate sense of the significance of different risks within the risk register, the probability and impact of the risks can be graded on a 'traffic light' system Red, Amber, Green (RAG), where Red is the highest (see Table 8-1)

Table 8-1: Traffic light (RAG) grading for risks within a risk register

Likelihood	Impact	RAG Status
High	High	RED
High	Moderate	RED
High	Low	AMBER
Moderate	High	RED
Moderate	Moderate	AMBER
Moderate	Low	GREEN

Likelihood	Impact	RAG Status
Low	High	AMBER
Low	Moderate	GREEN
Low	Low	GREEN

Source: [l]

8.36 When considering the possible response actions it may be helpful to consider[li]:

- how to prevent it from happening - either by putting some counter-measures in place or putting the project in a position where it would have no impact
- how to reduce the risk - what action is needed to reduce the probability of the risk happening and/or to reduce the impact if it does occur
- whether it may be possible to transfer the risk to a third party (e.g. take out insurance) or share it in some way (shared risk - shared gain)
- what to do to if the risk does occur – do you need a contingency plan
- ensuring that all the stakeholders are aware of the possible consequences of the risk.

8.37 Another possible addition to a risk register is a field to track the status of each risk. This helps to focus management attention and actions on risks that still pose a threat to the project and those that are most severe or increasing in severity over time. Suggested categories that can be used in tracking the status of risks are:[lii]

- **open**: risk identified but no actions agreed
- **actioned:** actions have been agreed and responsibility allocated
- **closed**: risk no longer is a threat to this project
- **increasing**: the likelihood and/or impact have increased since the last review of risk
- **decreasing**: the likelihood and/or impact have decreased since the last review of risk
- **issue:** the risk has become reality and is now an issue for direct management.

Project risk communication

8.38 For project risks to be effectively managed and their likelihood of occurring reduced, risks need to be communicated with various project stakeholders. Within an authority the communication will include the members of the project team, the senior responsible officer and potentially for the most significant/strategic risks, executive decision makers in various departments/roles.

8.39 Where suppliers and/or partners are involved in a project, it is important to have a shared understanding of risks and agreed plans for managing them. On larger projects it is helpful to

organise specific discussions on projects risks between key stakeholders, possibly via a risk workshop held in the early stages of the project.

8.40 The 'summary risk profile' tool has been identified as a simple mechanism to increase visibility of risks and support the communication and escalation of information about risks. It provides a graphical representation of the information normally found within a full risk register and should therefore be updated in line with the risk register on a regular basis throughout the life of the project. The summary risk profile is also referred to as a probability/impact matrix. An example of a summary risk profile is shown in Figure 8-3. Each risk (indicated by an * on the diagram) would normally have a number or other reference and supporting details. The position of the risk tolerance line would depend on the organisation and the nature of the project.

Figure 8-3: Summary risk profile for communicating project risks to senior decision makers

Probability

Very High					•
High	• •		•		
Medium	•		***Risk***	***tolerance***	***line***
Low		• •	• •		
Very Low			•		
	Very Low	**Low**	**Medium**	**High**	**Very High**

Impact

• = Risk

Source: [liii]

Contingency planning

8.41 Risk assessment and risk management enable response actions or 'risk mitigation' to be put in place. Where potential risks are considered to be serious it may also be worthwhile to consider the question 'what do we do if this risk occurs?' via a contingency plan[liv]. Contingency plans explore and address the most relevant scenarios where risks are occurring and they may also assess the budget required to implement it (i.e. only if the risk occurs).

Managing risks in practice in implementing an energy efficiency initiative

8.42 Energy efficiency and sustainability initiatives supported by ICT solutions, alongside many other types of projects, are commonly run by local and regional authorities applying some form of project management process. This enables the projects, and their associated risks, to be controlled. A traditional phased approach to a project lifecycle identifies a sequence of stages to be completed. Two examples of the project stages are shown in Table 8-2.

Table 8-2: Typical project management stages

Stage	Stages associated with a traditional/generic engineering project	Stages set out in the Europaid Project Cycle Management Guidelines [iv]
1	Project initiation stage	Programming
2	Project planning and design stage	Identification
3	Project execution and construction stage	Formulation
4	Project monitoring and controlling systems	Implementation
5	Project completion	Evaluation & Audit

8.43 The management of risks can be effectively organised around the project stages. Table 8-3 describes how the various risk assessment and management tools and approaches can be employed at each stage.

Table 8-3: Overview of the project risk assessment and management activities through a traditional project cycle

Project stage	Project risk assessment & management activities
Initiation	• Establish project risk management approach • Establish resources and responsibilities (including training needs) for the risk management approach • Initial project risk identification, assessment and development of response actions (risk register)
Planning & Design	• Updated project risk assessment and development of response actions (risk register), perhaps via a project team risk workshop • Consider contingency planning for serious risks • Communication of serious risks to senior stakeholders
Execution	• Periodic updating of project risk assessment and development of response actions (risk register)
Monitoring & Control	• Monitoring and response actions/management of risk events arising • Feedback to enable updates to the project risk assessment (risk register)
Closure	• Review of effectiveness risk management approach • Communication of the final risk register to relevant colleagues/stakeholders to help with managing risks on similar projects in the future

Conclusions and recommendations for authorities

Conclusions

8.44 Implementing new energy efficiency and sustainability projects involves introducing change, and therefore inevitably involves taking some risks to deal with uncertainties and unforeseen issues. Many risks may be unlikely to occur and/or would have minor consequences for the project and the authority implementing it. However some risks may be more likely to occur and, if they did arise, would have more serious implications, for example in terms of incurring financial costs, impacts on health and safety or negative publicity/political fall out. Equally there may be beneficial opportunities that arise from a project that can be captured if the project team are open to identifying and handling risks and uncertainties.

8.45 There are various tools and methods available that can be adopted by local and regional authorities to manage the risks associated with new energy efficiency and sustainability projects involving ICT. When risks are managed well, authorities will benefit in terms of:

- the ability to identify, prioritise and handle the common areas of uncertainty and project risks
- achieving the most effective use of financial and other resources
- generating and maintaining confidence amongst project partners and funding bodies.

Top five recommendations for authorities

- Be aware of the common risks that can affect the successful implementation of energy efficiency projects involving ICT. Direct risks to such projects include: delays; the failure or shortcomings of technologies; and situations where the intended benefits of the initiative are not realised
- Be aware also of risks that might be associated with the broader context for energy efficiency/sustainability initiatives such as: misalignment of partners' expectations; and changes to people, institutions or policy goals
- Make use of tools to help the project team to manage the most significant risks. For example, prepare and periodically update a 'risk register' (also known as a risk log) to list all of the identified risks and actions to be taken to control them
- Put in place an appropriate approach for risk management right at the outset of a new project. That way the approach can be tailored for the scale, nature and environment of the particular initiative and a proportional level of time and resources can be allocated to be spent on risk management
- Address project risk assessment and management throughout the project cycle of planning and implementing an energy efficiency initiative. Seek to embed risk management so that project teams naturally consider the risks and opportunities for an initiative.

Sources of further information

BERR (2007) Guidelines for Managing Projects http://www.berr.gov.uk/files/file40647.pdf

Europaid, (2004), Project Cycle Management Guidelines
http://ec.europa.eu/europeaid/multimedia/publications/publications/manuals-tools/t101_en.htm

Office of Government Commerce Programmes and Projects resources toolkit
http://www.ogc.gov.uk/ppm_resource_toolkit.asp

9: Procurement

Introduction[lvi]

9.1 As urged by the European Council on 4 February 2011, public authorities should lead by example, particularly as public spending accounts for 17%[lvii] of EU GDP. A stronger emphasis on energy efficiency in the public sector is crucial, covering public purchasing, the refurbishment of public buildings and encouragement of cities and communities with high ambitions and performance[lviii].

9.2 In terms of ICT, public procurement has been recognised as being particularly important in view of dematerialisation[lix]. This can be achieved by optimising the use of existing physical resources, by optimising the configuration of ICT systems and by ensuring that extensions or upgrades to existing systems are not contractually or technically limited[lx].

9.3 The majority of ICT, however, will involve an external supplier of goods (or equipment) and/or services. There are various ways that the public procurement process can be utilised to purchase supplies, depending on the type and scale of the initiative. These range from direct purchases (from a particular supplier) to open public calls for tender (for example, open procedures), through to organising collaborative (or joint) procurement.

9.4 Various strategies can be adopted as part of the procurement process to help ensure that the best available solution on the market in fact is the one purchased by public authorities. These strategies include engaging and dialoguing with the market, or formulating performance or outcome based specifications to include in tender documents.

9.5 This narrative outlines concrete approaches for use to set up procurement activities to help local and regional authorities achieve the best solution available on the market for ICT technologies for a low-carbon economy.

The problem and objectives of this guidance

Issues addressed

9.6 Public procurement[lxi] is a relatively complex process, but one which also contains scope for achieving excellent results, provided it is used optimally. There are a number of key barriers which are faced by public authorities in getting the right solution through procurement, particularly when relating to relatively new and innovative ICT solutions:

- **co-operation between different departments & authorities**: Purchasing innovative, technically advanced ICT solutions will likely require effective co-operation between several departments within the local or regional authority – procurement, environment, construction, ICT, finance, etc. Furthermore, smaller public authorities may find substantial benefits in working together with other public authorities in joint or collaborative procurement arrangements

- **understanding how to use the tendering process most effectively**: The typical tendering process offers considerable scope for targeting energy efficiency outcomes. However, these opportunities are not necessarily well recognised and exploited. Furthermore, the procurement of ICT technologies may require different approaches to minimise risk (technical and financial)

- **lack of knowledge of solutions available:** Public authorities are unlikely to know the latest innovative solutions available on the market for achieving their goals. There remains relatively little contact between procurers and potential suppliers outside the procurement process. As such, the public sector tends to be slow in adopting new approaches, and typically prefers traditional solutions.

9.7 This narrative attempts to respond to the following frequently asked questions regarding public procurement of ICT for sustainability, and particularly for achieving greater energy efficiency.

- how can the public procurement process be utilised strategically to assist local and regional authorities improve energy efficiency, and thus contribute to a more sustainable development

- how can sustainability requirements best be integrated into the procurement process for solutions involving or using some form of ICT application

- what legally sound approaches are available for public authorities so that they can acquire the best available solutions on the market, particularly in terms of low carbon technologies/solutions.

Objectives

9.8 This narrative aims to provide guidance to local and regional authorities in Europe on how best to use the public procurement process to purchase ICT products and solutions which enable reductions in energy consumption, and hence support the transformation to a low-carbon and more sustainable global environment.

Guidance for local and regional authorities

Setting up co-operative arrangements between departments and joint procurement

9.9 Prior to commencing the process of procuring a particular ICT technology or solution, a number of steps should be taken and actions carried out to ensure that the procurement action that follows effectively fulfils (or goes beyond) the sustainability goals of your organisation.

9.10 Strong **political support** from within your organisation for green/sustainable procurement, sustainability, climate change, energy efficiency or innovation is highly valuable and should be used to help determine your ambition level, in terms of CO_2 reductions. Identification of specific policy targets or ambitions levels in terms of CO_2 savings should also be made at this stage, for example, a reduction of CO_2 emissions of 20% from all public buildings by 2015. These specific policy targets should inform how the procurement is undertaken; hence

ensuring that the technology or solution procured contributes to achieving the policy target. Should this type of policy not exist, consider whether one could be developed for the future.

9.11 Not all procurement actions can be addressed at the same time, and some may be more appropriate for energy efficiency purposes than others. For detailed guidance on how to address the challenge of prioritising which energy efficiency initiatives to implement first, Developing energy efficiency implementation plans to 2020 may help.

9.12 Explore support schemes available to assist public authorities (financially or technically) with the procurement of energy efficient/CO_2 reducing technologies. Some of the resources available are the following:

- the narrative on funding explores many of the issues around funding energy efficiency ICT initiatives, and provides information on EU and international funding sources available to local and regional authorities
- a number of national websites dedicated to sustainable public procurement are available and listed on the European Commission's Green Public Procurement (GPP) website[lxii]
- EU GPP Training Toolkit[lxiii], which provides sustainability criteria to include in the public procurement process for various sectors relevant for ICT. For example, office IT equipment, construction, transport, and road construction and traffic signals
- Sustainable procurement criteria[lxiv] from the Sustainable Procurement Campaign, Procura+
- having clear data on both the potential CO_2 reduction, and the costs over the lifetime of energy efficient technologies/solutions, is vital in making informed procurement decisions. A list and links to a number of LCC tools is available at this specific page on the website of the European Commission for GPP. Furthermore, a tool for calculating LCC and CO_2 emissions[lxv] has also been developed through the EU SMART SPP project
- advice for procurers on energy intensive appliances is available from the Eurotopten[lxvi] website
- Covenant of Mayors[lxvii] website offers a range of advice on curbing CO_2 emissions (such as links to funding institutions) and list of local government signatories to the international initiative
- ICT Policy Support Programme[lxviii] (ICT PSP) offers links to a list of projects on ICT and also funding
- European Commission DG Information Society and Media (DG INFSO) i2010 provides advice on EU policy for ICT as well as links to technical and funding information.

9.13 Furthermore, for cases which entail procurement of innovative products or services involving ICT, risk mitigation strategies (financial, technical or legal risks) should also be explored, if these are new and untested. Certain steps could be considered, depending on the risk, such as, drawing up a 'risk register' to keep track of the possible risks and those who should manage the risk. Running pilot projects first, before committing to purchasing the full volume, or asking suppliers to include a risk analysis and mitigation proposal as part of their bids are also other avenues that could be pursued. For more detailed guidance on the issue of risk, refer to managing approaches to risk.

9.14 Once the above steps have been taken, preliminary discussions should take place with other departments that could potentially be involved – in particular:

- procurers (or central purchasing departments) – to determine when relevant contracts are coming up for renewal, and openness/knowledge of new technologies
- end-users – for feedback on potential improvements requirement, and to determine openness to change
- decisions-makers – to reach agreement about the objectives of the project (or procurement), and to determine the resources available
- financial officers – to discuss opportunities for using life-cycle costing (LCC) calculations for decision making purposes.

9.15 Closely collaborating with relevant departments on understanding their needs, for example in terms of their IT requirements in the pre-procurement phase is the approach that was taken by the City of Copenhagen in virtualising their data centres.

9.16 It is important to put together a team of staff with appropriate project management, technical and legal expertise. Procurement actions, depending on their scale and the nature of the technology or service purchased (for example, a highly innovative technology, such as a fleet of electric vehicles, or a virtual data system installed in several public offices) may be considered as an entire project. It is critical to ensure that all necessary skills are available for the duration of the action:

- project management skills, to manage the staff, work flow and budget
- technical skills, in order effectively to assess new technologies, precisely define needs and interact with the market
- legal skills, to ensure market engagement activities and tendering procedures are legally compliant.

9.17 In identifying project team members, it often pays to look throughout the whole organisation (or consortium in cases of joint or collaborative procurement) to identify the skills required. Moreover, different skills will be required at different stages of the process and setting up an indicative time plan is essential.

9.18 Success, both for the procurement action and for the practical application of the solution selected, will likely require the involvement of others beyond the direct project team,

particularly considering end-users. Other actors (end-users, external advice providers) may need to be involved/consulted at specific in the course of the project.

9.19 Local authorities are increasingly setting up and partnering with municipal energy agencies on initiatives concerning energy use and supply. These agencies tend to be excellent sources of expert technical advice and are often particularly well placed to participate in procurement activities.

9.20 It can also be helpful to join forces with other public authorities in carrying out procurement actions. Potential benefits include lower prices, reduced costs and additional expertise. Moreover, if specific skills gaps have been identified, it might be helpful to consider external assistance which may come from:

- government agencies providing support relating to innovation and/or energy efficiency
- research institutes and consultancy services
- national and/or international networks of public authorities and professional associations and networks
- procurement agencies which may even, for a fee, take on the procurement process.

9.21 In **joint or collaborative procurement**, the demands of two or more authorities are tendered for jointly. Different types of arrangements can be found:

- **central purchasing bodies** - permanent organisations which purchase on behalf of, or establish framework contracts for, a number of public authorities regionally or nationally
- **collaborative agreements** – between public authorities to joint procurement actions either on a regular basis or for one off actions. These can also involve private organisations.

9.22 Technologies or services involving ICT are often innovative and perhaps not widely available on the market. As a result, purchasing costs tend to be high, particularly if a more tailor-made solution is required. Economies of scale can play a crucial role for increasing cost efficiencies. Having large orders early on can make a significant difference to justifying development and production costs for innovative technologies.

9.23 Bundling of demand by joining procurement actions of several public authorities is one of the approaches recommended to reduce risks and costs for individual procurers and also seen as beneficial in terms of knowledge sharing and for fostering 'strong and prosperous communities'. The case study on optimising waste collection routes in Daventry describes in more detail the benefits offered by joint procurement by eight local authorities in Northamptonshire to obtain an improved result in the efficiency of the waste collection service.

9.24 As joint procurement can be a relatively complicated, resource intensive and time-consuming process, a number of factors should be considered when deciding whether to take this approach:

- **consider the market sector** – market sectors differ in the potential role economies of scale can play, impacting on the value of using a joint approach
- **co-ordinating the needs of all** – agreeing on a specification that addresses the needs of all members of a buying group may prove difficult and time-consuming. Aligning contract renewal dates can also be problematic. Only consider joint procurement if the needs of all parties can be adequately met
- **avoid supplier over-reliance** – if the bundled demand would most likely attract only very large suppliers who are not themselves reliant on government contracts and therefore have strong negotiating positions, buyers may risk becoming over-reliant on these suppliers.
- **avoid excluding smaller companies** – smaller companies may be automatically excluded from participating in large contracts for capacity or geographical reasons. This could deprive purchasers of offers of innovative products or services, and specialist or niche offerings; using separate lots is one potential solution
- **consider the size of the consortium** – although unlikely under European competition law, if your consortium is large, it may be worth seeking specific legal advice on whether the action could constitute cartel behaviour.

Designing tenders to achieve energy efficiency goals

9.25 The typical public tendering process[lxix] offers considerable scope for targeting energy efficiency outcomes for actions involving ICT. However, these opportunities are not necessarily well recognised and exploited. Furthermore, the procurement of innovative technologies may require adopting different approaches to minimise risk or to maximise the benefits for sustainability. For more detailed advice on how to use the public procurement process to help contribute to sustainability goals, refer to the European Commission's website on Green Public Procurement (http://ec.europa.eu/environment/gpp/index_en.htm).

9.26 To encourage innovation and maximise CO_2 savings through public procurement, one of the most important steps is to think in terms of what functional outcome you wish to achieve and not in terms of a specific technical solution to achieve that outcome; use an innovative procurement approach which allows the market to find the best solution for your needs. Defining your functional needs and also your energy efficiency target will set the basic parameters for your action.

9.27 The way you define your procurement needs may need to be revisited several times before actual tendering takes place as you become better informed about what is technically and financially feasible, and how your needs should best be expressed in order for suppliers to understand.

Define your functional needs

9.28 Within the project team, and in direct consultation with end-users, come up with a list of parameters which will help to define your functional needs. For example, for lighting procurement, consider the lighting needs which different parts of the building have at different times of day and the required brightness. There may also be aesthetic aspects, such as the colour of the light, to ensure user acceptance.

9.29 Having as clear and detailed a definition of functional needs will help to consult the market effectively, allowing suppliers to provide ideas for how these needs can be met and whether they are feasible at all. Market consultation activities (described later) will help to answer these questions and also help ensure that appropriate technical expressions and industry standards are used.

9.30 Provide as much detail as possible without being too prescriptive. As the project progresses, needs are likely to be refined further. Market consultation and dialogue activities will help to ensure the correct expressions are used, especially when it comes to innovative products and services.

Define your current energy efficiency/CO_2 emission performance

9.31 In order to assess the potential impacts of procurement s – both in financial terms and also in terms of energy or CO_2 savings – it will be necessary to have clear baseline information on the performance of current products or systems. Having this information can also help to communicate the potential benefits of actions to ensure support within the procuring organisation.

9.32 Having a minimum target is an important starting point for market engagement activities. These may be pre-set policy targets, in terms of improving energy efficiency or reducing CO_2 emissions. Having technical and market knowledge in the team will help to make an estimate of what might be realistic.

9.33 Targets may be adjusted before final tendering if these are shown by the market engagement activities to be too demanding or too easy. The use of award criteria in tendering can also help to go beyond minimum targets.

Carry out initial market research

9.34 Some basic market research at this stage will prove helpful to a) become familiar with potential solutions, and also b) to identify key market actors, such as business associations and key suppliers. The main purpose of this research is to identify a range of possible solutions the market can offer and not yet the definition of the bidding document.

Functional or performance-based specifications: What are they and how can they be helpful?

9.35 A performance-based (also called functional or 'outcome-based') specification describes the function or performance to be achieved rather than specifying the exact product or service which will achieve it. It focuses on needs and lets the market suggest the best way in which

these needs may be met, without being technically prescriptive. For example, for a school in need of new lighting equipment:

- a 'traditional' specification would be: "Supply and installation of XXX light bulbs of XXX Watts, and XXX light fixtures"
- a 'functional' specification would be: "Classrooms needs to be lit to XX quality for XX hours per day; corridors need to be lit to YY quality for YY hours per day, etc."

9.36 Environmental performance characteristics can also be formulated to follow the same logic. For example, a performance-based specification might be: "The electricity consumption of the lighting system installed must be XX% lower than the current system"

9.37 Functional or performance-based criteria may be used as either minimum (technical) specifications, as award criteria or a combination of both.

Engage and dialogue with the market before undertaking the tendering process

Informing the market

9.38 Giving clear information on upcoming procurement requirements early enough greatly increases the ability of suppliers to react to these demands. Depending on the procedure followed, informing and consulting the market may take place simultaneously, for example through seminars organised by procuring authorities targeting potential suppliers, such as "meet the buyer" seminars. However, they may also be undertaken separately – this section specifically examines some of the most effective ways to communicate your procurement intentions to the market.

9.39 Identify appropriate information channels:

- look well beyond your regular suppliers – solutions involving ICT application may come from suppliers not used before. Maximise your geographical coverage and also seek to reach smaller companies who may not typically do business with the public sector
- look beyond your existing communication channels and consider which communication channels may best reach innovative companies. Trade associations and chambers of commerce can help to reach smaller, innovative suppliers, as can specialist magazines and exhibitions. Using national and international networks of public authorities can also help to identify potential suppliers
- it takes time to reach the right companies but is critical to the success of the final tender.

9.40 Publish your requirements and attract interest:

- publish information about your procurement plans as widely as possible, providing detail about your specific needs including energy efficiency or CO_2 targets. This information can be published through websites, electronic newsletters and relevant publications

- many public authorities now have a specific section on their website dedicated to potential suppliers that includes information on upcoming tenders. It may also contain information on the procedures to follow in bidding for public contracts
- it can be helpful to publish such information as a Prior Information Notice (PIN). This can then be published directly through the market information channels identified above, including the Official Journal of the European Union[lxx] (OJEU) and posted directly on your own website. The PIN should have clear information on the defined needs, usage patterns and expected performance regarding energy savings and/or CO_2 reductions
- if there is an intention to undertake market consultations later in the process, clear information on how these activities will be organised should be outlined within the PIN to ensure full transparency. Depending on the approach to be taken, the PIN can therefore also be used to ask suppliers to submit written proposals
- the PIN (or other form of tender information) can be sent directly to companies which have been identified as potentially interesting and interested
- companies may be invited to declare their interest in the future tender and in participating in upcoming market consultation activities.

9.41 It can be helpful to engage with potential suppliers through seminars:

- a seminar for potential suppliers provides an opportunity to explain requirements in depth and answer questions on the spot. This can be a highly effective way of raising market interest and also in helping to test the clarity of specified requirements
- such seminars may just be a forum to provide information and offer the opportunity for suppliers to ask questions, or they may be set up as a form of technical dialogue aimed at more in-depth discussions about potential solutions
- seminars should be open to any interested company to participate and communicated widely through the market information channels identified.

Consulting the market

9.42 Some of the possible consultation approaches are listed below. In all cases, it is possible that suppliers require the signing of non disclosure agreements (NDA) to address confidentiality concerns:

- **open seminars and workshops**: Opening dialogue with a group of suppliers around the key questions mentioned above can be held with interested suppliers. However, given its public nature, it is unlikely this format would solicit information on confidential technical developments and pricing aspects
- **written proposals**: Ask suppliers to provide provisional proposals, containing information on:
  - the proposed technical solution and its functionality

- information on CO_2/energy savings achievable
- the current status of development and market readiness
- cost indications
- potential risks
- testing standards they have used to determine figures and performance results.

- **closed discussions**: The most direct form of communication will be to hold direct discussions with potential suppliers behind closed doors. In such closed discussions it is critical to ensure that the basic principles of non-discrimination, transparency, and equal treatment are complied with. The results of such meetings should therefore be documented. When carried out before formal tendering takes place the outcome of these meetings should not be to restrict potential competition but rather to open up the tendering procedures to other alternatives

- **anonymous questionnaires**: In order to collect reliable information without the need for companies to give away private information about their products or services, an anonymous questionnaire may be used asking suppliers whether they can meet each of the different proposed functional and performance needs. This may indicate to the authority whether their needs are realistic or need to be revised.

9.43 It is important to ensure that there is equal access to all market operators, including all the companies which have indicated interest in the process. There is also a need to ensure that there is the capacity within the project team, or by bringing in external assistance, to discuss the questions arising from the tender process.

9.44 It can also be beneficial to involve organisations such as research institutes and universities in the consultation process. Their presence could stimulate the interaction between the contracting authority and the research world.

9.45 Once completed, it is imperative to communicate information on the outcomes of the consultation process. To ensure transparency and equal treatment it may be best to publish the results of the market consultation round online, without disclosing any confidential information. This publication marks the official closing of the round.

9.46 More information about the EU legal framework for market consultation are:

- guide on "Driving energy efficient innovation through procurement – a practical guide for public authorities", recommended also by the European Commission in their guidance on green public procurement online

- online guidance provided by the United Kingdom's Office of Government Commerce (OGC) on "Identify need, strategic planning and early market engagement" or the Guide on "Early market engagement – principles and examples of good practice"[lxxi].

Conclusions and recommendations for authorities

Conclusions

9.47 Local and regional authorities are urged to lead by example, particularly given that public sector spending accounts for a significant share of the EU's GDP. Green public procurement is an effective way to demonstrate a public authority's commitment to environmental protection and sustainable consumption and production; if utilised effectively, it can provide numerous environmental and economic incentives[lxxii].

9.48 In cases where local or regional authorities require the contracting of services or purchasing supplies of goods/equipment involving or utilising ICT, the integration of sustainability requirements in the public procurement process (including the pre-procurement phase) can prove indispensable for achieving reductions in energy consumption.

9.49 A number of mechanisms are available to support local and regional authorities in their sustainable procurement practices, both technically and financially. These mechanisms have been developed by organisations working at the supra-national, national, regional or local level of government, and cater towards the operative and policy frameworks which local and regional authorities function within.

Top five recommendations for authorities

- Co-operation between different departments and public authorities (local and/or regional) is imperative when it comes to green public procurement involving ICT.
- Smaller public authorities may find substantial benefits in working together with other public authorities in joint or collaborative procurement arrangements.
- The greatest benefits for energy efficiency through public procurement can be achieved by planning and organising the tendering and pre-tendering process effectively.
- Consider the use of performance-based specifications in tendering documents. Performance-based specifications provide the mechanism to embed quantifiable outcomes in terms of energy saving levels and more generally can encourage sustainable innovation, such as those involving ICT.
- Sound out the market. Solutions using or involving some form of ICT application are more and more wide ranging and are likely to different areas, including services. Sounding out the market in the preparatory (and pre-tender) phase, and actively consulting potential suppliers for the best available solutions on the market in terms of low carbon technologies/solutions, can lead to superior end solutions.

10: The role of municipal energy agencies

Introduction

10.1 Some of our case studies have highlighted the important role of energy agencies (also referred to as energy management agencies) in designing and implementing energy saving technologies in general and initiatives using ICT in particular. This narrative provides information on how energy agencies have been set up, what roles they are playing and what to consider when designing their scope and mode of operation.

The problem and objectives of this guidance

The problem

10.2 It is widely understood that 'information and encouragement are at the heart of successful local initiatives to encourage take-up of energy efficiency and renewable energy use.'[lxxiii] Given the breadth of responsibilities in all spheres of development, local authorities can be hard pushed to achieve the wide range of possible activities in the energy efficiency sphere without a dedicated institution, such as an energy agency, to take on or assist with this responsibility. Moreover, given the range of conflicting issues local authorities have to address, an energy agency can be helpful to achieve focus and prioritisation in this sphere and to develop a depth of technical and managerial capacity useful for implementing change.

10.3 Key questions to be addressed in this section include:

- what are energy agencies
- what do energy agencies do and how do different communities benefit from energy agency activities
- how are energy agencies set up
- what European support has been available for energy agencies
- what role do energy agencies play in moving forward ICT-based energy efficiency initiatives.

Objectives

10.4 The objectives of this section are:

- to give an overview of energy agencies in Europe, their funding, governance and range of activities
- to make reference to examples where energy agencies have been crucial to move forward ICT-based energy efficiency initiatives.

Guidance for authorities

What are energy agencies

10.5 Energy agencies are organisations set up to further energy saving and efficiency measures at the local and regional level. The first local and regional energy agencies (LAREASs) started in the 1980s from an appreciation that there was a need to shape and influence energy consumption at the local level.

10.6 While there is significant variety in how energy agencies are being set up and how they are operating, there are some core principles. These were summarised in the Energy Agencies Charter which was launched officially during the 1998 Annual Meeting of Local and Regional Energy Management Agencies in Cork, Ireland.

10.7 The key points from the Charter are summarised in Figure 10-1 below.

Figure 10-1: Charter of the Regional and Local Energy Management Agencies in Europe

Whereas

- Energy management (meaning energy efficiency and energy savings and the utilisation of local or renewable energy sources) is a basis component of sustainable development
- The solutions to most global environmental problems, and in particular the efforts to combat climate change, lie above all in energy management
- Approaching energy problems from the angle of demand from consumers, be they households, companies, or public authorities, is essential to have a significant influence on their choices and behaviour in order to limit wastage while improving the quality of life and the standard of living
- Owing to the large number of players involved and their wide diversion the corresponding policies and actions must be decentralised to a regional, urban or intermediate level
- Even though they may not be under any legal obligation, it is the civic duty of the public authorities at the abovementioned levels to pursue a voluntary and responsible energy management policy not only for themselves, but also and above all for all citizens and for companies
- In order to instil a maximum sense of responsibility in citizens, companies (and in particular SMEs) and interest groups, they should be informed, made aware and encouraged to take part and become involved, including in the decision making process
- In order to work efficiently and avoid duplication it is essential that the various levels of public authority (central government, region, province, county, department, district, municipality, etc.) become involved and work in perfect synergy
- In order to make rapid progress it is very important to exchange experience, in particular between regional and local authorities in different Member States in order to disseminate examples of best practice and the most efficient technologies as widely as possible

Aims and modus operandi of Energy Management Agencies

- Its principal aim is to promote energy efficiency and renewable energy sources
- Its area of operations corresponds to a sub national administrative and policy level
- It has political support from the regional and/or local authority or authorities within its area of operations
- Its constitution confers upon it genuine autonomy in relation to existing bodies. In particular, it has its own budget and administrative board
- Its administrative board includes representatives of a variety of players involved in energy management, and in particular local elected representatives and representatives of consumers and local companies
- It has an operations team with at least two permanent members, together with the necessary logistical facilities (headquarters, premises, etc) needed for its tasks and for maintaining its image as an impartial body in terms of energy options
- Its strategy is first and foremost directed towards energy demand from consumers, meaning households, public authorities and SMEs
- Its activities are diverse and concern, in particular, energy planning, consumer information and advice, assistance with setting up, funding, monitoring and evaluating energy management projects, and disseminating the results obtained

It has sufficient will and means for forging cooperation with other European agencies

The Energy Management Agencies hereby commit themselves:

- To ensuring that our Agency pursues its aims and modus operandi as described above
- To becoming members of the SAVE Agencies Network' and to enjoying the benefits deriving from that membership, such as the use of the logo developed by the Commission, to receiving information from it and to being associated with its various energy management activities on the same basis as the agencies that the Community has helped to create.

Source: www.managerg.net

What do energy agencies do and how do different communities benefit from them?

10.8 Energy agencies are involved in a wide range of activities, with benefits for public authorities, businesses, professionals and citizens. They generally support the introduction of good energy management practices, advocate the concept of sustainability, provide information and guidance on energy saving technologies and practices and offer a number of services based on the specific local energy needs.

10.9 There are three main types of added value from energy agencies for local communities[lxxiv]:

- for **local energy users**: provision of independent information and advice for which there is a growing demand at local level and which are not easily provided by the market
- for **public authorities**: provision of assistance and policy advice including technical assistance and training on energy policies and legislation; also relevant is a role in the implementation of local and regional energy policies; setting of local rules and standards; overseeing the implementation of policies and monitoring of adherence to standards; serving as a catalyst for institutional change in local government and public administration. The added value of these activities is highest where technical expertise is scarce
- for **commercial actors**: market facilitation by providing a platform for exchanging experiences, generating and disseminating innovative ideas and facilitating take-up and piloting innovative market-oriented products. The added value of these activities is highest where there is a lack of private activity in energy efficiency and renewable energies and a lack of access to credits.

10.10 Activities and target beneficiaries are summarised on Table 10-1.

Table 10-1: Activities of energy agencies and main beneficiaries

	Main target beneficiaries			
Activity	**Public authority**	**Business**	**Profess-ional**	**Citizen**
Information, advice and training on energy management	■	■	■	■
Awareness raising on energy efficiency, renewable energy sources and sustainable mobility issues	■	■	■	■
Provide a platform for all local stakeholders to meet and develop common projects on energy	■	■	■	■
Support for the implementation of local/regional energy plans	■			
Energy audits of public and private buildings	■	■	■	■
Technical advice on the design of energy management projects (including buildings management, public lighting and others)	■	■	■	■
Search for subsidies and incentive funds at local, national and international level	■	■	■	
Provide technical assistance for decision makers and potential investors	■	■	■	
Assist in developing renewable energy sources plans and plants at the local level	■	■	■	
Provide technical assistance to signatory cities to the Covenant of Mayors	■			
Draft, implement and monitor Sustainable Energy Action Plans (SEAPs)	■			
Provide technical assistance to SMEs and other businesses to become more competitive by reducing their operational costs		■		

Source: www.managenergy.net

How are energy agencies set up

10.11 The creation of new energy agencies tends to be on the basis of an appreciation of the benefits of such an agency at the local level. The current minimum population coverage of at least 200,000 people appears to be appropriate and many agencies are reaching out to larger populations.

10.12 There has not been a snowball effect from the creation of agencies as had been expected at some stage. The roles and activities of agencies are specific to their local situation and needs and the existence of a successful energy agency in one region is generally not sufficient to convince other public authorities to establish their own agencies without European funding.

10.13 There are different organisational models for energy agencies which include[lxxv]:

- agencies embedded in host organisations, in particular local and regional authorities (model 1)
- independent local agencies (model 2)
- independent agencies with significant private sector support (model 3).

Model 1 agencies

10.14 There are a number of **advantages** associated with this in-house model:

- it allows agencies to benefit from the financial security provided by its local or regional host organisation but still gives it exposure to the market
- particular in cases where there is strong political support for the agency, it helps in the definition of an ambitious long term vision
- being part of the local or regional authority facilitates smooth access to other government services which external organisations would not easily have access to. This makes energy efficiency action in activity fields such as education, health, municipal heating and waste disposal easier than otherwise
- it facilitates the setting of energy efficiency and GHG emission reduction targets which an outside agency would find more difficult to achieve.

10.15 Amongst the potential **disadvantages** of model 1 are:

- agencies can be vulnerable when political support disappears following a change in government and/or government policy
- difficulties in establishing a high-performance organisation with a specialist skills set within the culture of a local authority
- general constraints on aspects such as recruitment and procurement imposed by the local or regional authority host that can impede the effectiveness and efficiency of the agency.

Figure 10-2: Example for model 1 agency: Leicester Energy Agency

Leicester Energy Agency aims to help make Leicester a leading authority in the energy sector. The agency's role is to help individuals, businesses and organisations realise the potential effects of climate change and rising energy prices on their work and help them reduce their energy consumption. The agency is part of as part of Leicester City Council and works with different partner agencies to implement energy saving activities in the United Kingdom and beyond.

The agency was formed in February 1996 with funding from the European Commission SAVE II programme as a partnership between Leicester City Council and de Montford University.

The objectives of the energy agency initially were to help 5,000 businesses in Leicester save at least 10% of their energy bills through a variety of methods. Since the end of the European Commission funding in 1999, the agency continued by attracting external funding, as well as drawing on the support of the City Council and de Montford University. It currently employs five full time staff managing local, regional and national European projects and hosting the Secretariat of the Carbon Action Network (formally UK HECA).

The Leicester Energy Agency case study demonstrates the role the agency played in an initiative to explore the benefits of implementing a combined Intelligent Metering Behavioural Change Programme in a range of public sector buildings. The initiative involved partners from Denmark, Austria and Germany who brought expertise and services to the consortium. Leicester Energy Agency was helped in initiating the initiative by its local and European reputation. As an established member of Energy Cities, it could easily find good partners in other European locations and its reputation opened doors in converting interest into commitment. Trust between project partners was built up quickly and this was supported by the strong cooperation with local authority partners who provided the data and information for the project to develop swiftly.

Source: www.energyagency.co.uk

Model 2 agencies (independent funding)

10.16 Model 2 agencies are independent organisations which rely on tapping into different funding sources for their setting up and operation. These funding sources include local, regional and central authorities in their host countries as well European sources (see section on European support for energy agencies). Quite often, this funding is limited for a period of time after which the agencies have to rely on creating their own revenue streams through fee earning activities and sponsorship.

10.17 A common problem for model 2 agencies can be to bridge the transition period between when they are receipt of external funding and the need to be reliant on other revenue funding for when this funding runs out. These funding uncertainties can impact on the strength of the vision of the agency and the vigour with which it pursues objectives and activities.

10.18 Another problem for model 2 agencies is that existing or potential funding constraints prevent them from reaching a critical mass of activity, allowing them to be recognised as strong and capable partners for a range of energy efficiency measures. The issue of critical mass can be alleviated if model 2 energy agencies concentrate on a core set of activities which are appreciated by their beneficiaries.

Figure 10-3: Example for model 2: Berlin Energy Agency

The Berlin Energy Agency was founded in 1992 as a private limited company on the initiative of the Berlin Senate with the aim to identify energy saving potentials and to facilitate the implementation of renewable energy sources.

Source: www.manageenergy.net

Figure 10-4: Example for model 2: Codema Dublin

Codema was founded in 1997 as a not-for-profit limited company. It was set up on the initiative of Dublin City Council, with support from the European Commission. Since its establishment, Codema has acted as the sustainable energy adviser to Dublin City Council. The agency widened its remit to the other three Dublin local authorities in January 2009.

The company works with the public and private sectors to create wide-ranging sustainable solutions for Dublin's citizens, including residential, business and infrastructural projects.

In the private sector, Codema operates as energy and sustainability advisor for building developments and other major projects. For residential and commercial developments that need to meet specific energy standards, Codema advises at both the masterplan and detailed design stages of a project and can work in close liaison with professionals on a team.

Codema employs a staff of nine people with backgrounds in consultancy, engineering, project management and communications.

Being a private entity helps the agency 'in touch with reality', reminds key partners and stakeholders that the organisation can bid on tenders and can win publicly or privately tendered work. Other advantages of its independent status are the credibility associated with being 'a real player' in the market as well as being attractive for employees in terms of their own career development.

Source: www.codema.ie and Vademecum of Energy Agencies

Model 3 agencies (independent funding with significant private sector support)

10.19 Model 3 agencies are to some extent a subset of model 2 agencies, just with a higher share of private revenue funding. These agencies tend to focus more on revenue generating activities.

Figure 10-5: Example for model 3 agency: Grazer Energieagentur

Grazer Energieagentur was set up in 1998 to increase energy efficiency in and around Graz and to promote the use of renewable energy sources. These activities are designed to support energy efficiency and environmental objectives as well as support the stimulation of economic development in Graz by promoting new markets and supporting the competitiveness of businesses in Graz.

The agency's range of services includes:

- consultancy and support including feasibility studies for building and renovation projects
- undertaking energy efficiency audits
- administering an energy efficiency check for small and medium sized companies
- awareness raising campaigns for public sector clients.

At the time when European support was running out, the agency sought to work out very carefully its mission as an independent organisational entity, define its target groups and identify how to earn income for the agency. The agency's development from 2005 has seen a steadily increased share of private sector funding which is attributed to the agency's strengths in technical and economic issues. This has led to a virtuous cycle of rising customer numbers, increased staffing, higher credibility and further increases in the share of private sector revenue.

Source: www.grazer-ea.at

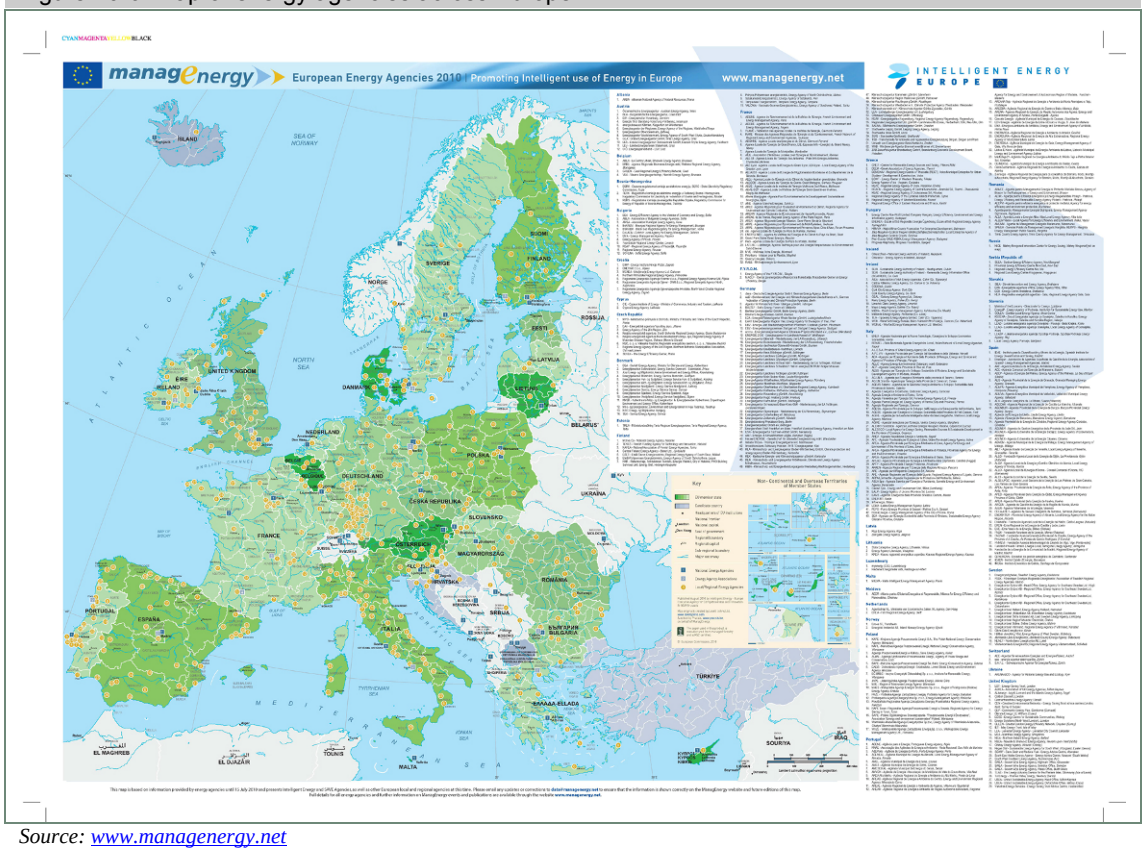
European support for energy agencies

10.20 In the 1990s, the European Commission took the initiative to support local actors in the energy field through the SAVE and SAVE II Programmes[lxxvi] with the aim to integrate European support on regional and urban energy management. The programmes were designed to stimulate a 'bottom up' approach to energy issues, in particular by encouraging local and regional action for energy efficiency, the use of local energy resources and sustainable development at the local level. The importance of having dedicated institutions for this agenda was recognised and SAVE co-founded the creation of agencies at local and regional level.

10.21 Today there are some 400 energy agencies within the EU and new agencies receive support through various European programmes. These agencies are cooperating within various associations including FEDARENE (www.fedarene.org), Energy Cities (www.energy-cities.eu) and ISLENET, a network of island authorities (www.europeislands.net).

10.22 Figure 10-6 contains a map of all energy agencies in Europe.

Figure 10-6: Map of energy agencies across Europe



Source: www.managenergy.net

What role do energy agencies play in moving forward ICT-based energy efficiency initiatives

10.23 There are a number of cases where energy agencies have played an important role in encouraging, designing and implementing ICT-based energy efficiency measures.

- Malaga's Energy Agency, wholly owned by the Municipality, is the main body responsible for promoting renewable energy and energy efficiency in the city. The agency is the instigator, manager and promoter of the Malaga Sustainable Schools Initiative and considers information and training of citizens (including children and young people) as one of its key responsibilities

- the establishment of the local energy agency Energa P was seen as the turning point for energy management in the City of Maribor in Slovenia. The agency was established in 2006 on the initiative of promoters from Maribor and 15 neighbouring municipalities of the North Poravje Region in order to support municipalities, citizens and businesses in their efforts to save energy, reduce energy-related emissions and increase the share of renewable energy in the energy generation and transport sectors. The energy played an important role advising the public sector on energy-related issues and raising awareness of the need to act with environmental sensitivity, particular amongst young people. The agency also played a supportive and consultative role in the design of the Local Energy Concept of the Municipality of Maribor; this strategy started to be developed in 2007 and was approved by the City Council in February 2009

- the local energy agency of Rennes, l'ALE (Agence Locale de l'Energie du Pays de Rennes) is helping a number of local authorities within the Rennes area of Britanny to reduce energy usage in their public buildings, municipal lighting and municipal fleet transport with the help of IT software. L'ALE offers local authority clients a subscriber-only service called Conseil en Energie Partagé or CEP, the shared energy advisory service. The bedrock of this service is a database called Déclic which holds data on local authority energy and water consumption and spending. Energy advisors at l'Ale use Déclic to help analyse trends and compare performance. This analysis is then used as the basis to help the energy agency advise local authorities on potential measures which might save energy. L'ALE has extended its services from just five districts in 1997 to 44 districts

- there are also interesting examples of energy agencies which are working across national boundaries. For instance, the energy optimisation of public buildings in Austria and the Czech Republic is spearheaded by the Energy Agency of the Regions located in the Waldviertel in the North West of Lower Austria, next to the Czech border. The cooperation includes a number of municipalities in both countries and is concerned with first identifying energy saving opportunities and then acting on them.

Conclusions and recommendations for authorities

Conclusions

10.24 Energy agencies can play an important role in promoting energy efficiency at the local and regional level. Energy agencies are involved in a wide range of activities, with benefits for public authorities, businesses, professionals and citizens. They generally support the introduction of good energy management practices, advocate the concept of sustainability, provide information and guidance on energy saving technologies and practices and offer a number of services based on the specific local energy needs.

10.25 The number of energy agencies has expanded steadily since the 1980s/1990s and today there are some 400 energy agencies operating within the EU. Energy agencies can take various forms but in whatever shape they are set up, their core focus is the promotion of energy efficiency in all spheres of public and private activities. This makes them a champion of energy efficiency activities across the board, helping to provide a positive undercurrent for the introduction of any specific initiative.

Top five recommendations for authorities

- Consider establishing an energy agency to catalyse action on energy efficiency and renewable energy. Energy agencies can be involved in a wide range of activities, with benefits for public authorities, businesses, professionals and citizens. In various cities and regions they have been found to be critical to the success of energy efficiency initiatives.

- If considering establishing an energy agency, be aware that there are different organisational models for them. For example agencies can be embedded in host

organisations such as in a particular local or regional authority. Alternatively they can be independent local agencies with or without significant additional private sector support.

- Call upon energy agencies, where they exist, as they provide an excellent resource of knowledge and expertise. They employ people with detailed expertise in the technical and organisational issues arising from introducing energy efficiency initiatives. See Table 3-1 for further details of the activities carried out by energy agencies.
- For ICT-based initiatives in particular, working with energy agencies can have a positive impact as they can advise on appropriate technologies and likely obstacles to be encountered in introducing them.
- Make use of the opportunities to learn from elsewhere. Energy agencies tend to be well networked with other organisations – including other energy agencies – at the national and international level. This enables them to bring in relevant knowledge and expertise for specific initiatives and wider strategies and policies.

11: Urban road user charging

Introduction

11.1 Transport demand management is an important strategy to reduce congestion, CO_2 emissions and air pollution for most European cities and many larger towns. Solutions based on or involving some ICT element are common for these measures – anything from traffic light control systems that are used in most cities and towns right through to urban road user charging schemes that can require considerable investment and have been implemented in relatively few locations to date.

11.2 The narrative will focus particularly on urban road user charging schemes using ICT in the context of integrated transport demand management solutions for European cities and towns.

The problem and objectives of this guidance

The problem

11.3 72% of Europe's citizens live in towns and cities and approximately 40% of Europe's CO_2 emissions are from road transport. Furthermore private car ownership and use have been rising rapidly. For example, between 1995 and 2006 car ownership in the EU-27 Member States increased by 26%, and passenger car use measured in passenger km increased by 18%[lxxvii]. It is now widely accepted that increasing the provision of road infrastructure leads to increasing traffic levels and a deteriorating urban environment, so authorities are increasingly turning to demand management (also known as mobility management) measures.

Objectives

11.4 The objective of this guidance is to help authorities in their consideration of ICT-based urban road user charging schemes and other transport demand management measures in pursuit of energy efficiency and other policy goals. The guidance seeks to address the following questions:

- how can authorities address the problems arising from increasingly congested cities and towns, including travel delays/economic costs, air pollution and CO_2 emissions
- what role can road user charging schemes play and what is the state of the art in implementing them in European cities
- how should urban road user charging schemes be planned in order to achieve public/political acceptability
- what the technologies should be used in order to achieve maximum success
- what other guidance and supporting resources are available.

Guidance for authorities

Taking an integrated approach to transport demand management

11.5 Transport demand management (TDM), also known as mobility management, refers to many approaches or strategies for more efficient transportation behaviour. A recognised problem with planning TDM measures for a town or city is that any given local and regional authority may only be familiar with a small number of possible strategies, e.g. telecommuting, congestion charging, cycling measures[lxxviii]. It is therefore recommended that authorities draw on experiences from other cities and begin with a review of the full range of possible TDM strategies, as well as a realistic understanding of what each can achieve in particular situations.

11.6 As illustrated in Table 11-1, potential strategies include improving transport options, introducing incentives (including urban road user charging), land use management and implementation programmes.

Table 11-1: Strategies for transport demand management/mobility management

Improves Transport Options	Incentives	Land Use Management	Implementation Programs
Transit improvements	Congestion pricing	Smart growth	Commute trip reduction programs
Walking & cycling improvements	Distance-based fees	Transit oriented development	School and campus transport management
Rideshare programs	Commuter financial incentives	Location-efficient development	Freight transport management
High occupancy vehicle priority	Parking pricing	Parking management	Tourist transport management
Flextime	Parking regulations	Car free planning	Mobility management marketing programs
Car sharing	Fuel tax increases	Traffic calming	Transport planning reforms
Telework	Transit encouragement		
Taxi service improvements			
Guaranteed ride home			

Source: [lxxix]
This table lists various mobility management strategies. Many include subcategories.

11.7 The range of strategies and measures available to authorities continues to grow over time with further innovation. For example a Mobility Credits concept for sustainable urban transport management was piloted for the first time by the City of Genoa. The concept is designed so that it can be combined with existing measures, including road pricing models, to regulate the access of vehicles in a particular area of the urban city centre. In Genoa, the concept has been applied to the traffic affecting the historical city centre, which is principally caused by vehicles operating as goods and freight distributors. The Mobility Credits concept in Genoa was designed to target two groups: economic operators (retailers, wholesalers, artisans, hotels, etc) and carriers (vehicles delivering freight to economic operators and also customers using

private vehicles). Essentially, the concept serves to incentivise parties needing to make trips into the historical city centre, particularly delivery vehicles, to optimise their delivery loads and thereby reduce the number of times they need to enter into this part of the city by road transport.

11.8 The Civitas (CIty-VITAlity-Sustainability) initiative helps European cities to achieve a more sustainable, clean and energy efficient urban transport system by implementing and evaluating an ambitious, integrated set of technology and policy-based measures. Civitas identifies the following building blocks for an integrated urban transport strategy:

- increasing the use of alternative fuels and clean and energy-efficient vehicles, and enhancing their integration into the urban transport system
- stimulating high quality and innovative energy-efficient collective passenger transport services, including intermodal integration with other transport modes
- implementing demand management strategies based upon economic (dis)incentives, regulatory measures (including zoning and spatial planning) and tele-services
- influencing travel behaviour and modal choice through mobility management plans, marketing, communication, education and information campaigns
- developing safe and secure road infrastructure and means of transport for all users
- introducing mobility services that promote new forms of more energy-efficient vehicle use and/or ownership and a less car dependent lifestyle
- promoting energy-efficient freight logistics services and new concepts for goods distribution
- enhancing the use of innovative transport telematics systems for traffic management and traveller support, including solutions based upon satellite applications/GALILEO.

11.9 An integrated transport package for a city is likely to draw on a number of these building blocks/themes in a way that enables them to work together to achieve the objectives. Many TDM strategies may on their own only have a limited impact in reducing journeys, modal shift and in reducing CO_2 emissions. However by implementing them as part of a comprehensive and truly multi-modal package, significant economic and societal benefits can be achieved.

11.10 An illustration of this integrated approach in practice is provided by the case study of the city of Craiova in Romania. As part of the European MODERN project, the following measures were introduced in Craiova:

- transition towards a clean public transport fleet
- energy saving on the tramlines
- freight distribution schemes

- integrated e-ticketing system
- access restriction policies
- software tools for mobility management actions in industrial areas
- public transport security programme
- flexible services for industrial areas
- infomobility tools for public transport fleet management utilising GPS based tracking components
- priority traffic light regulation for public transport in Craiova.

11.11 The analysis, prioritisation, stakeholder engagement and decision making can become complex when seeking to develop an integrated transport package for a city. However guidance and decision support tools are available to assist authorities in these activities, for example the process outlined in Table 11-2.

Table 11-2: The GUIDEMAPS six stage transport decision making process

Stage	Stage name	Activities involved in this stage
Stage 1	Scheme definition	This stage involves the detailed definition of the scheme, either based on the objectives and programme set out in a strategy, or from the direct identification of the problems or issues to be addressed. It includes the specification of requirements and the identification of constraints as well as the selection of performance indicators.
Stage 2	Option generation	Several options (e.g. different features or routes) need to be prepared in order to find an effective and efficient scheme, which maximises stakeholder support. Various tools can be used to aid professional creativity and stakeholder involvement in the option generation process.
Stage 3	Option assessment	This involves the appraisal of options with regard to their potential impacts and cost effectiveness. Typically, this process assesses many of the characteristics, covering impacts on the local economy, environment and society. It includes a technical analysis of each option and an assessment of likely public acceptance.
Stage 4	Formal decision taking	The decision is taken by the responsible institution (or delegated body for smaller schemes), taking into account the findings of the option assessment stage. It includes agreement on the preferred option, arrangements for when the project will be implemented and by whom, and the allocation of resources.
Stage 5	Implementation	This includes all necessary preparatory and site work to bring the scheme to the point of operation. For infrastructure projects, final details regarding the phasing of construction must be agreed and authorisation for construction obtained. This stage can also include other tasks, such as the recruiting of operating staff, the promotion of the scheme, or an information campaign.
Stage 6	Monitoring and evaluation	Data on the performance of the scheme is collected and analysed to determine whether the objectives have been met. This can lead to improvements in future scheme design and contribute to the evaluation of the strategy of which it has formed one part.

Source: [lxxx]

Current status of urban road user charging in Europe

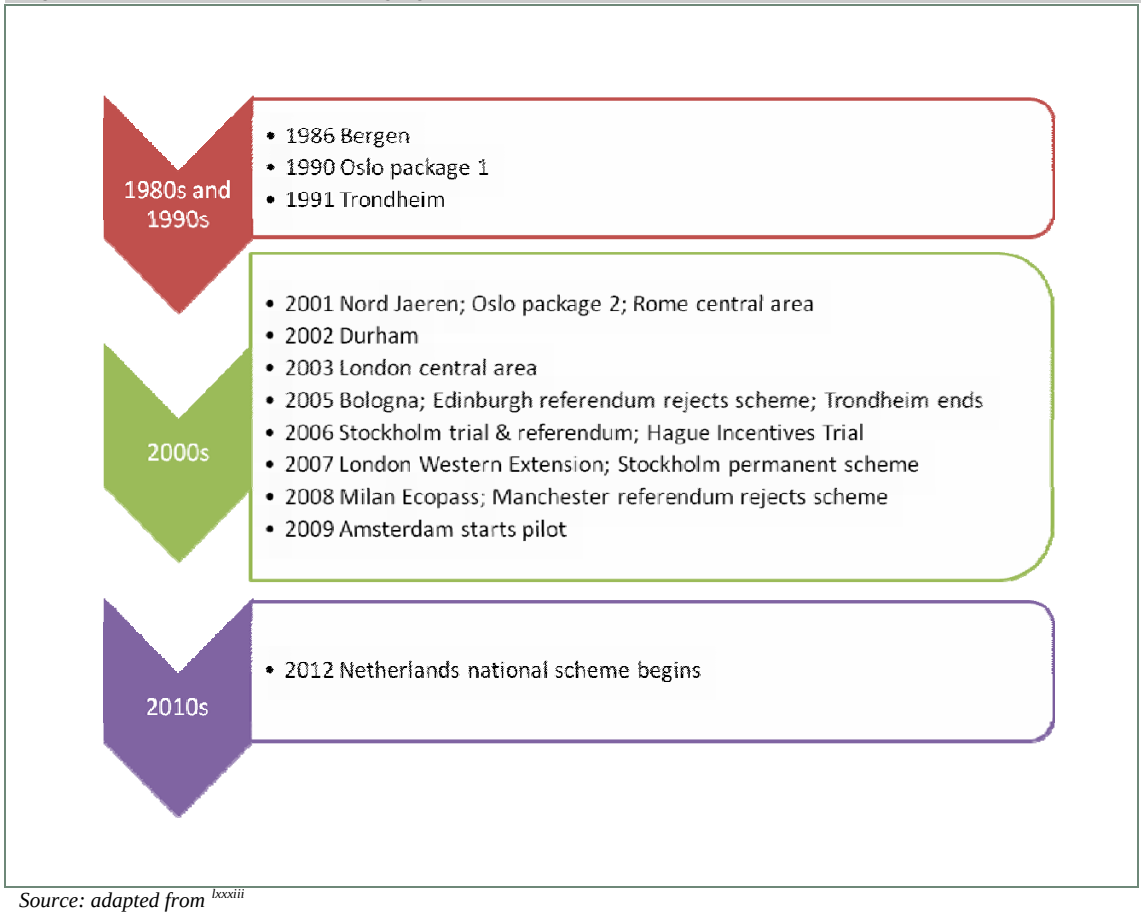
11.12 The origins of urban road user charging schemes (also known as road pricing and congestion charging schemes) are thought to date to the 1950's[lxxxi]. William Vickrey first proposed that fares be increased in peak times and in high-traffic sections for the New York City subway system in 1952. He went on to make a similar proposal for road pricing and then in 1959 he made a proposal to the US Congress regarding the control of the District of Colombia's traffic congestion using electronically assessed user fees.

11.13 There are four main types of road charging schemes[lxxxii]:

- point-based charges: Such as tolls to cross a bridge or to enter a section of motorway.
- cordon-based pricing: A charge is levied for *crossing* a cordon, and may vary with time of day, direction of travel, vehicle type and location on the cordon. There could be a number of cordons with different prices.
- area licence based pricing: A charge is levied for driving *within* an area during a period of time. The price may vary with time and vehicle type.
- Distance- or time-based pricing: Price is based upon the distance or time a vehicle travels along a congested route or in a specified area, and may vary with time, vehicle type and location.

11.14 For a combination of reasons, most importantly the need to achieve the necessary support and acceptability for such schemes, urban road user charging has not been adopted extensively in European cities to date. However, there has been considerable progress made in the past decade, not least through the successful launch of congestion charging schemes in Stockholm and London. The timeline of the introduction of urban road user charging schemes in Europe is summarised in Figure 11-1.

Figure 11-1: Urban road user charging in Europe - timeline



Source: adapted from [lxxxiii]

11.15 In common with other TDM measures, urban road user charging schemes may be adopted in different cities to achieve different outcomes. Common objectives include congestion relief and revenue-raising, but other policy goals can also be addressed through charging schemes such as environmental (including CO_2 reduction and air pollution control), road safety and local economic development. Whilst there is normally a primary reason for a road user charging scheme, most schemes are developed and justified (e.g. in terms of the benefit to cost assessment) on the basis of multiple benefits. The range of intended objectives of some schemes (planned as well as operational) are summarised in Table 11-3.

Table 11-3: The primary and secondary objectives of selected urban road user charging schemes

								Cities with scheme in operation							User Need Assessment
	Bristol	Copenhagen	Edinburgh	Genoa	Gothenburg	Helsinki	Rome**	Trondheim	London	Oslo	Bergen	Durham	Stockholm	Singapore	Sample of 21 European cities
Congestion relief															
Liveability															
Health															
Equity															
Safety															
Environment															
Economic growth															
Future generations															
Raising revenue															

*Key: * Trondheim was the only city with a scheme already in operation which participated in PRoGRESS; ** Rome implemented a ZTL (Limited Traffic Zone) in 2001; Dark Cells represent the primary objective. Grey cells indicate that the objective was secondary.*

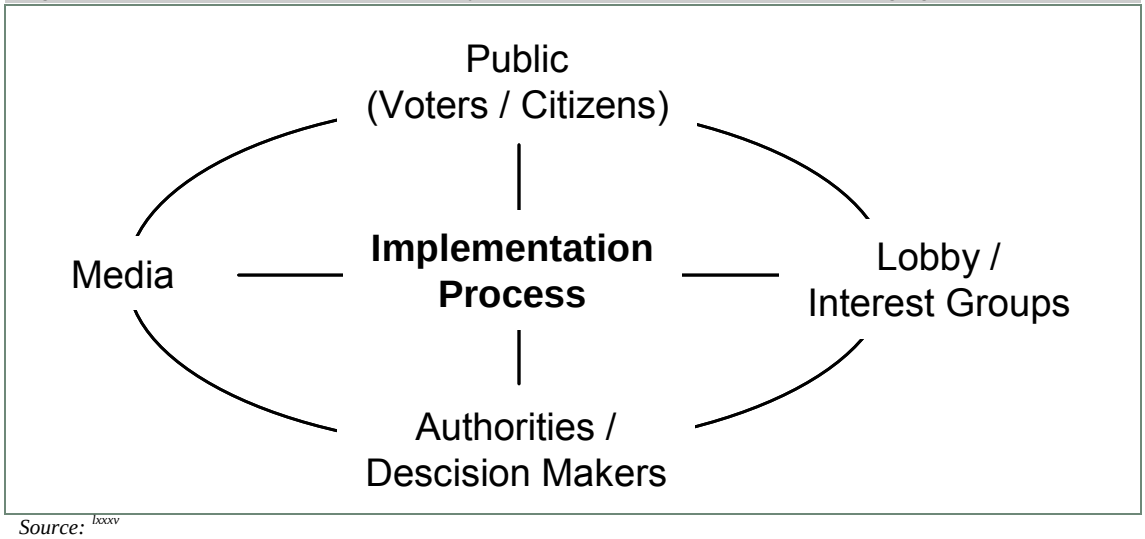
Source:[lxxxiv]

Acceptance of urban road user charging

11.16 Road user charging is potentially a highly contentious issue for communities and politicians alike. Whilst many people and organisations may agree with some of the intended outcomes of the schemes for a city, introduction of road user charging usually represents a large change in which roads that have historically been largely 'free at the point of use' for private car owners and businesses are no longer free to use. Furthermore, the schemes are commonly perceived to be introducing a new 'tax' burden that is in addition to vehicle tax, fuel tax and local taxation for the road infrastructure.

11.17 It is therefore important for authorities to give significant attention to communication with stakeholders in order to gain acceptability over the period of planning, designing and implementing a scheme. Figure 11-2 identifies some of the key groups of stakeholders that are likely to be involved in urban road user charging schemes.

Figure 11-2: The relationships between key stakeholders for urban road user charging schemes



Source: [lxxxv]

11.18 In times of scarce resources for the delivery of public services, including maintaining and improving transport infrastructure, politicians and public authorities may be attracted by the revenue raising potential for urban road user charging schemes. For example the Stockholm congestion charge has been estimated to be raising approximately €52million net revenue annually. In London the annual figure has been estimated at €140million (2006-7). Ultimately though, decision makers will want to take account of and be confident of the prevailing opinions of local businesses and local people before committing to a scheme. For that reason, in many cases a public referendum forms part of the process of developing and implementing a scheme.

11.19 The Stockholm congestion charge scheme was introduced via a set trial period, followed by a referendum; it was recognised that it was not the trial but successful engagement of citizens which was the critical factor and the change in public opinion was absolutely key to the success of this scheme. A number of subsidiary factors helped engage citizens, all of which are useful learning points for other cities. These include:

- there must be visible and tangible benefits for those impacted by the scheme
- simplicity, transparency and fairness are also important factors in engaging stakeholders
- the technology MUST work – so that people trust it. (Although some felt too much resource had been devoted to ensuring flawless operation, this was viewed by most as an important factor in user engagement)
- communication is key: users must be well informed on both the purpose of the scheme and its operation. Processes should be simple, accessible and foolproof
- adequate capital investment must be made up-front to ensure that promised benefits are felt even at early implementation stages.

11.20 Research into the public acceptability of urban road user charging schemes provides further perspectives of the importance of this aspect of planning a new scheme. A review of British charging scheme studies found an average acceptability level of 35%, albeit with considerable

variations in the levels across different schemes (from 8 % to 76 %)[lxxxvi]. The European research project TRANSPRICE provides a more pessimistic view in that only up to 16 % of the respondents agree with this form of travel demand management.

11.21 Levels of acceptability will clearly vary by the location of the people/businesses/organisations affected with respect to the scheme boundaries. For a city's business community, levels of acceptability may also vary considerably according to the type of business. Illustrating this point, the level of business acceptance of the London congestion charging scheme (with accompanying provision of investment in public transport) a few years after implementation was '61% agreement' within the leisure/hotel sector compared to '39% agreement' within the freight/distribution sector[lxxxvii].

11.22 Levels of acceptability will clearly also vary over time. Opinions change as external factors change and also through improved knowledge and understanding of the details of the scheme and its potential impacts on the stakeholders during the scheme planning and implementation process. The Stockholm case study provides a number of important lessons emerged in terms of promoting, accepting and accommodating change:

- people adapt to change and their speed and extent of adaption should not be underestimated. In this case behaviour changed rapidly and also stabilised into a new pattern very quickly
- opinions can change - dramatically. In this case public opinion changed from negative to positive but the opposite could be true for a badly administered scheme that taxed without delivering visible benefits
- the effects of a scheme may change over time as people adapt: in early years the scheme reduced traffic, more recently it has driven a change in vehicle type
- the scheme must be adaptable so that it can be modified or tweaked for instance if impacts are not as expected – e.g. new unexpected behaviours emerge.

11.23 In summary, achieving acceptance of urban road user charging schemes is fundamental to their success. The issues surrounding acceptance amongst different stakeholder groups are potentially complex and require serious attention in planning and implementing schemes. Some of the key lessons from recent projects are summarised in Table 11-4.

Table 11-4: Do's and don'ts for achieving acceptance of urban road user charging schemes

Do	Don't
• Public attitudes towards urban road user charging have to be continuously monitored • Secure political support, using every window of opportunity • Design something simple • Do publicise an integrated package of measures including road user charging, revenue hypothecation and the transport improvement • Ensure a visible public consultation process to show that solutions are designed that take into account the views of all stakeholders, and to ensure broad-based support • Establish a good partnership with the press to conduct a proactive information strategy • Be sure to release the right information to the press from the very start. Do not leave it for the press to come up with stories themselves. Take the initiative in the first round of publicity • The system must work well from the very first day, or else public support will quickly evaporate • Consider implementing urban road user charging for a limited period of time or as a trial • A referendum can be a game with very high stakes at a time when acceptability is often lowest, timing and preparation is crucial	• Do not focus on pricing but on traffic problems and on solutions which people perceive as helpful (the wider transport package) • Do not let the public see themselves as victims of congestion rather than contributors to congestion • Do not forget that effects will differ across society; equity and fairness need to be carefully considered • Do not forget to redistribute revenues and to provide good alternatives • Unless there is a legal obligation to hold a referendum, authorities should be cautious in using this method to determine whether or not urban road user charging is introduced

Source: [lxxxviii]

Planning an urban road user charging scheme that is suitable for your city or town

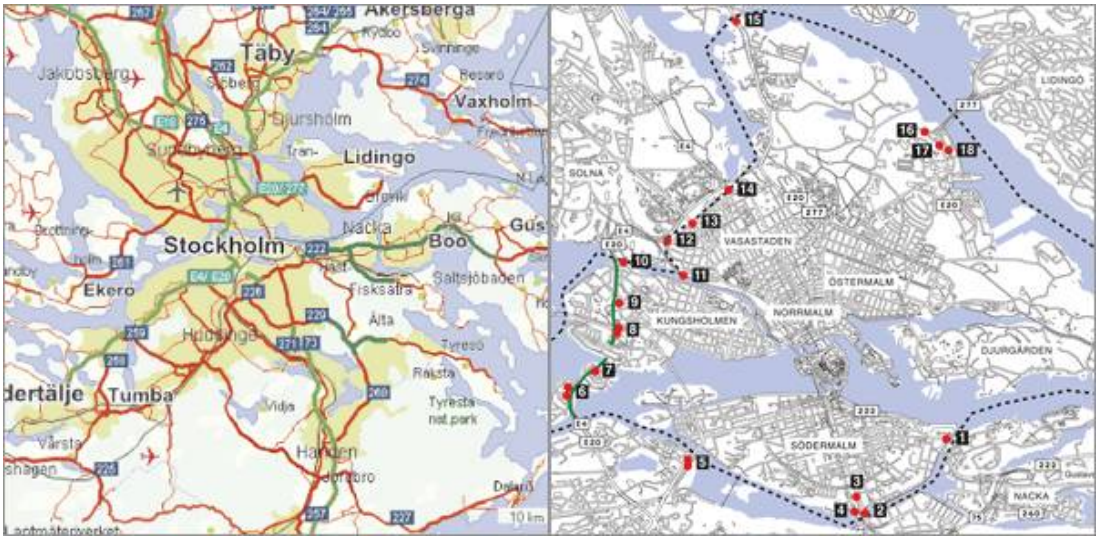
11.24 There are a wide variety of issues to be considered when planning an urban road user charging scheme for a particular city. The CURACAO project (Coordination of Urban Road User Charging Organisational Issues) highlights the following advice based on research and feedback from authorities that have been involved in promoting an urban road user charging scheme[lxxxix]:

- Who should be charged?
  - cycles, buses, emergency vehicles and disabled drivers should be exempted. Motor-cycles are often exempt for practical reasons
- Where should road users be charged?
  - this was found to depend largely on urban form and the scheme objectives. If the main objective is to reduce congestion, then city centre or citywide, using either area licensing or cordon charges. If main objective is 'mobility management', then metropolitan area, using distance-based charging

- How should road users be charged?
  - in general Dedicated Short Range Communication (DSRC) solutions were preferred. Vehicle Position Systems (VPS) are envisaged to be a useful alternative in the future.
- How should enforcement operate?
  - most cities felt that Automatic Number Plate Recognition (ANPR) technology was the optimal approach
- When should road users be charged?
  - working weekdays, either 'all day' or morning peak only. Charging in the evening depends on characteristics of evening traffic in the city concerned
- How much should be paid?
  - €1-3 was suggested by cities with fixed priced schemes. Charges of between €0.01 and €0.6 per km were suggested for distance-based charging (when feasible), with the figure depending upon the size of the charging area
- How should revenue be used?
  - revenues should be used within the transport system (i.e. hypothecation). There was widespread interest in investing revenue in public transport
- How should privacy be ensured?
  - all cities were concerned, but privacy did not appear to represent a fundamental barrier.

11.25 When considering a new urban road user charging scheme, there are certainly many lessons that can be learnt from other cities and towns that have successfully implemented (or tried to implement) their own scheme. However, it is important to appreciate the local physical and socio-economic context when seeking to transfer scheme designs. For example for the Stockholm scheme, the city's geography was particularly helpful as the restricted access points to the city made it easier to monitor traffic flows and implement automatic number plate recognition (ANPR) infrastructure (see Figure 11-3). It is also important to note that the congestion charging was accompanied by improvements to public transport such as better bus services, new trams, a new park and ride and an extension of commuter rail.

Figure 11-3: City location and enlargement showing charging zone and entry points.



Source: IBM/City of Stockholm

11.26 In terms of transferring ideas from other major schemes, the following contextual factors have been recognised as important through the CURACAO research project[xc]:

- **Singapore:** It is widely understood that the city-state and island geography of Singapore has made adopting road pricing much simpler than in other locations, where competition from neighbouring cities may be a significant factor. In addition, the unique cultural setting is regularly cited as having reduced stakeholder resistance compared to what might be expected in Europe

- **Norwegian Toll Rings:** The longstanding history of toll payments for using transport infrastructure in Norway is widely considered to have helped achieve acceptance for the principle of urban toll rings. In addition, the sole objective of raising revenue for transport infrastructure projects, while not attempting to reduce travel, has allowed policy-makers to sidestep many of the controversial issues relating to demand management and to justify the tolls on the basis of new infrastructure from which travellers benefit. So, acceptability experience may not be so easily transferable, although the Norwegian cities have been facing a unique acceptability problem when the initial infrastructure funding justification for pricing has run out

- **London:** It is generally accepted in the UK that London's size, the scale of its public transport network and the very high proportion of journeys to central London by rail (around 70% prior to the implementation of congestion charging) make it atypical. On the one hand congestion is seen to be more serious there, making the case for charging stronger. On the other, it was much easier to accommodate the diverted journeys on bus and rail services. The dominance of central London's economy will also have diluted the threat to economic activity. Table 11-5 provides further lessons learnt from the London scheme in terms of the perceived 'winners and losers' following its implementation

- **Durham:** At the other end of the spectrum, the single road scheme in Durham is also atypical, though there is some interest in replicating it in rural tourist attractions.

Table 11-5: Winners and losers from the London congestion charging scheme

Winners	Losers
• City centre bus riders • All public transport passengers (due to increased funding for improvements) • Taxi riders and drivers • Motorists with high-value trips • Most city centre businesses • Overall city productivity • Pedestrians and cyclists	• Motorists with marginal-value trips • City centre businesses that depend on low cost weekday car access • Residents and motorists in border areas who experience spillover impacts • City centre parking revenue recipients

Source: [xci]

Technologies for urban road user charging schemes

11.27 The potential practicality and cost effectiveness of urban road user charging has been greatly improved since the advent of electronic technologies. Alternatives to electronic technologies include the collection of tolls at toll booths (or automatic coin collection machines). This offers a reliable and effective technology but is relatively costly and impractical in many urban situations due to the space requirements for the infrastructure and because the toll areas cause congestion. Another alternative is the use of paper licences which were used in the initial Singapore and Bergen schemes. A major disadvantage of paper licenses is the enforcement arrangements as well as limits in the practical arrangements in terms of charging classes and distribution arrangements.

11.28 There are three main types of electronic technologies for urban road user charging schemes. These are probably best considered as complementary rather than competing technologies as they can play different roles in a single scheme. The types of technology are:

- Automatic Number Plate Recognition (ANPR) / Virtual licences
- Dedicated Short Range Communication (DSRC)
- Global Navigation Satellite Systems/Cellular Networks (GNSS/CN).

11.29 A description of each of these technologies is provided in Table 11-6, with further information available via the CURACAO project documentation.

Table 11-6: The three main technologies used in urban road user charging schemes

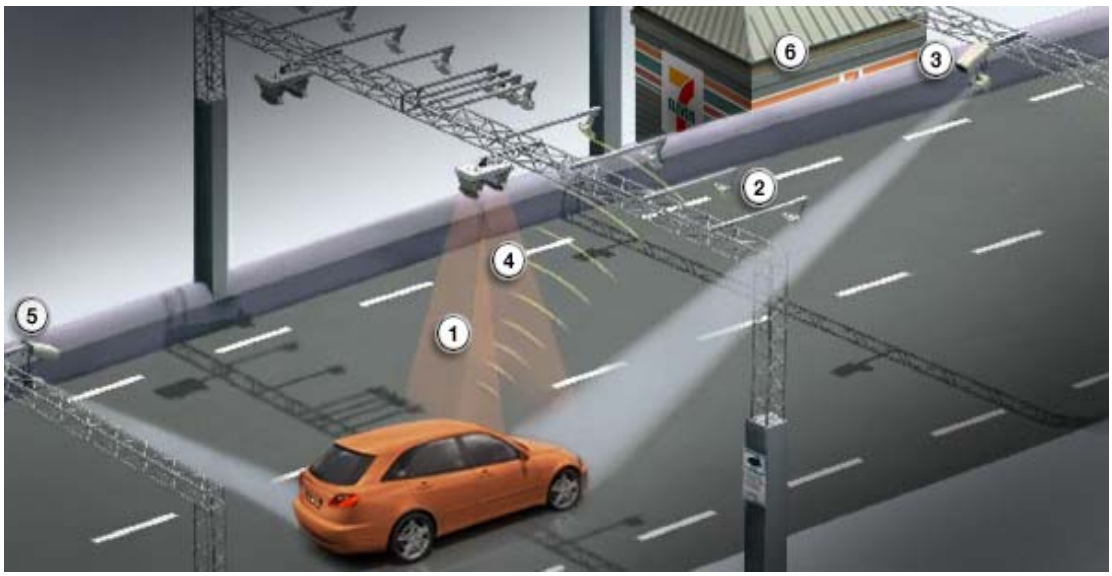
Technology	Description
Automatic Number Plate Recognition (ANPR) / Virtual licences	ANPR uses optical character recognition (OCR) on images taken by cameras. This is a type of technology, mainly software that enables computer systems to read automatically the registration number of vehicles from digital pictures. The pixels of the digital image are then transformed into the ASCII text of the number plate. This is the same technology that lets you scan paper documents and turn them into electronic, editable files. Usually, images of the licence plates of vehicles that should have paid the charge are recorded, interpreted using a computer-based OCR (Optical Character Recognition) system, and then compared to a database of registered users. The owners of those vehicles for which no charge has been paid are identified through reference to the national vehicle registration system, and enforcement action initiated. However, it does not have to be a requirement that users should pay in advance, i.e. before the transport service is used. The user may have a deadline to post pay for

Technology	Description
	the service. This is especially convenient for occasional users, whose vehicles are not already registered in a database before the service is used. ANPR has the advantage of being an established technology. The London congestion charge scheme is an ANPR system. It uses hundreds of cameras, both stationary and mobile units, and ANPR to help monitor vehicles in the charging zone. The advantages are that enforcement operations have no impact on traffic flow, and the system provides photographic evidence to support enforcement proceedings. Also, this system is space saving in comparison with entry points / toll collection areas. However, ANPR requires signs and cameras which can cause problems in historic urban centres.
Dedicated Short Range Communication (DSRC)	Electronic fee collection based on DSRC is a common technology used throughout the world by toll road operators. On-Board Equipment (OBE) like a tag is mounted on the vehicle's windscreen and communicates with road side equipment. Tags are activated by a roadside transmitter, which sends a signal to the tag; the tag then responds with its identity. This response is read by an associated receiver at the roadside, enabling a charge to be added to or deducted from a centrally held credit or debit account. Active tags can also hold funds on inserted smart cards required to pay the charge. DSRC can be used with a variety of charging concepts, including entry and area licensing, cordons, cells and screen lines. Tags make account management easier but require more street furniture than ANPR alone, and require vehicles to be fitted with equipment. DSRC charging points are now being optimised concerning physical size and mounting possibilities. The new requirements from London concerning roadside equipment in urban areas have been one of the main driving forces for suppliers to compress their equipment down to a minimum. Both DSRC and GNSS/CN (see below) systems are based on OBEs (tags) mounted in the vehicle. There are two types of OBEs; passive and active. A passive tag is an OBU that is not working as a sender until awakened by the roadside equipment. Active OBEs are equipped with a power supply, using a battery for the small and simple tags in DSRC systems and the vehicle power supply for GNSS/CN due to its more complex OBEs, which have interfaces to GPS, sensors, tachometers, IC-cards and displays.
Global Navigation Satellite Systems/ Cellular Networks (GNSS/CN)	GNSS/CN systems are also often referred to as Autonomous Electronic Fee Collection (EFC) systems. GNSS were developed by the US and Soviet governments for military purposes, but a wide range of civil applications have been developed for the US GPS. GPS is already widely used by truck operators for tracking of location of vehicles, and in Germany and Switzerland for distance-based charging of heavy goods vehicles. The on-board unit combines a GNSS location system and a communications link, with a digital map either on-board or in the 'back office'. The vehicle's position is used to identify the road segment and thus the correct charge can be assessed. A major advantage is that no street furniture is required for charging, although infrastructure for enforcement may still be required. In Germany, which has the only operational GNSS/CN charging scheme currently in use, compliance checking (enforcement) is performed by DSRC at fixed gantries as well as with mobile and hand-held enforcement equipment. Also, the roadside infrastructure uses camera systems for ANPR in order to detect the vehicle status and validate payment (ITS United Kingdom, 2007). Early experience with GNSS/CN showed operational problems with 'urban canyons' in dense high rise urban environments, and parallel and close highways. This can be improved by using 'map-matching' techniques and inputs from sensors such as accelerometers and the odometer. The GIROADS Project (Cosmen, 2008), a reference project in Europe for GNSS road applications, states that lack of signal is today a minor issue due to high sensitivity receivers. However, GNSS has weaknesses, especially the random position errors that can be large from time to time and lead to incorrect charging. GALILEO, the European global navigation system, will be interoperable with GPS and GLONASS and it will provide a highly accurate global positioning service under civilian control. The availability of these new satellite constellations will improve matters by providing better multipath performance, improved signal acquisition, signal integrity and real-time positioning capability. Most important for URUC systems will be the overall improvements in heavily built-up areas and urban canyon environments. Estimates of when GALILEO will be fully operational vary between 2013 and 2015. When it is fully deployed it will consist of 30 satellites (27 operational + 3 active spares) in three circular orbits, providing good coverage even at latitudes up to 75 degrees north (which corresponds to the North Cape) and beyond. GNSS-based charging enables the introduction of road pricing on the entire road network. This makes it possible for governments to withdraw fixed taxes and to avoid increased use of smaller roads, which may be free of charge when using other systems. GNSS can be regarded as a cost effective and flexible technology for meeting the challenges of combining interurban and urban road charging.

Source: [xcii]

11.30 The Stockholm case study illustrates the practical use of two out of three of the technologies listed in Table 11-6. The identification methods used included both automatic number place recognition (ANPR) and in-vehicle transponders or On-board Units for the trial. However, for the permanent scheme the transponders were not needed as the identification rates from the automatic readers were better than expected. The operation of the charging points during the initial scheme is illustrated in Figure 11-4.

Figure 11-4: How the charging points work in the initial Stockholm congestion charging scheme



Source: IBM

Key:

1: The vehicle breaks the first laser beam, triggering the transceiver aerials as shown in Step 2.

2: The transceiver signals the vehicle's onboard transponder, capturing the time, date and tax amount.

3: At the same time as the transceivers, a camera photographs the vehicle's front license plate.

4: The vehicle breaks the second laser beam, triggering the second camera as shown in Step 5.

5: The second camera photographs the rear licence plate, all without the vehicle slowing down.

6: Payment is debited from driver's account or paid via Web, a bank or retailers 7-Eleven and Pressbyran.

Demonstrating success - monitoring and evaluation for urban road user charging schemes

11.31 Given the relatively novel nature of urban road user charging schemes, the investments required and the range of objectives that they are seeking to achieve, monitoring and evaluation is a critical consideration for authorities. When the scheme is first implemented, a strong monitoring and evaluation process can indicate whether the scheme's benefits are impacts are as planned and within acceptable limits or whether adjustments to the operation of the scheme are needed. In the case of a trial or pilot phase of the scheme, monitoring and evaluation can be critical in providing the evidence to support the decisions on whether or not to continue with the scheme.

11.32 Evaluations can also serve other purposes. For example a comparison of evaluation results with the up front scheme appraisal data for a particular scheme will help to improve an

authority's ability to predict the performance of future TDM projects. The comparison of evaluations across different schemes in different cities can also contribute to improved understanding by helping other cities to design more effective schemes.

11.33 The scope of the monitoring and evaluation activities often needs to be quite broad, reflecting an integrated transport planning approach and to address a scheme's objectives and potential impacts. The monitoring indicators will commonly draw on those used for other transport planning within the city. Recommended indicator sets to encompass economic, social and environmental parameters are identified in Table 11-7. Further information on the indicators for ICT-enabled energy efficiency initiatives generally is also available in the guidance on metrics and indicators.

Table 11-7: Recommended indicator sets for sustainable transport planning

	Economic	**Social**	**Environmental**
Most Important (Should usually be used)	Per capita mobility (daily or annual person-miles or trips). Mode split (personal travel: non-motorised, automobile and public transport; freight: truck, rail, ship and air). Average commute travel time and reliability. Average freight transport speed and reliability. Per capita congestion costs. Total per capita transport expenditures (vehicles, parking, roads and transit services).	Per capita traffic crashes and fatalities. Quality of transport for disadvantaged people (disabled, low incomes, children, etc.). Affordability (portion of household budgets devoted to transport). Overall satisfaction rating of transport system (based on objective user surveys). Universal design (consideration of disabled people's needs in transport planning)	Per capita energy consumption, disaggregated by mode. Energy consumption per freight ton-mile. Per capita air pollution emissions (various types), disaggregated by mode. Per capita land devoted to transport facilities (roads, parking, ports and airports). Air and noise pollution exposure and health damages. Impervious surface coverage and stormwater management practices.
Helpful (Should be used if possible)	Relative quality (availability, speed, reliability, safety and prestige) of non-automobile modes (walking, cycling, ridesharing and public transit) relative to automobile travel. Number of public services within 10-minute walk and job opportunities within 30-minute commute of residents.	Portion of residents who walk or bicycle sufficiently for health (15 minutes or more daily). Portion of children walking or cycling to school. Community cohesion (quality of interactions among neighbours). Degree cultural resources are considered in transport planning.	Community livability ratings. Water pollution emissions. Habitat preservation. Use of renewable fuels. Transport facility resource efficiency (such as use of renewable materials and energy efficient lighting).
Specialized (Use to address particular needs or objectives)	Portion of households with internet access. Change in property values.	Transit affordability. Housing affordability in accessible locations.	Impacts on special habitats and environmental resources. Heat island effects.

Source: [xciii]

11.34 For the Stockholm scheme a clear and comprehensive monitoring framework was developed. The case study identifies some of the results and successes. Traffic monitoring revealed significant benefits from the trial, including a reduction in traffic by 20-25%, a reduction in congestion (travel time) of 30-50% and a reduction in emissions within the central charging

zone by 12-14%. During the main implementation phase these savings were maintained. Inner city traffic has continued to decline slightly and is 25% lower now compared to what it would have been without the system. One reason that the levels have not gone down more since the trial is the higher number of exempt vehicles.

11.35 The reduced congestion, coupled with a higher proportion of alternative fuel vehicles, has led to lower emissions of carbon dioxide, carbon monoxide, nitrogen oxides and particulates. In the inner city emissions of hydrocarbons and CO_2 were reduced by about 1/3 between 2006 and 2008 due to changes in vehicle types. Particulates released from exhaust fumes and road wear reduced by 6% and 2% respectively and PM10s (respirable particulates of less than 10 microns) have been reduced by 3%. Emissions of nitrogen oxides are calculated to have decreased by around 13 % for the same years and CO_2 emissions have decreased by around 8 % since 2006. For the city as a whole nitrous oxides have reduced by around 8% and CO_2 by around 4%.[2] Air quality monitoring reflects some impressive improvements in air quality, such as 15% reduction in CO_2 and 10% reduction in NOX and a 10-20% reduction in PM10s.[2]

11.36 The impacts of other urban road user charging schemes are similarly wide ranging and significant in many cases. Table 11-8 illustrates the traffic reduction and CO_2 emission reductions achieved by some recent schemes.

Table 11-8: Traffic and CO_2 reduction monitoring results in certain schemes

City/scheme	Traffic % change	Traffic notes	CO_2% change	CO_2 notes
Bologna	-23%	Access reduction during charging hours on a working day, 2004-2006	Not available	
Durham	-85%	From over 2000 to approximately 200 vehicles per day	Not available	
London	-16%	% change in vehicles, 2006 versus 2002 during charging hours	-16%	Change between 2002 and 2003
Milan	-14%	Decrease in vehicles accessing the Ecopass Zone, 2007 to 2008	-14%	Change after first nine months of operation
Rome	-18%	From 80,000 to 72,000 vehicles, 2000 to 2005	-21%	Change in mean values between 2001 and 2004

Source:[xciv]

11.37 Authorities are advised to consider monitoring and evaluation arrangements right at the start of considering urban road user charging schemes. Drawing on the lessons from other schemes, Table 11-9 summarises some of the key ‘dos and don’ts’.

Table 11-9: Do's and don'ts for monitoring and evaluation of urban road user charging schemes

Do	Don't
• Develop a monitoring programme: define where and when the data are to be collected; determine the spatial coverage based on the design of the scheme and its anticipated impacts • Identify indicators for each policy objective • Implement a plan for data collection and surveys • Use the results to understand the impacts of the scheme and the need for any remedial measures • Disseminate the results to other cities	• Do not conduct surveys at different times of the year as this might introduce extraneous effects and confuse the picture • Do not hide the weights used in the consideration of trade offs between objectives in the evaluation process

Source: [xcv]

Conclusions and recommendations for authorities

Conclusions

11.38 Technology-enabled urban road user charging is one of a range of responses to address the negative consequences of increased traffic levels in Europe's towns and cities. For authorities considering this solution, an integrated approach is advocated to identify and consider the transport problems so that a coherent package of Travel Demand Management measures can be introduced.

11.39 Whilst there have been a relatively limited number of urban road user charging schemes implemented in European cities, much has been learnt from the successful solutions as well as from schemes that were partially developed but not implemented due to a lack of acceptance or funding support. The small number that have been implemented have all generally been considered to be successful in meeting their policy objectives, and many have achieved very significant benefits in terms of traffic reduction, CO2 reduction and revenue generation.

Top five recommendations for authorities

- Do not consider urban road user charging in isolation. It will be most effective as part of an integrated approach to managing travel demand and the provision of transport infrastructure and services in pursuit of various policy goals.
- Consider how best to use different technologies within any scheme. The three main types of technology are: Automatic Number Plate Recognition (ANPR) / Virtual licences; Dedicated Short Range Communication (DSRC); and Global Navigation Satellite Systems/Cellular Networks (GNSS/CN). These are probably best considered as complementary rather than competing technologies as they can play different roles in a single scheme.
- Bear in mind that achieving acceptance of urban road user charging schemes is fundamental to their success. The issues surrounding acceptance amongst different stakeholder groups including businesses, residents and politicians are potentially complex and require serious attention in planning a scheme.

- Develop a monitoring programme so that the scheme's performance against its policy objectives can be evaluated. This involves defining where and when the data are to be collected; and determining the spatial coverage based on the design of the scheme and its anticipated impacts.
- Seek to learn lessons from other cities and towns that have successfully implemented, or have tried to implement, their own schemes such as in Stockholm and London. However, it is also important to appreciate the local physical and socio-economic context when seeking to transfer scheme designs.

Sources of further information

Civitas – Cleaner and Better Transport in Cities, http://www.civitas-initiative.org

CURACAO's Online Knowledge Base for Urban Road User Charging in Europe, http://www.isis-it.net/curacao/index.asp

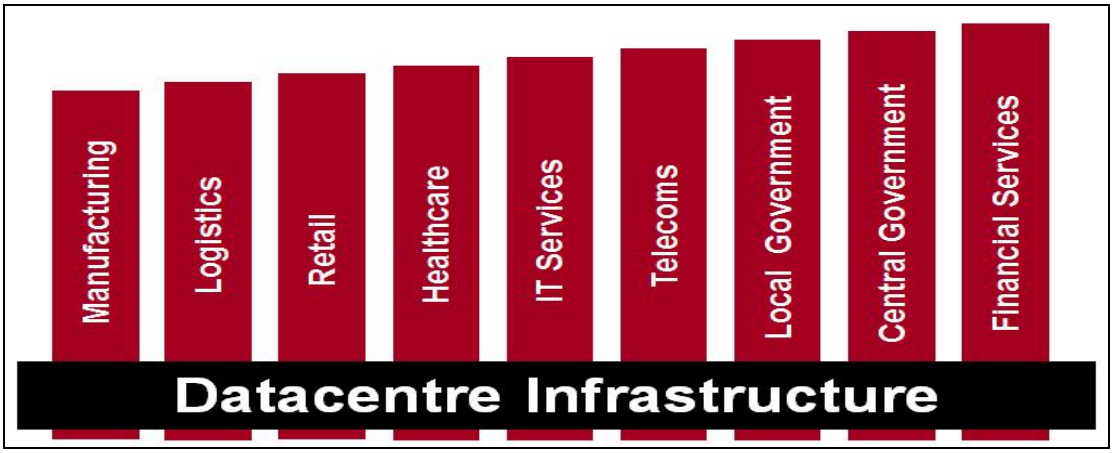
European Local Transport Information Service (ELTIS) web portal, http://www.eltis.org

12: Green municipal data centres

Introduction

12.1 Local authorities are increasingly reliant on ICT to deliver services and to improve the efficiency and cost-effectiveness of their operations. Citizens are also becoming increasingly computer literate and now expect to be able to communicate and transact online with their local authorities. This increasing reliance on ICT means that local authorities have to manage, process, store and secure growing quantities of digital data. In fact, local government operations are so heavily reliant on data centres, that only financial services and central government are more dependent on their data centre infrastructures (see Figure 12-1).

Figure 12-1: Relative reliance on data centre operations by sector



Source: Intellect: Data Centres, the backbone of the UK Economy, 2009

12.2 Digital data are stored and processed by special computers called servers which are housed in server rooms and data centres. These servers use microprocessors (or chips) which do all the work of organising and managing data. These processors need energy to work; moreover, when they work they emit heat which can increase the ambient temperatures in data centres and server rooms so much that the equipment fails. Servers therefore need a fixed temperature range to operate reliably and this means that the temperature in data centres needs to be kept below certain thresholds and this means that elaborate cooling systems are needed.

12.3 These cooling systems have a significant energy burden; in fact the energy needed for cooling is usually around 1/3 of the total energy needed by the data centre and can be almost the same as that needed to power the IT equipment in a data centre and data centres run 24 hours a day, seven days a week. Power used by a data centre that is not going into the IT systems is called parasitic power. Rapid improvements are being made to reduce parasitic power but they have not yet been implemented widely enough.

12.4 Although each server uses only a small amount of power, this is multiplied many thousands of times for a large data centre. In fact a large data centre may cover the area of several

football pitches and contain thousands of servers, with an annual energy bill that frequently runs into millions of Euros.

12.5 Local authorities are therefore faced with the urgent need to make their growing data centre operations as energy efficient as possible, for two reasons. Firstly they need to achieve the EU's 2020 emissions reduction targets and secondly they can make significant financial savings. For local authorities under financial pressure these kind of savings can allow them to maintain services and retain head count that might otherwise have to be sacrificed to cost cutting.

The problem and objectives of this guidance

The problem

12.6 All local authorities need to store and manage digital data in order to deliver their service obligations to their citizens. The essential problem is that managing data on this scale is an energy intensive process. This narrative will explain how local authorities can optimise the energy efficiency of managing their data and by so doing, how they can reduce costs and carbon impacts. In real terms, there is no alternative to implementing efficiency measures – they are a pragmatic necessity, not a luxury.

Figure 12-2: The view of a data centre from the outside

Source: Capgemini

Objectives

12.7 This narrative guide will answer the following questions:

- what are the main energy issues relating to data centres
- how can we make data centre functions more energy efficient

- what data are we storing and why
- how can we optimise computing performance (improvements in hardware technology and new approaches to data storage)
- how can we manage the physical infrastructure more efficiently (both in new build and when retrofitting and managing existing facilities)

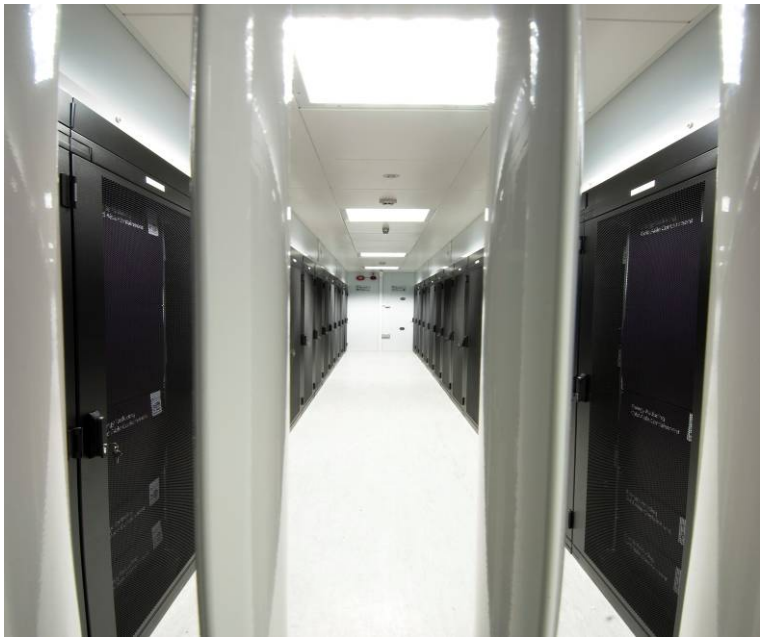
- what other issues are relevant (including service level agreements, contractual arrangements and legal requirements)
- tools and references (including existing standards and guidance for efficient data centre operation).

Guidance for authorities

What are the main energy issues relating to data centre

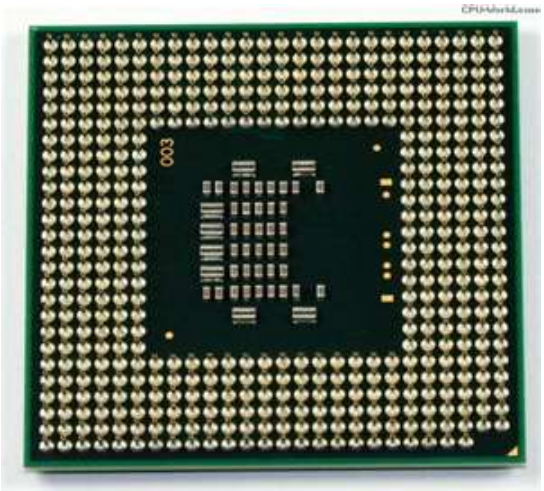
12.8 Data centres are energy intensive environments filled with racks of servers (see Figure 12-3 and Figure 12-4). Within each server, the central processing units (CPUs) are busy performing all the core computing functions and these processors need a constant power supply to work.

Figure 12-3: Server racks on a data centre



Source: Capgemini

Figure 12-4: A micro processor

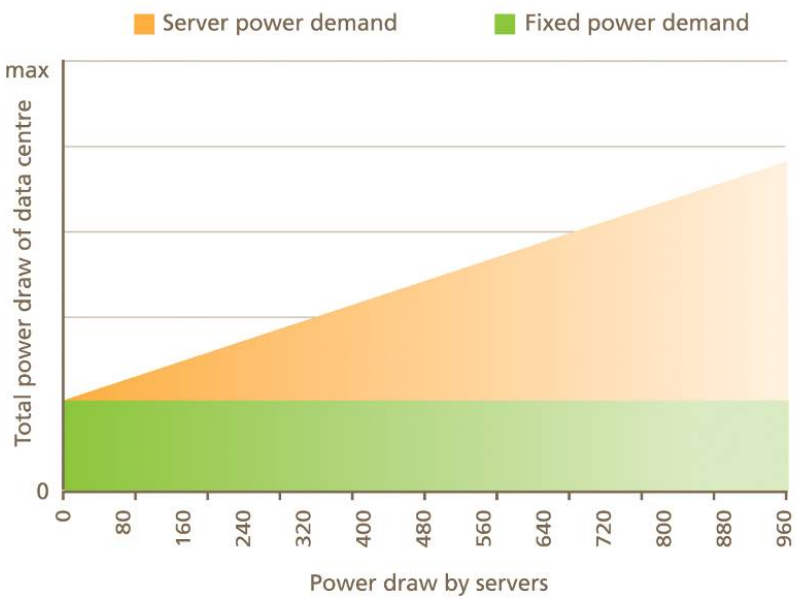


Source: Intel

12.9 However, powering the IT equipment often only uses a minority of the total power demand of the data centre, particularly in older facilities. The majority of the power demand is taken up by more peripheral things like air conditioning and transformers.

12.10 Figure 12-5 shows the difference in energy use of a data centre when no servers are in use compared to when all servers are drawing maximum power. It is evident that between a third and half the energy demand of traditional data centres is purely to run the fixed infrastructure rather than powering the IT.

Figure 12-5: Proportion of fixed energy to IT function in data centre



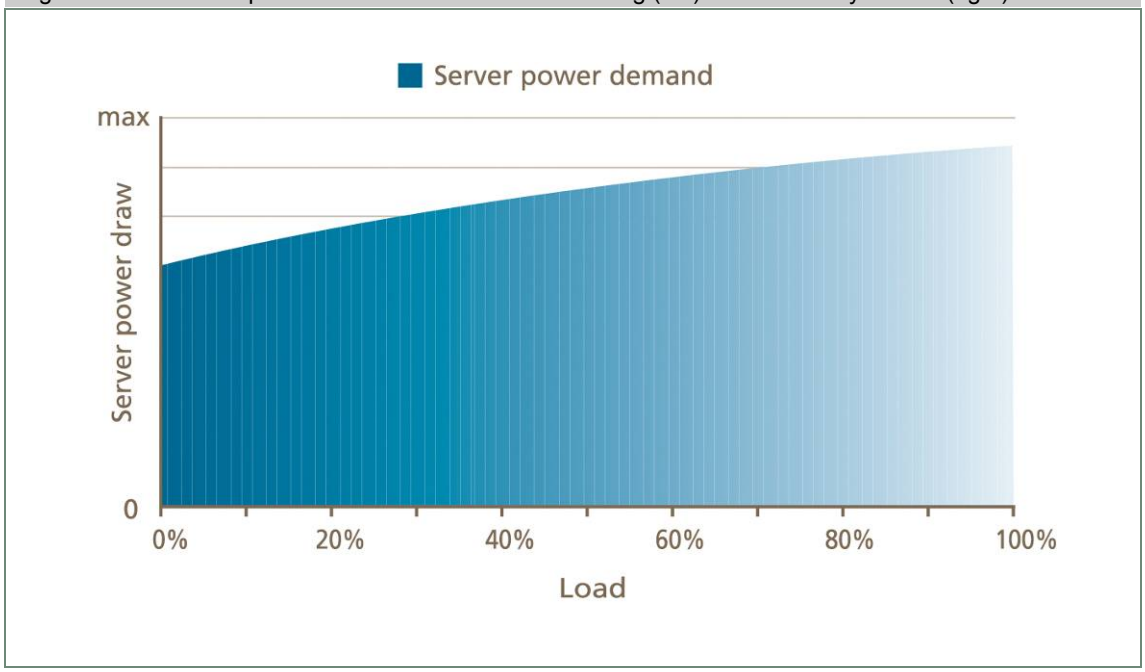
Source: Intellect, High Tech: Low Carbon, Feb 2008

12.11 Data centres are intensely complex and this means firstly that there is a wide range of different solutions that can achieve similar effects in terms of efficiency. It also means that changing one parameter can result in unexpected changes elsewhere, so modifications have to be carefully and intelligently managed. This complexity also means that a 'one size fits all' approach is not always the right one and different solutions have to be assessed both individually and as part of the overall architecture before being implemented.

12.12 The relationship between the overall energy demand of a data centre and the energy used purely to power the IT function is called PUE which stands for Power Use Effectiveness and is the ratio between the amount of power delivered to the data centre facility compared to the amount of power delivered to the IT function within it. Leading edge, very efficient data centres have PUEs of just over 1 – the best currently being Capgemini's Merlin data centre in Swindon which has a PUE of 1.08. Average good practice PUE is around 2 but many data centres have PUEs of 4 and above which is extremely inefficient. Essentially a PUE of 5 means that for every 5KWh of power delivered to the data centre, only one is used for the IT function and the rest is taken up by peripheral activities like cooling (i.e. by the parasitic power demand).

12.13 Secondly, most servers work most efficiently when they are running at full load. When running at low load they are much less efficient.[xcvi] Figure 12-6 shows how a server at zero load can use between 50% and 70% of the power it uses at maximum load – even though it is not doing anything.[xcvii] So it is best to run the servers at, or close to, maximum load.

Figure 12-6: Relative power demand of servers when idling (left) and when fully loaded (right)



Source: Intellect, High Tech: Low Carbon, Feb 2008

12.14 Moreover, a percentage of the power actually used is also wasted for other reasons – organisations often massively over-provide hardware (this is called 'over-provisioning') to guarantee resilience or to cope with potential (but often non-existent) spikes in demand. Regulations or certain business functions may also require instant access to certain historical data which means it has to be kept on actively spinning disks in a data centre instead of being stored passively. Although only 5% of data are said to be 'mission critical', the approach is

frequently to treat all data in this way and build in unnecessary (and energy intensive) levels of redundancy[xcviii] and it is also true that obsolete data are sometimes stored almost indefinitely, perhaps because its life-expectancy is unknown or even because nobody understands its true function.

12.15 Other issues relate to infrastructure management. In some cases server function is not actively monitored and managed – so the less active servers (which require less cooling) are not differentiated from those running at capacity. Some cooling mechanisms are also sub-optimal. Poor asset management can even mean that servers that no longer have any function at all are simply left running instead of being switched off or reallocated. There is also a staggering amount of duplicate data stored as multiple copies. These are only a few items from a long list of potential inefficiencies in data centres.

How can data centre functions be made more energy efficient

12.16 As mentioned above, data centre energy use is split between the facilities (the building, air conditioning, power supplies, etc) and the actual IT equipment that does the work. This means that a whole range of technologies will be needed to optimise data centre efficiency. Some will make the IT equipment operate more efficiently and others will improve the efficiency of the facility (the building that houses the IT). But before looking at equipment efficiency, it is imperative to look at what is being stored and why.

Assess what data need to be stored and how best to store them

12.17 All too often organisations have no real understanding of what data they are storing, how long they have been storing them and whether they need ongoing access to the data or not. A data centre should not be regarded as a magical attic which can store infinite amounts of data indefinitely because everything that is stored in this way has an energy impact. So it is very important for local authorities responsible for data to develop a proper storage strategy in which data are regularly reviewed, rationalised and purged. Purging data does not necessarily mean destroying them; data can also be stored on passive media such as tapes and disks, which can be retained securely but do not use any energy themselves. The environment in which they are housed will still have some energy impact but this will only be a tiny fraction of storing data on an active server in a data centre. As a rule of thumb, the less data you need to store, the less energy you need to store it. So authorities should avoid simply storing everything indiscriminately.

12.18 The other problem is that authorities often have data stored in different places, where each department has a separate IT service and separate data storage facility. A shared service approach, where all data are housed in a single facility, can be much more energy efficient. So the IT function itself (and how it is delivered) also needs to be reviewed and rationalised.

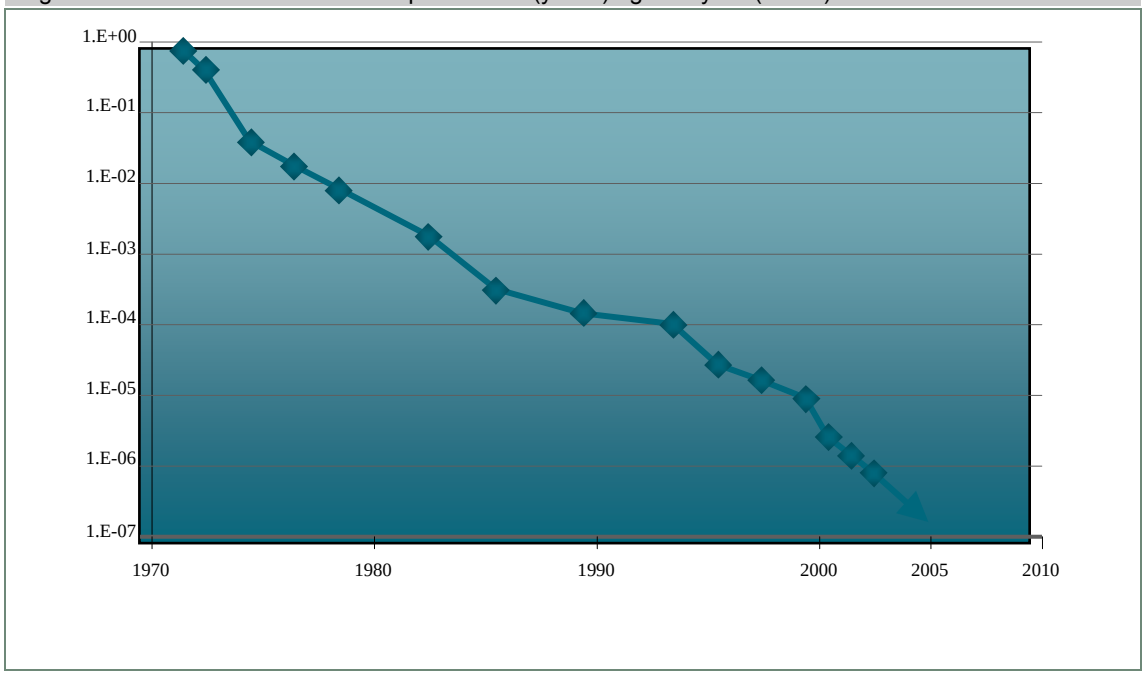
12.19 IT functions in the City of Copenhagen were spread between seven different departments, all of which were brought together as a shared service and a large number of different server rooms and data centres were consolidated into one single, efficient data centre. This not only delivered huge improvements in energy efficiency but also enhanced service levels and reliability whilst dramatically reducing the total cost of ownership (TCO).

Action 1: Review and rationalise your data, including your IT function.

How can we optimise computing performance, what technical solutions are available and how do they work?

12.20 ICT is perhaps unique in the speed at which the technology develops, particularly in terms of energy efficiency. In fact, microprocessors have become a million times more energy efficient in the last 30 years. Figure 12-7 shows the amount of energy required to process a given amount of data. Note that the scale on the y axis is logarithmic.

Figure 12-7: Power demand of microprocessors (y axis) against year (x axis)



Source: Intel

12.21 New hardware, such as multi-core processors, offers greater capacity with reduced energy consumption and reduced heat generation. Managed hosting provider Memset revealed that in one year server hardware had become around three times more powerful whilst reducing energy consumption by about 40%, an increase in overall energy efficiency of around a factor of five.[xcix]

12.22 At the server level, blade servers are starting to replace 'pizza box' servers. This is because multiple servers sit in a cabinet. Pizza box servers each need individual power connectivity so the cabinet needs multiple power sources going into it. Blade servers sit in a docking slot within a blade chassis that in turn sits in the cabinet and so multiple power supplies are not necessary.

12.23 These rapid improvements in technology mean that new equipment is far more energy efficient than old equipment, and so local authorities need to keep this in mind when deciding whether to upgrade. An old inefficient server will be inefficient 24 hours a day, 7 days a week. Unlike some other ICT equipment which tends to have high energy intensity in the manufacturing stage, a server can use up to 90% of its lifecycle energy demand during the use phase, so local authorities need to look closely at total cost of ownership when reviewing their IT services. There is a lot of emphasis on 'sweating assets' at the moment, but it only pays to

prolong the use of older equipment if it is efficient – sometimes the total cost of ownership with older servers can be much more than with upgraded equipment.

Action 2 – Do your sums! Check performance of existing equipment compared to performance of new equipment to see how long the ROI on cost of refresh will be and whether it is better to sweat assets longer.

Approaches to data storage: consolidation, virtualisation, utility, grid and cloud

12.24 **Consolidation** simply means squeezing as much processing activity onto as few servers as possible. When a new IT function is created, new servers are frequently requested to run this new activity. This is often unnecessary because this function could be performed by existing servers that are not being used to capacity. So consolidation simply optimises the use of servers so that they are all working to capacity. If server capacity is not optimised then the result is energy waste on a colossal scale. There are some excellent examples of how data centre operators have made substantial energy savings through consolidation.

12.25 **Virtualisation** and consolidation go hand in hand. Virtualisation can be applied to just a few machines or to a whole data centre infrastructure, involving more than one facility. At a server level, virtualisation transforms the hardware resources into a functional virtual machine that runs its operating system and applications like a real computer. However, virtual machines can share hardware resources without interfering with each other. This enables the consolidation of a number of virtual computers (or servers) onto one physical computer (or server), whilst maintaining the individual properties of each of those systems – so they behave exactly as though they are still on individual servers, although they are in fact all together. This technology is known as VMWare). This kind of practice can achieve power savings well in excess of 50%.[c] The City of Copenhagen reduced the energy demand of its IT function dramatically through virtualisation and consolidation.

12.26 The importance of virtualisation and consolidation is that they reduce the energy demand of the IT function within the data centre. This has a magnifying effect on overall savings because the energy used to run the servers is only a fraction of the overall demand. i.e. when fewer servers are run, not only the energy to run them is saved, but the energy for cooling and other infrastructure is also reduced.

12.27 **Utility computing** is the next logical step to virtualisation and essentially means treating computing resources like a utility such as water or electricity, available on demand. The objective is to enable organisations to buy computing services on a metered basis, according to requirement– as a service. This means that there is no need to purchase hardware or software or make large up-front investments and it also provides excellent flexibility. The computing resources are provided remotely and economies of scale can be achieved.

12.28 Utility computing enables what is known as **on-demand computing**, where computing services are accessed as needed. **Grid computing** is a specific type of utility computing that is particularly suitable for large scalable tasks like transaction processing by pooling the capacity of different computers (distributed computing is another way of doing this).

12.29 **Cloud computing** is the latest evolution in this area. Cloud computing is independent of location and depends on virtualisation technologies to allow shared servers to provide computing resource to users on demand. As in grid computing, resources are effectively shared between different users, allowing economies of scale to be realised.

12.30 The ICT market is increasingly adopting a service delivery model. Utility computing and the 'cloud' facilitate the delivery of **software as a service** rather than as an asset which is one means of reducing both the energy demand and the cost of software for organizations.

Action 3: Review the latest approaches such as server consolidation, virtualisation and grid computing.

Facilities management: how to improve infrastructure efficiency

12.31 The physical infrastructure of the building that houses the IT equipment has a major energy impact on the overall energy demand. There are many different approaches for improving energy efficiency. Some of these are at the build stage and others are at the management stage.

Build stage

12.32 Build stage technologies now tend to move more towards containerised or modular builds (used by companies like Capgemini in their Merlin data centre in Swindon). A modular build means that the data centre can grow flexibly depending on the demand for processing power. Figure 12-8 shows that even when no servers are working the building infrastructure has a significant energy demand. With a modular build, this energy demand is minimised, especially when fewer servers are active. So when the servers are not active the building uses much less power, and rather than being a straight line, the power demand of the building rises more in proportion to the power demand of the servers, but starting from a much lower point. This is particularly useful if demand fluctuates, because a modular approach is so flexible.

Figure 12-8: New data centre building with modular units

Source: Cagemini

12.33 Other approaches such as fresh air cooling systems are implemented at the build stage. If fresh air cooling is to be used then the location of the data centre is very important, as are the position and elevation which have to generate sufficient volumes of cool air. Careful positioning of a new data centre can, as a result, be very effective in improving energy efficiency (i.e. at an elevation or in a position where plenty of moving air passes the data centre). It is said that for each 1ºC of cooling needed the energy demand increases by 4%, so there are significant gains to be made from taking advantage of natural air flows for cooling.

12.34 The geographical siting of any new data centre can also be effective in reducing carbon impacts for other reasons. Data centres need a combination of high telecoms connectivity (i.e. broadband – often called a 'fat pipe') and a large, reliable power supply. Increasing consideration is being given to placing data centres close to renewable energy sources such as hydro electric or geothermal power – data being probably the most mobile commodity in existence. Whilst this does not reduce the energy demand, it will dramatically reduce the carbon emissions associated with the data centre function. Other initiatives are placing data centres next to other facilities that can make use of the waste heat generated. One example is the new Lockerbie data centre in Scotland, planned next to a new village.

Management technologies

12.35 Most local authorities will not have the opportunity to build new data centres but must make best use of existing stock. Much can be done by retrofitting and by installing intelligent building or energy management systems.

12.36 Energy management in data centres is a complex area which is attracting increasing scrutiny. Solutions already exist that can radically reduce energy use through good facility management. Smart data centre management tools optimise heat and cooling; sophisticated

analytical software monitors what the servers are doing and feeds that information to intelligent energy management systems. Further technologies have incorporated wider use of more efficient water cooling (in the case of IBM) or even using CO_2 -based refrigerant, better management of airflow and challenging temperature standards.

12.37 The essential thing to remember is that the key to good energy management in data centres is a good understanding of fluid dynamics – moving hot air away from servers and cool air towards them with minimal mixing or waste. Some solutions are very simple – cheap plastic panels placed behind cabinets prevent warm air re-entering the servers and force it out and replacing ceiling or floor tiles prevents air escaping. Hot and cold aisles also help control the flow of air more efficiently.

12.38 Other options for good energy management include:

- careful monitoring of temperature set points and automatic adjustments to minimise the power used in cooling
- identification of 'hot spots' and direction of cool air only to where it is needed
- use of individual cooling systems at the server level; for example, HP uses an integrated approach to power management called Dynamic Smart Cooling
- converting the AC mains power supply to DC which reduces transformer losses at the individual machines
- energy efficiency lighting and lights-out operation can be adopted – computers do not need the lights on to work
- more recent approaches target the software applications themselves to minimise energy use.

12.39 Not all approaches will be suitable to a specific data centre environment - so it is important to explore the different options.

Action 4: ensure that energy use of the physical data centre infrastructure is minimised.

What other issues are relevant?

12.40 Local authorities will have to take a number of factors into account when implementing measures to improve the energy efficiency of data centres. These include statutory obligations, reluctance to relinquish control to third parties, contractual barriers, split incentives, culture and cost.

12.41 Local authorities have certain statutory obligations relating to data security, data protection and the retention of data, which they cannot avoid. For instance, regulations like MIFID mandate instant access to financial and transactional data for seven years and therefore have significant energy impacts because these data cannot be stored passively but has to stay in a data centre, using energy.

12.42 Internal considerations often present barriers to a shared services approach. For instance, departments are often reluctant to relinquish control of their data or their IT function. At the political level, those accountable to rate payers and voters want to retain direct control of the services for which they can be held responsible. Other fears, usually unfounded, about data protection and data security may also make authorities unwilling to adopt a shared service or a more virtualised approach to their computing needs.

12.43 There may also be a whole range of contractual barriers that can impede the implementation of energy efficiency measures for local authority data centre operations. Many local authorities have contracted out their IT function, often to a large number of different suppliers, whose individual contracts will expire at different times, so changing contractual arrangements could be hampered. Other contractual arrangements may relate to service level agreements. For instance, we now know that servers can operate reliably at higher temperatures than previously believed (safe operating temperature ranges for servers are defined by ASHRAE standards, overseen by CIBSE, the Chartered Institute of Building Surveyors and Engineers in the UK). However, maximum operating temperatures for data centres are often stated in contracts as part of the service level agreement and cannot be exceeded without the supplier breaking the terms of the agreement. This means of course that significant opportunities to reduce costly and energy intensive air conditioning and cooling processes are not taken up. Suppliers may also charge local authorities who wish to change the contractual arrangements to include energy efficiency measures, particularly if these involve an up-front cost, because these will be outside the contract.

12.44 Split incentives also may occur in contracted out situations, as local authorities wishing to implement energy saving measures may not benefit from the carbon and cost savings they bring but these may be enjoyed by the supplier instead. That said, third party data centre suppliers should automatically implement efficient arrangements in their data centre operations because these will reduce their cost of supply.

12.45 Culture is also a major obstacle to implementing innovation in terms of either equipment or systems. Many IT projects are really change management projects enabled by technology, rather than technology projects. Change in any form is often resisted simply because it is change and reluctance to adapt to new ways of working can be a significant problem.

12.46 There are also other more tangible barriers to implementation: significant upgrades or virtualisation exercises will need up-front investment to achieve a medium term payback and the necessary funding may not be easy for local authorities to access. Copenhagen is an excellent example of the medium and long term savings that can be achieved but the project depended on up-front outlay by the authority. The battle between “capex” (capital expenditure) and “opex” (operational expenditure) will be a familiar problem to many local authorities and the data centre environment is just another place where these have to be juggled.

Action 5: Identify non-technical barriers and issues that may have to be addressed.

Tools and references

Initiatives for improving energy efficiency in data centres

12.47 The current data centre environment is very energy intensive and few facilities use energy optimally. There is clearly much room for improvement. However, the concept of a green data centre is rapidly evolving and a number of initiatives are already underway. These include:

- **the Green Grid:** this is a global consortium of IT companies and professionals aiming to improve energy efficiency in data centres and in business computing systems around the world. Data centres now underpin most modern business operations and as demand for data processing increases, data centre operators and managers are encountering limitations to growth in terms of power supply and space. The objective of the Green Grid is to unite global industry efforts to develop a standardised set of metrics, processes, methods and technologies which will drive improved efficiency in data centre operations. The reasoning behind this is that once the industry has adopted a standard set of measurements, it will be easier for end-users to manage their equipment and facilities. Metrics include PUE, CUE (Carbon Use Effectiveness – measuring the carbon impact of energy generated for data centre operations), ERE (Energy Reuse Effectiveness – which takes into consideration alternative uses for waste energy from data centre operations), DCcE (Data Centre Compute Efficiency, which enables operators to assess the efficiency of their computing resources) and ScE (Server Compute Efficiency, a sub-set of DCcE) www.thegreengrid.org

- **the EU Code of Conduct for data centres:** local authorities should check that their data centre provider is a signatory to this code, which is a voluntary initiative aimed at bringing together a range of stakeholders. Signatories to the Code must follow it both in terms of intent and abide by a set of agreed commitments. The Code of Conduct was created to help address the growing energy consumption of data centres and by so doing address related issues of cost, security of energy supply and carbon emissions. Its objective is to encourage data centre operators to reduce energy consumption cost effectively without compromising the mission critical function of data centres. The Code aims to raise awareness and improve the level of understanding of energy use in the data centre environment and providing recommendations for operators in the form of best practice and reduction targets. http://re.jrc.ec.europa.eu/energyefficiency/pdf/CoC%20data%20centres%20nov2008/CoC%20DC%20v%201.0%20FINAL.pdf

- **the BCS DCSG** (British Computer Society, Data Centre Specialist Group) has developed a modelling tool in conjunction with The Carbon Trust (also based in the UK) that enables meaningful comparisons to be made on data centre efficiency– an extremely difficult task given the complexity of the environment and the manifold

constraints on operators and suppliers. It also works as a predictive tool and they are also developing an open source simulation tool to allow operators to realise the potential savings offered by different technologies (http://dcsg.bcs.org).

Initiatives for helping local authorities identify and implement green ICT

12.48 There are a number of initiatives which local authorities interested in this field may find helpful:

- **Green IT Consulting Bureau**: This is a joint initiative organised by BITKOM and the German government to provide free, impartial advice on green IT solutions for organisations (www.ITK-beschaffung.de)
- **the UK's Greening Government ICT Strategy**: This is a UK-based initiative led by Cabinet Office with the intention of helping public sector organisations reduce the carbon impact of their ICT estate. The strategy sets out 18 quick wins that local authorities should adopt to improve energy efficiency. A further, long list of around 75 activities is also under consideration.

Conclusions and recommendations for authorities

Conclusions

12.49 Data centres are complex, energy-intensive environments. Because of the range of technologies involved, a one-size-fits-all approach may not be the best route to efficiency. At a strategic level, there are three key factors that will help optimise the energy efficiency of a data centre. They are forward planning, active energy management and a holistic approach.

12.50 **Careful planning** is critical at the build stage or when refreshing hardware or refitting the facility, and this planning has to accommodate changes in workload in the future. The ROI and the whole life cost /total cost of ownership must be taken into account

12.51 **Active energy management** is essential all the time the facility is in use. Good energy management will also help identify when servers should be refreshed to reduce total cost of ownership and when their lives should be extended. Automatic systems can monitor, benchmark, adjust and optimise energy flows through the buildings, particularly for cooling the hardware.

12.52 **A holistic approach** is also critical. The data centre facility and the IT contained within it are intimately connected. Moreover, the data centre is only one part of the IT infrastructure and decisions about IT services provided for citizens will have an impact on the data centre infrastructure, and vice versa.

12.53 Fortunately there are many tools to help local authorities understand, measure and optimise the efficiency of their data centre operations.

Top five recommendations for authorities

- Review and rationalise your data – don't keep stuff you don't need. Don't store data on spinning disks that could be archived passively; de-duplicate your data and separate any mission critical data so that it can be treated appropriately
- Do your sums! Check performance of existing equipment compared to performance of new equipment to see how long the ROI on cost of refresh will be and whether it is better to sweat assets longer or to invest in new, more efficient hardware
- Review the latest technologies and approaches such as server consolidation, virtualisation and grid computing. Find out whether a service approach would avoid the need for up-front investment
- Ensure that energy use by the physical data centre infrastructure is minimised. For most authorities existing facilities will need upgrading and refitting. Many energy management technologies can be implemented at very low cost. For guidance always refer to the EU Code of Best Practice for Data Centres and remember that most of it boils down to fluid dynamics
- Identify non-technical barriers and issues that may have to be addressed, such as contractual constraints, legislative obligations and legacy contracts. Most system integrators specialise in handling these complex problems so they may not be as hard to overcome as they seem.

Sources and Acknowledgements

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Special thanks to Derek Allen, Head of Data Centre Services, Cable & Wireless

13: Audit simulation in buildings

Introduction

13.1 Buildings account for as much as 40% of the overall energy use and there is increasing interest at European, national and local level in exploring the potential for energy savings through improving energy efficiency in buildings. National governments in some EU member states are introducing a range of policy measures that require improvements in energy use from local governments including legislative requirements that oblige local governments to report their annual energy consumption rates to the national government. To be able to do this in an efficient way and allow for mid-way corrections, energy audits and energy monitoring systems are important tools.

13.2 An important EU legislation that has great impact on local governments is the European Energy Performance of Buildings Directive, now introduced in all EU countries. This act provides detailed provisions for achieving higher energy efficiency through the renovation of existing buildings. The European Commission's communication 'One Energy Policy for Europe' (COM/2007/1) provided extensive guidelines for national policy making. More recently, the European Green Digital Charter launched at the end of 2009 aims to encourage cities to link their ICT activities to energy efficiency for buildings, transport and energy.

13.3 Effective management of buildings can bring about proportionally large savings and introducing ICT presents many opportunities to optimise energy use and save money. However, although these opportunities exist, in reality many European municipalities are either unaware of them, lack relevant expertise or financial resources. This narrative will look at the most frequent barriers and how local and regional authorities have managed to overcome them.

The problem that this narrative is addressing and objectives of the narrative

The problem

13.4 All European municipalities have a relatively large stock of buildings which they own and manage including the municipality's own offices, schools, hospitals, sports centres and a range of administrative and public service buildings. Moreover, municipalities often also have social, financial or legal obligations relating to private homes. These include pre-fabricated buildings which are particularly widespread in the new Eastern European EU members some of which have introduced national programmes that give local authorities an important role in increasing the energy efficiency of pre-fabricated buildings as co-funders, implementers and evaluators of demonstration and full scale projects to improve the energetic and overall rehabilitation of such buildings.

13.5 This narrative addresses a number of questions:

- what can local and regional authorities achieve by adopting an ICT-enabled building audit and management system
- how can municipalities save money by investing into ICT-enabled buildings
- what kind of buildings could benefit from an ICT-based energy-management system
- what are the main technical tools that help local authorities saving money and energy
- how to introduce an effective ICT-enabled building audit and management system, whom to partner with, what project components to consider and which typical project milestones to set
- what are the main ways of financing these investments
- what are the typical risks and problems and how they can be tackled
- how to maximise success and how to measure it
- how to communicate success … and failure
- how can other municipalities replicate your success.

Objectives

13.6 This section introduces the main approaches of saving energy in buildings through the use of ICT and provides insights from practical experiences which were gathered by European local authorities when implementing these measures. It is addressing two main objectives:

- provide a general overview of local initiatives introducing ICT-enabled building management tools
- help local authorities develop such energy saving programmes, by avoiding pitfalls and achieving the greatest benefit.

Guidance for authorities

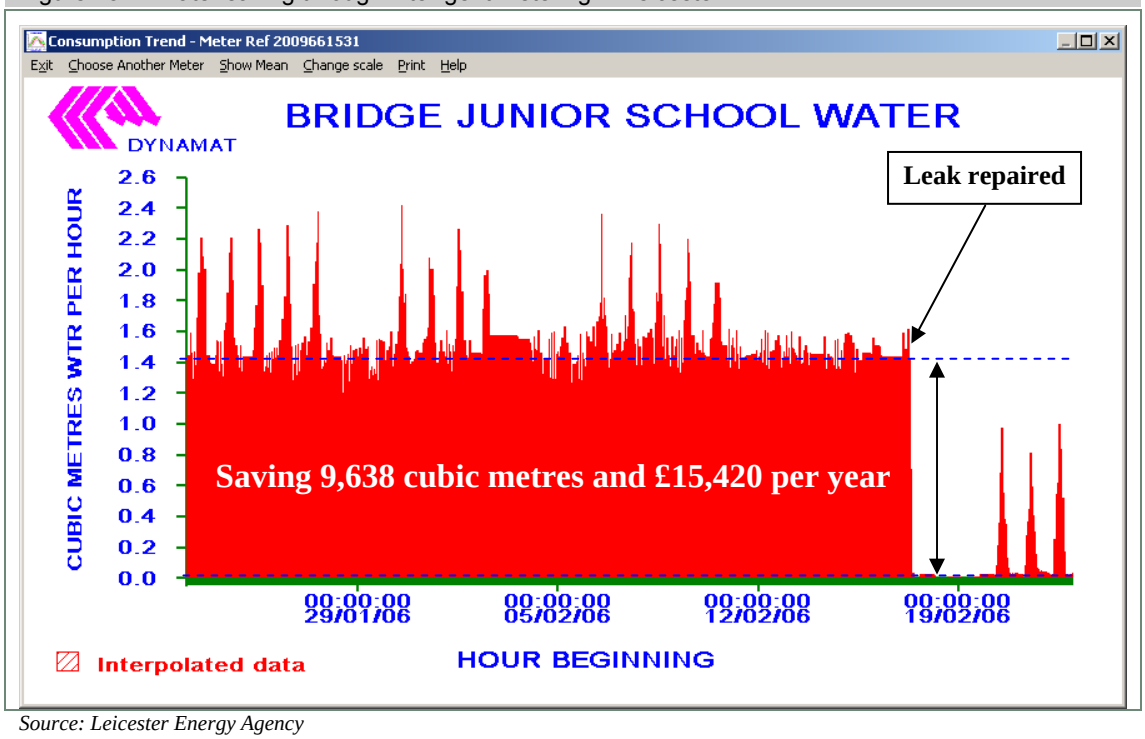
What can local and regional authorities achieve by adopting an ICT-enabled building audit and management system

13.7 Currently, most local and regional local authorities do not rely on ICT-enabled building audit and management systems and even if they have started using them, they tend to be on a small scale or address only one or two issues. However, technologies and methods for intelligent buildings have passed beyond the research stage and have reached maturity, ready for large scale commercial market introduction.

13.8 Such systems are usually implemented as part of a wider portfolio of sustainability measures (e.g. green procurement, awareness raising, waste reduction etc.). Most case studies reviewed in this section demonstrate that in energy saving measures the human factor is still the key to

success; however these new technologies can make building management and awareness raising activities much more efficient. An example is intelligent metering. It can be used for collecting data from water, electricity and gas networks. In Leicester the smart water meter drew the attention to a water leakage in a local junior school. As a result, 9600 m^3 of water was saved annually, which corresponds to saving £15,000 (see Figure 13-1). In the same way, smart meters can identify and draw the attention to unnecessary consumption habits, such as gas consumption during weekends in schools.

Figure 13-1: Water saving through intelligent metering in Leicester



Source: Leicester Energy Agency

13.9 Besides savings of cost and energy, the case studies demonstrate a range of secondary benefits including better in-door air quality, airflow and humidity, more optimal room temperature, better quality lighting and less noise (for instance through better noise insulation).

13.10 A number of case studies also demonstrate that such pilot projects trigger large-scale follow-up activities. For example, in Czestochowa, the thermal insulation of public buildings and the purchases of materials and products from suppliers were all made based on the results of ICT-based monitoring activities. The case studies from Budapest and from Aalst also demonstrate that energetic improvements can have important secondary benefits, which improve the well-being of users.

How can municipalities save money by investing into ICT-enabled buildings

13.11 Building automation systems can bring efficiency improvements to every single building where electric or heat energy is used. The case studies provide a range of examples for reducing energy use in heating, cooling, ventilation, electricity saving and lighting.

13.12 The case study in Maribor describes a system where 117 buildings were integrated into an ICT-based system. This measure alone brought energy savings in excess of 10%. By using a more comprehensive system (Building Automation Systems coupled with Energy Monitoring and Control Systems), an energy saving of 30% was achieved by Aalst Hospital. In Växjö, a 5% energy use was achieved by installing smart meters and presenting these data in a user-friendly and interesting way to the consumers. In some controlled environments, this percentage was as high as 34%. This dramatic reduction was achieved entirely through equipping households with new intelligent displays and engaging them to reduce energy use.

13.13 In terms of **direct return of investments**, there are large variations, depending on the local situations. In the case of the Aalst Hospital, the initial investments totalled EUR 31,000 and the actual energy saving of 10-15% of the yearly energy costs yielded an annual net saving of EUR 11,000 as a net value, with annual maintenance, training and development costs already deducted, a payback time of less than three years.

13.14 In terms of **carbon credits**, the level of CO_2 emission reduction tends to be relatively easy to measure. For example, in the case study from Valmiera, 94 tons CO_2 were saved annually; considering the current market price of CO_2, this translates into an emissions credit of EUR 1,410. This income would pay back the one-time cost of EUR 7,300 of the energy audit in five years.

13.15 With respect to **long-term savings**, in Växjö, 5% of electricity in private homes was saved by installing smart meters. Considering the large number of private homes included in the system, this accounted for saving 450MWh electricity in less than a year.

13.16 Very often, the most substantial savings can be made by **follow-up activities** through retrofitting buildings in a way that is suggested by an energy audit or by an energy monitoring system. The case study from Leicester lists a number of low cost interventions that were implemented in this way, achieving energy and cost savings in heating, electricity and water use.

13.17 With the **liberalisation of electricity markets**, the city of Czestochowa could make additional savings by purchasing electricity at reduced prices. Intelligent metering and monitoring of energy use enabled the city to take advantage of changing tariffs. The city achieved very significant savings by tendering and contracting its electricity supplier in the most optimal way. Similarly, in Leicester better rates could be negotiated from the electricity and water providers.

What kind of buildings benefit from an ICT-based energy-management system

13.18 As a general rule, local authorities can use an ICT-based energy-management system for any building that uses energy. Examples include schools, public service buildings, administrative buildings, community centres, sports centres or residential buildings. The case studies in this resource provide useful examples for practically any type of buildings that a local authority may own or have responsibility for, including public and residential buildings.

13.19 The case study in Aalst describes the experiences related to a system in a local **hospital** which has now been in place for more than ten years. In the Czech Republic, energy certificates were made for **hospitals** as well as **schools**. The case study from Malaga focused entirely, and the one from Leicester mostly on schools. But in fact, any types of public buildings can benefit from such a system. In the case of Maribor as many as 117 buildings are centrally supervised through an ICT-based centralised energy management system. In Czestochowa, media use (energy and water) was optimised in 121 public buildings.

Figure 13-2: A pubic swimming pool in Czestochowa (Poland) which is part of an energy monitoring system.

Source: Bozena Herbus

13.20 The case study in Växjö aimed to alter the energy use behaviour of **private tenants** by installing smart meters for them to see their energy use right away and make corrective steps. In Amaroussion, intelligent meters were used in private homes as the main tool to alter consumers' energy using habits. In Budapest, Hungary and in Valmiera energy audits were undertaken in private households to prepare the most efficient scenario for subsequent thermal renovations.

13.21 In Eastern European countries (but also in the West) there is a large stock of **pre-fabricated buildings**, made of poorly insulating concrete panels. It is estimated that around 100 million people live in such buildings in Eastern Europe. Considering this scale, even small improvements can bring very large energy savings. The case study from Budapest describes scientific 'before' and 'after' measurements to validate local and national energy efficiency policies. The case study from Valmiera shows that an energy audit was developed for three residential buildings using locally developed software. Subsequently, three alternatives were worked out to identify the most optimal and cost-efficient method for insulating the buildings.

Figure 13-3: Test buildings in Valmiera, Latvia

Source: Kaidi Tingas

What are the main technical tools that help local authorities saving money and energy

13.22 All throughout this toolkit it is emphasised that the main key to success is the human factor. In other words, even if the actual projects were about the installation and management of a particular ICT-based building automation tool, in every case it was reported that activities such as training and awareness raising, dedicated and skilled personnel, personal motivation and political support were essential in bringing an initiative to success. Once these conditions have been secured, there are a large variety of technical tools that can assist local authorities and building managers to identify unnecessary use of energy and to suggest the most optimal paths of remediation actions. In the following, we summarise key observations from the case studies.

13.23 A general question is whether it is better to purchase a standard software tool or develop a purpose-built one. There is no clear answer to this question and both options can be viable. In the case study from Valmiera and in Maribor, a locally developed modelling software was used to undertake the energy audit and later recommend different scenarios for insulating the selected buildings. In the Leicester initiative one of the project partners developed an on-line

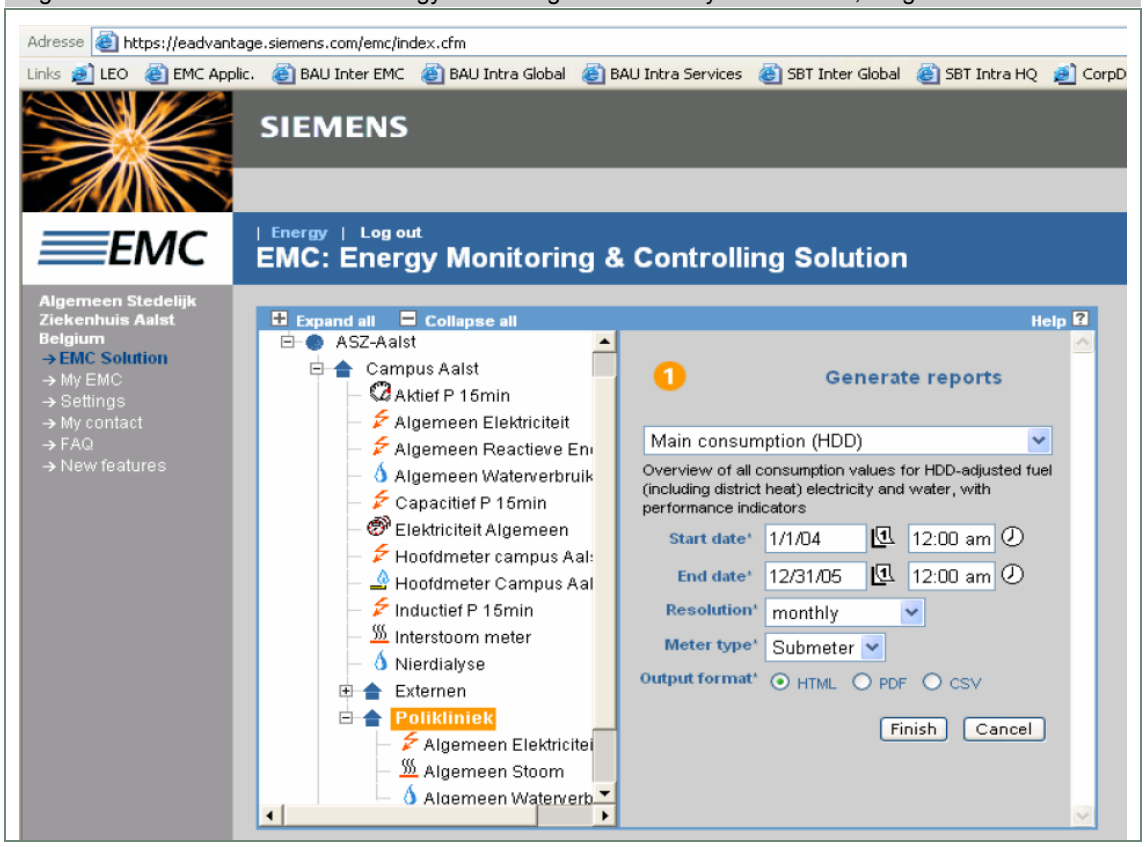
SQL database to upload consumption data for monitoring and analysis. In many other cases, internationally marketed software was used, such as that of Siemens (Czech Republic and Aalst) or OmégaWatt (Amaroussion). To some extent, the question local versus standard software is linked with the complexity of the system in question.

Energy monitoring and control systems

13.24 Depending on the complexity of the project, there are two main approaches, complex systems and simple systems.

13.25 The case study in Aalst demonstrates the installation of a complex system, which delivers real-time information and is an integral part of the building management system. In other cases, local authorities opted for a simpler system. The case study from Budapest describes a pilot project where local university researchers were commissioned to collect basic data by simple data gathering tools (thermometers, wind speed meters, humidity meters etc.). These devices were linked up to a wireless data network and the data were recorded by portable palmtop devices.

Figure 13-4: A screenshot of the energy monitoring and control system in Aalst, Belgium



Source: ASZ – Aalst / Siemens (2009)

Energy audits

13.26 Energy audits can be performed with local know-how, and often using locally developed auditing software. The cost for the energy audit for three residential buildings in Valmiera was EUR 7,300 but this investment then helped to save a much larger amount, having identified the most optimal way for building reconstruction. In the Czech Republic, energy

audits were performed for public buildings that were selected based on their high potential for replicating audit results.

Data analysis

13.27 Data analysis can be done on the basis of state-of-the-art computer simulation or simple visual analysis made by standard office applications. In Aalst, Austria/Czech Republic and Leicester, energy usage was visualised by using specialised software while in Budapest, standard office application was used. In Amaroussion, electricity consumption data were visually presented by using Microsoft Excel.

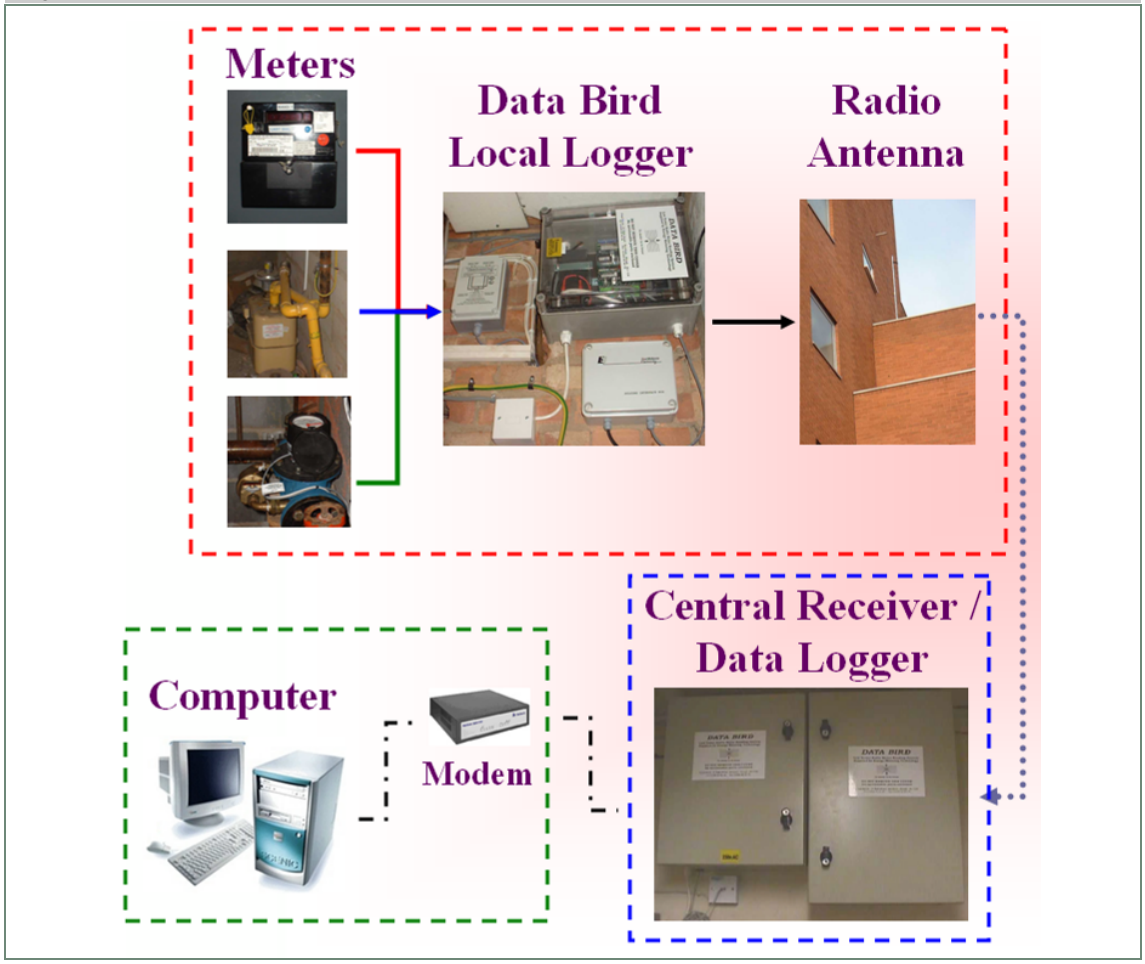
Centralised energy management systems

13.28 ICT-based tools allow the central management and optimisation of energy use in large numbers of municipal buildings. In the case of Maribor, this included the central management of well over 100 public buildings.

Smart metering

13.29 In Växjö, demand side management was implemented by using smart meters for heating, electricity and water in private homes. Consumers were motivated to improve their behaviour through seeing their energy usage on the smart meter display. The information was then collected by an online management tool (OMT) called EnergiKollen which allows people to visualise their energy use and competitively compare their consumption with that of others. In Amaroussion, smart electricity meters were installed in selected households and were used as a main tool for awareness raising. In Leicester, smart meters were used in the most comprehensive way, collecting consumption data from gas, electricity and water utilities in private homes. Analysing these data then enabled a number of interventions for optimising utility use (see Figure 13-5).

Figure 13-5: The data route from the individual meters to the central computer in Leicester, UK



Source: Leicester Energy Agency

Intelligent lighting

13.30 Lighting is estimated to account for 14% of all EU electricity consumption. In Malaga, the existing lighting systems of the 29 public schools were replaced with new smart highly energy efficient lighting systems that rely on the use of ICT for regulating and controlling the light emitted, with an estimated savings of 65% in annual electricity consumption.

How to introduce an effective ICT-enabled building audit and management system

13.31 This toolkit recognises that there is great diversity amongst Europe's regional and local authorities in key indicators including population, financial strength, political interests, social characteristics, historical background and architectural stock. For this reason, no generic 'one fits all' solution can be suggested for those municipalities that intend to introduce an ICT-enabled building audit and management system. In every case, the optimal solution will need to be worked out based on the local priorities and circumstances.

13.32 This section discusses the main management components and findings emerging from the various projects reviewed in this toolkit.

Partners to consider

13.33 One of the first questions to consider is the number and range of partners to involve. Case study evidence points to advantages of starting with a small project consortium. Significant savings only tend to materialise after sustained efforts and to ensure an initiative's longevity, there is merit in building a core team that can survive fluctuations in funding streams. Once the core team is in place, there are other partners to consider including:

- **software companies** to provide the hardware and software environment, technical consulting and basic training. These can be large international companies or local providers. In the case study from Aalst, Siemens Building Technologies was chosen as the main service provider after an extensive tendering process. In Valmiera, Maribor, and in Växjö, local software companies were chosen to provide software solutions and consulting

- **energy agencies** to support municipalities, citizens and businesses in their efforts to increase energy efficiency (see the separate narrative on energy agencies for more information)

- **central ministries,** either as co-funders of initiatives or as national-level policy makers influencing local authorities' work. In Budapest, the national ministry was involved as funder and as the national entity in charge of taking up the policy recommendations

- **communal service company** to become involved at the planning, investment and operation

- **Energy Service Companies (ESCO's)** which are commercial enterprises which implement energy saving measures and their service is paid from the energy savings. The case study from Budapest gives an example for the reconstruction of a residential building where the tenants' share of one third of the reconstruction costs was covered by an ESCO through a 15 year long term contract

- **local residents** to input through energy audits and be actively involved in the implementation of initiatives. Establishing a good cooperation with tenants is especially important when it comes to co-financing follow-up energy saving measures

- **international** networks to provide technical and 'moral' support. The municipality of Amaroussion had already implemented a number of projects with other partners of ICLEI (Local Governments for Sustainability). The Leicester initiative brought together an international project partnership through the local energy agency's membership in Energy Cities. The initiative in Valmiera was implemented as part of the Municipal Network for Energy Efficiency

- **university researchers** to provide technical and scientific underpinning. In Budapest, the lead partner was a research team from a local university. This arrangement can be a good solution to provide a solid scientific basis for identifying the best ways for energy saving measures.

'Soft' project components

13.34 The following section explores a number of 'soft measures' (as opposed to 'hard' infrastructure improvements) which have proved to be central to the success of the featured initiatives:

- **research and accumulated know how** can sometimes be even more important than the actual energy-saving of a given pilot project. The Budapest project was primarily a research project, with the aim to channel findings back into local and national policy-making. The project in Växjö also had an important research angle to understand consumer behaviour and attitudes towards energy use. It also set out to understand and evaluate the technical, economic and educational measures needed to deliver a reduction in domestic energy demand. Both initiatives implemented 'before' and 'after' data collection and analysis and involved private homes

- **communication** with the end users was a key feature of the project in Växjö. Because each partner had access to consumers via their own media, a number of different communication channels were used at the same time, each reinforcing the other. Communication in Leicester was implemented through a wide range of communication measures

- **training, user engagement and awareness raising** was important in almost all case studies; indeed some of the case studies had awareness raising at their core

- **know-how transfer**; a number of the case studies in this toolkit include examples of intensive cooperation among partners, to help create sustainable behaviour over time.

Typical project milestones

13.35 **Step 1: Collecting data.** In this step, the main energy consumers (the buildings and the consumers within the buildings) are identified and an energy audit is being performed. This involves the collection of real-time data on the energy consumption for heating, cooling, lighting, electrical appliances and ventilation, for example by using smart meters. This task may be completed by an outside consultant, an energy agency or a university research team. Basic data can be collected prior to an IT-based monitoring system being in place.

13.36 **Step 2: Creation of an action plan.** In this phase the collected data are analysed and an action plan is drafted. It can be made either by in-house (municipal) experts, by project partners or a subcontractor. Along with the detailed description of the main action items, it includes an investment plan. In this phase partners and people to be involved in the initiative are being identified.

13.37 **Step 3: Implementation of measures.** This step often begins with the public announcement of a tender for the technical service provider (see case study in Maribor or in Aalst). Then, the activities outlined in the action plan are implemented, usually incurring a one off investment.

13.38 **Step 4: Continuous measurement and adjustments.** It is the nature of energy saving measures that they must be continuously monitored and improved as consumption patterns change and corresponding actions are needed.

13.39 **Step 5: Horizontal activities.** These activities tend to be implemented in parallel with Step 3 and/or Step 4 and typically involve training programmes and awareness raising activities.

Approaches to project financing

13.40 The main sources of finance for saving energy through building automation and audit systems include:

- **own municipal funds.** In many cases, energy-saving measures are financed by the municipalities' own budgets, particularly keeping in mind that the upfront cost is expected to generate savings in running costs before long
- **commercial donors.** These can be either ESCOs or commercial enterprises that provide in-kind or financial assistance for implementing pilot projects. Involvement in pilot projects may bring business opportunities later and therefore private companies are often willing to contribute to projects which have a high potential for replication
- **European and international donors.** There are a number of programmes which help to mobilise project funding (see separate narrative on project funding)
- **national donors.** In Budapest, project activities were mostly financed through a national programme for the energetic improvement of panel buildings. By now most European countries have national funds for climate change mitigation.

What are the typical risks and problems and how they can be tackled

13.41 The following section summarises those risks that were found especially important when implementing monitoring systems in buildings. For a more detailed review of potential risks, please visit the separate narrative on project risk.

13.42 As with anything new, there are a number of associated risks, in particular cost and time overrun in implementing the system and underachievement of planned results. However, just as mainstream computer and communications tools are now part of everyday life, building automation tools are beginning to be seen as proved and tested technologies, some of them having been used for more than ten years.

13.43 The following list provides a number of practical steps to address risk:

- **hire a technician**. The effort for maintaining complex systems is often underestimated; it is not enough to install a system and let it run by itself but there is a need for constant supervision and development. In practice this means that municipalities may need to hire an additional full time technician to look after the system. On balance, the cost of such an additional person can be covered from the energy savings; however, in practice the employment costs are tangible and immediate while the energy savings may time to generate returns
- **gain political support.** Although energy efficiency is high on the official political agenda of most European local authorities, a determining factor in bringing an

initiative to success is the political support for it. For this reason, sufficient time should be reserved for discussions in official and private settings

- **gain the support of key stakeholders.** An important issue is how to motivate various stakeholders who may not necessarily be intimately interested in the implementation of energy efficiency measures. Examples for such individuals vary by type of building but school headmasters, local residents or directors of any public institutions concerned. To tackle this issue, it is important for the energy saving measures not only to focus on the technical components but for a significant share of time and budget allocated to training activities and awareness raising

- **plan long term. W**hen it comes to changing human behaviour (as it is very much the case in energy saving measures), the time scales are often underestimated. The relatively short lifetime of a pilot project can be seen as a means to get the process moving. A critical mass of consumer change may often extend well beyond the initial project period, again emphasising the need for awareness raising activities

- **ensure consistency of monitoring data.** Especially in those cases where many and diverse stakeholders are involved, it is crucial to achieve a consistent data format

- **maintain data security.** While most case studies focused on public sector savings which generally do not involve data ownership and confidentiality issues, such problems cannot be ruled out. In the case of the Czech-Austrian cross-border project monitoring data were stored on the web server of the commercial service provider and the local authority was concerned about data safety and therefore decided to change to a new, independently developed and operated system.

How to maximise success

13.44 Optimising energy use in public buildings may be called a ‘low hanging fruit’, with a good chance for success at a moderate risk. The chances are high to find the optimal project scope and the appropriate technical tools to make the project work and as it is also about saving money, public acceptance is likely to be forthcoming. However, there are some pitfalls to avoid and some best practice lessons to consider:

- **proceed gradually**: For most local authorities the technologies and processes involved are new and it is recommended to try out one method through small scale pilots and only to scale up when there is confidence that the chosen approach works reliably and there is adequate expertise to assure long term maintenance. This step-by-step approach has the additional benefit of allowing to invest energy savings into the implementation of the next project steps

- **ensure smooth systems integration**: It is important for the overall success of an initiative that all technical components are - or can be - integrated into one system which allows it to grow by adding new components without having to change the underlying basic system

- **set up the right team**: Know-how, both in-house and outside experts, is crucial for setting up a functioning technical system. Involving the right people from the very start was crucial for the success of a number of case studies
- **keep it simple and ensure a clear focus**: An important key to success is to have a clear and well defined focus of the local initiatives
- **obtain necessary top level and stakeholder support at the beginning**: A municipal initiative can only succeed if the mayor is convinced of its benefits and supports it fully. It will also a higher chance of success if the relevant stakeholders express interest and support from the beginning
- **raise awareness**: Energy efficiency measures are facing obstacles because of perceived risks ('too complicated', 'it worked there but not with us', 'it is not too expensive for what it is worth', 'we have bigger problems than to worry about this' etc.) Talking about your experiences to your peers and 'spreading the word' can help for the initiative to succeed on a wider scale
- **get wider recognition through national and international prizes or certificatioms**: The city of Czestochowa was awarded with the Polish prize 'Nowy Impuls 2009' (New Impulse 2009) for the activities promoting energy efficient technologies, awareness raising on energy efficiency among the citizens. Another way of getting recognition of a local authorities' work is the ISO environmental management standard. Since February 2010 the municipality of Amaroussion has been certified according to the requirements of ISO 14001:2007
- **engage in intense communication within consortium, particularly in cross-national projects.** In Leicester frequent communication among partners – including a project website - was seen as a key factor that contributed to the success of the initiative.

How to measure - recommended indicators and metrics

13.45 The most typical indicators include the energy saving itself (e.g. kWh/year/m^2) as well as the corresponding cost saving (e.g. EUR/year) and CO_2 emission reduction (e.g. tons of CO_2/year). These can be collected either by a fully fledged energy monitoring and control system or by a simple system such as thermometers hooked up to a wireless network and a palmtop data server. Further data may include temperature (inside air, outside air, wall), humidity, noise levels, solar irradiation, wind speed/direction.

13.46 In Maribor, a sophisticated set of indicators and metrics was used and further elaborated in an international project which was entirely dedicated to energy bookkeeping.

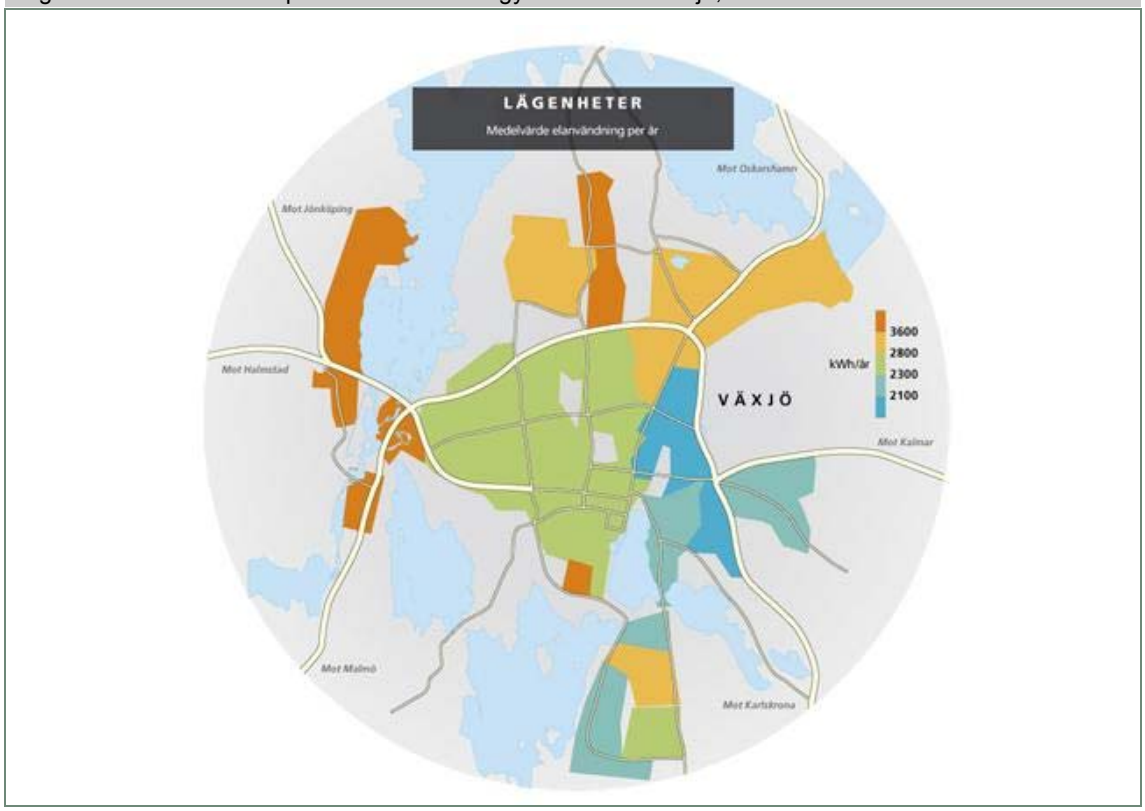
13.47 In addition to quantitative indicators, qualitative data help to document impact. In Budapest, a questionnaire survey was conducted among residents to collect data about their general well-being and feed back about the implemented energy saving measures. In Amaroussion, a questionnaire survey was used as a main tool to collect qualitative data about the success of the initiative.

How to communicate success … and failure

13.48 Most of the cities that are referred to in this toolkit already have good reputations in working out and implementing progressive policies in the field of sustainable development. For example, Växjö has a substantial policy portfolio that has helped to make it a leading city in terms of energy efficiency and sustainability. Similarly, Valmiera is also at the forefront of experimenting with energy saving measures in Latvia. However, good work in itself is not enough. There should always be an active communications component which not only 'sells the product' but also builds up a general positive image of the given local authority. A well established communications portfolio helps to build up public trust, and also makes it easier to communicate when something goes wrong.

13.49 One approach to communicating success or failure is to 'let the product sell itself' through real-time representations of success. In Växjö, the SAMS website provides an open forum where people can exchange ideas, pick up information and discuss energy matters (see Figure 13-6). The web site includes results from competitions and information on the amount of energy saved. It is embedded into a wider communications portfolio which also includes dedicated magazines, flyers, exhibitions and car stickers and promotion in other media including newspapers and magazines, radio programmes, adverts on buses and videos at cinemas and supermarkets.

Figure 13-6: Real-time representation of energy use data in Växjö, Sweden



Source: SAMS (www.sams.se)

13.50 The main output of the case study from Budapest was a publication which documented in detail the data collection and analysis work and provided recommendations for technical improvements and policy making. This resulted in the modification of relevant national legislation and some of the findings were also picked up by mainstream media.

13.51 The city of Czestochowa has been aiming at increasing energy efficiency for almost a decade. Public communication is an integral part of its activities in this field with a dedicated website as one of the central tools. The website includes information on the city's actions to increase energy efficiency, problems and issues arising, downloadable guides, promotional materials and a discussion forum.

13.52 Communication must be clear and simple. People may not necessarily understand if 100 MWh electricity is much or not much. But if it is presented in a simple, preferably graphical way it can be a very powerful tool for raising awareness and encouraging behavioural shift among consumers.

How can other municipalities replicate your success

13.53 Once your initiative is in place, tell others about it! Sharing good – and bad - experience with other stakeholders, most importantly with fellow local authorities, is of great help to promote successful initiatives and prevent others from making your mistakes. For example, Aalst Hospital has successfully introduced a number of energy efficiency measures which are now widely replicated in other hospitals in Belgium.

13.54 Replication is often not a matter of technical possibilities but perception of whether something will really work. As the Valmiera case study shows, innovative local initiatives can have great importance in demonstrating to other municipalities that simple activities (such as energy audits) can have great value for municipalities and do work in practice. In this particular case, within three years of the end of the pilot project, the number of energy audits in Latvia increased from 10 to 200.

13.55 In Czestochowa, the local authority is recognised as one of the leading Polish cities in improving energy efficiency. To exchange experiences, the city of Czestochowa is a member of the Group of Experience Exchange on Energy Efficiency of the Association of Polish Cities. Besides this, the city engineer of Czestochowa is Head of the Committee on Local Ecological Policy of the Silesian Association of Communities and Districts.

13.56 Once a methodology is in place, existing networks can help to make replication in other cities easy. In the cross-border case study of Austria and Czech Republic, the networks of local and regional energy agencies is used to promote good practice. In the case of Czestochowa, the Polish Energy Regulation Office has used results from Czestochowa's monitoring and reporting as reference points in tender documents for electricity purchase for other regional and local governments.

13.57 When a pilot project has yielded positive results, it may also lend itself to be replicated by stakeholders other than municipalities. In Leicester, the consortium leader Leicester Energy Agency transferred the know-how relating to smart metering to small and medium sized businesses, pointing out that that they may need even greater support than the local governments themselves.

Conclusions and recommendations for authorities

Conclusions

13.58 Energy efficiency measures for public buildings (including local authority offices, schools or hospitals) can be most effective when implemented as part of a systematic process involving audits and ongoing management, supported by ICT-based monitoring and simulation tools. Authorities adopting such measures can achieve added benefits by demonstrating the potential for energy efficiency to other organisations and businesses locally.

13.59 Many of the energy efficiency solutions for buildings outlined in this toolkit have large potential for replication and scaling up. Although a 5% energy reduction may not seem very high, due to the large number of households participating in the municipal smart metering programme (30,000 homes), as much as 450MWh/year electricity was saved in Växjö, Sweden.

13.60 Energy saving in buildings is not necessarily a matter of personal limitations and troubles. It can also be fun! The EnergiKollen website of Växjö, Sweden is a great way of giving feedback about people's energy consumption and altering their behaviour. People can enter competitions and compare their performance with others.

13.61 Almost all of the case studies had a component of training and confirmed that a large portion of energy saving can be achieved by changing human behaviour. In Czestochowa, Poland, the administrators of 170 public buildings participated in training programmes between 2004 and 2009. After the training, the reduction in energy and water use was clearly measurable. This change in behaviour was facilitated by the ease with which monitoring data could be read and interpreted.

Top five recommendations for authorities

- Consider whether ICT-enabled building audit and energy management should be a high priority initiative for your authority. Generally speaking this can be one of the most cost effective ways for authorities to save carbon and energy with a relatively fast payback period.
- Bear in mind that relatively simple tools using standard software packages can play an important role in supporting building energy management as well as more sophisticated software.
- Seek to scale up once building energy audit and simulation processes are run effectively in one place. The extent of public buildings and housing mean that there should be opportunities to replicate successes and achieve economies of scale.
- Technology alone will not change behaviour – user/consumer engagement is critical if real change is to be achieved. Building/facility managers and the building occupiers are both key parties and will have different needs in terms of communication and support.

- Alongside the direct energy savings from building energy audit and management initiatives, seek to maximise other benefits for building users and your authority. For example, helping to change attitudes about energy efficiency generally.

14: What to do next?

Concluding remarks

14.1 ICT has great potential to assist in the delivery of a wide range of energy efficiency and sustainability initiatives in a myriad of ways. There are a growing number of practical examples of successes at local and regional levels and these examples vary widely in terms of:

- the types of situations that authorities are addressing including ICT equipment and infrastructure, buildings and construction, transport or other areas of energy monitoring
- scale – from projects in a single building to city wide initiatives
- the complexity and type of ICT being used
- the status from research to piloting/trialling to full scale roll out.

14.2 ICT is generally part of a solution, not the total solution. The importance of supporting people and helping to achieve behavioural change is widely recognised as being important in many successful energy efficiency projects.

Recommended next steps

14.3 The opportunities for harnessing ICT for energy efficiency are constantly improving. It is therefore beneficial for local and regional authorities to share information and learn from each other. This knowledge sharing can be enabled through regular contact with sustainability and energy efficiency teams in neighbouring cities, municipalities and regions.

14.4 Sharing knowledge between authorities across the EU can also be facilitated, for example via the online toolkit from this project (available via www.ict4e2b.eu). The toolkit provides lessons from specific examples (case studies) and a wealth of other guidance to support authorities in accelerating the planning and implementation of energy efficiency projects involving ICT.

14.5 The toolkit can help authorities to:

- identify ways of getting started with new energy efficiency projects including the most cost effective initiatives where support and funding is most likely to be easily achievable
- start to take a more strategic approach to energy efficiency planning and implementation towards a range of policy goals over the longer term
- identify and overcome potential barriers associated with the practical implementation of ICT enabled energy efficiency projects on the ground

- consider different models of collaboration with industry to deliver sustainability and economic development goals (e.g. public-private partnerships, eco-innovation centres/clusters)
- identify existing networks that can support activities (e.g. networks associated with Municipal Energy Agencies, Green Digital Charter/Eurocities, Covenant of Mayors, Smart Cities)
- provide access to practical advice and a community of practitioners through which experiences can be shared – www.ict4e2b.eu.

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[c] Memset