Building material to isolate the recession

Fighting the economy crisis by stimulating energy efficiency, sustainable energy and more social cohesion in the built environment

Report
Delft, September 2009

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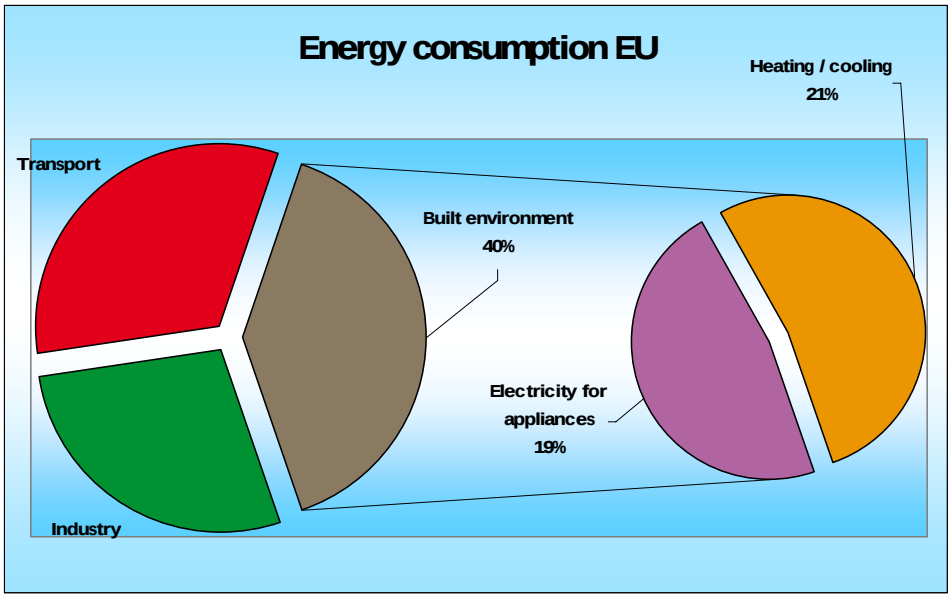
1 Introduction

In December 2008, the European Union adopted a climate and energy package with the target to reduce CO_2 emissions by 20% in 2020 below its 1990 emission levels (rising to 30% if other industrialised countries join). Buildings use as much as 40% of all final energy in the EU (see Figure 1); they also offer the single largest potential for the reduction of greenhouse gases. Policies to reduce these greenhouse gas emissions can generate large numbers of green jobs, which will give a boost to both the climate and the economy.

Figure 1 **Energy use in the EU**



Source: Eurostat Energy Statistics, 2007.

Applying energy efficiency measures in buildings generally yields multiple benefits:

- *Environmental* – reduced CO_2, NO_x and SO_2 emissions.
- *Employment* - retrofitting and construction are generally labour intensive[1].
- *Social* - improving energy efficiency is a well-known strategy to eradicate fuel poverty and offer extra comfort.
- *Strategic* - less dependency on international energy markets, slowing the depletion of the EU's own fossil fuel resources.

[1] Wade et al. (2000) looked at 44 energy efficiency investment programmes in the EU and found that 38 generated additional employment. However, the number of jobs created is relatively small compared to the size of the investments and therefore creation of employment should not be the primary objective of energy efficiency programmes.

Such multiple effects encompass our aim for economic recession policy measures. However, for policies to be effective, one needs to take into account at least three more aspects:

- *Affordability (for governments)* – the cost effectiveness of the measures themselves as well as the structure of supporting instruments (pumping back mechanisms, etc.).
- *Negative side effects* - sometimes measures cause inconveniences or other negative effects and related costs, which must not be neglected.
- *Time* - effectiveness of measures in the short and/or long term.

This paper explores examples and ideas for policy measures that not only have a positive effect on the climate, employment and social cohesion but are also affordable and have limited or no negative side effects. Options that can be implemented in the short and long term will be reviewed. The long-term goal is a completely renewable energy supply.

The first stop of our journey will be at the 'technical measures shop' (section 2) addressing the 'what' question, and then, after having selected some promising products there, we will move on to the 'policy instrument mall' (section 3), addressing the 'how' question.

2 Shelves full of suitable materials

In this section, we address the 'what' question. In the shop, the technical measures to reduce greenhouse gas (GHG) emissions resulting from energy consumption in buildings can be categorised as:

1. Isolating the building from its environment by using insulation, optimising the glazing area and minimising the infiltration of outside air.
2. Increasing the efficiency of appliances (including lighting, heating and cooling equipment and ventilation).
3. Using solar and other renewable energy sources and sinks on and around buildings, either directly or by using heat pumps.
4. Changing the energy consumption behaviour of the occupants.

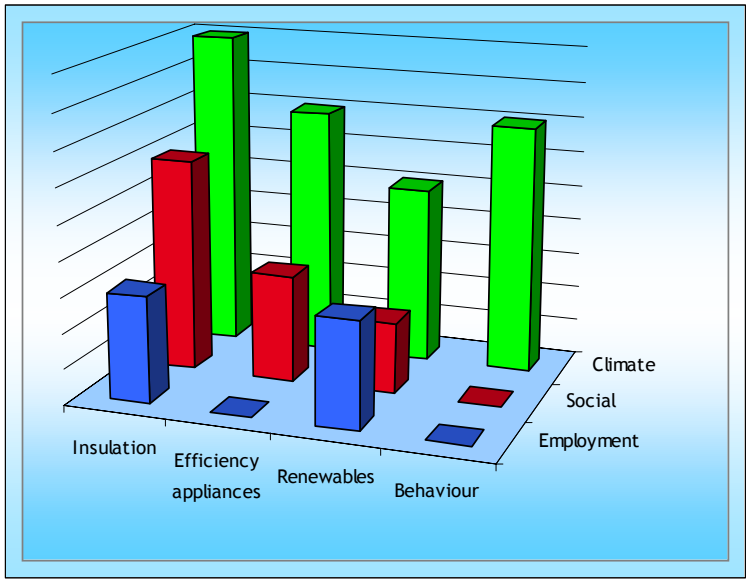
Before we take any product from the shelf we will make an initial assessment based on five crucial aspects: GHG emission, cost-effectiveness, social benefits, employment and possible negative side effects. These initial assessments are elaborated below.

Table 1 **Overview of technical measures**[2]

	Insulation measures	Efficiency of appliances	Use of renewables	Behaviour measures
Climate effect	**++**	**+(+)**	**+**	**++**
Short term	++	+(+)	+	++
Longer term	0/+	0/+	+	0/+
Cost-effectiveness	**++**	**++**	**-**	**+**
Social benefits	More comfort, less fuel poverty	Incidentally more comfort	Less fuel poverty	None
Employment effect	**+**	**0**	**+**	**0**
Short term	+	0	+	0
Longer term	0	0	+	0
Negative side effects	Temporarily: Inconvenience (mess, fuss, etc.)	Incidentally noise nuisance of vents	Visual effects, etc.	None
Total impression	+/++	**+**	0/+	0/+

[2] Rankings are given for an 'average' country, in which also lots of 'low hanging fruit' is still to be found.

Figure 2 Graphical visualization of the results of Table 1



2.1 Insulation measures

This category includes (extra) insulation of walls, ceilings and floors, improving the thermal performance of windows by multiple glazing and low-conductivity gases, and reducing air leakage by installation of weather strips, etc. The analysis is carried out with existing buildings in mind, i.e. retrofitting.

The effect on the climate is large in countries in a colder climate since these measures may typically lead to a reduction in energy use for space heating by a factor of two to four compared to standard practice (Levine et al. 2007). Insulation measures still offer the main potential to reduce GHG emissions both in developed countries and in economies of transition. Insulation measures generally are cost effective and improve indoor comfort for occupants, both with respect to heat distribution and to noise reduction. The insulation efforts will boost (local) employment in the short run.

Two major reasons why there is no widespread insulation in existing buildings are the so-called split incentive principle[3] and the temporary inconvenience of the installation.

Example: German Alliance for Work and the Environment
The German Alliance for Work and the Environment is an ambitious building retrofitting project. The Alliance is a collaboration among the government, unions, NGOs and employers' federations. From 2001-2006, an estimated € 3.8 billion of public subsidies stimulated around € 15.2 billion in investments and has resulted in over 350,000 apartment retrofits. Energy-efficient measures included improving the insulation of roof, windows and walls, introducing advanced heating technologies and using renewable energy such as solar thermal systems. This creates an estimated 145,000 additional jobs. (UNEP, 2008)

[3] Actors responsible for investment decisions are different from those benefitting from energy savings.

2.2 Efficiency of appliances

Included in this category are the efficiency improvements of installations for heating, ventilation and air conditioning, lighting systems and household appliances as well as consumer electronics. Generally, these measures are promising, in terms of both cost-effectiveness and energy-saving potential. For example, there are still about 188 million refrigerators and freezers of 10 years or older in Europe. Whereas appliances from 1990 typically consume about 600 kWh per year, the appliances that meet the criteria for energy efficiency A+ use approximately 255 kWh per year (WWF, 2009).

Only in the case of large-scale retrofit programmes in the built environment can a noticeable local employment effect be monitored. Household appliance production is far too scattered geographically for such effects to be observed, even though a demolition bonus for old appliances, for instance, would almost certainly have an effect.

EU directives 2005/32/EC and 92/75/EC
In the EU there are two directives that deal with the efficiency of appliances. The Ecodesign Directive 2005/32/EC establishes consistent EU-wide rules for improving the environmental performance of energy-using products through ecodesign[4]. The Energy Labelling Directive 92/75/EC obligates the labelling of household appliances according to their energy consumption.

Example: Top Runner Programme of Japan
The Top Runner programme, launched in 1998 in Japan, requires that by a specified date all new products must meet the efficiency level of the most efficient product that was at the market at the moment the standard was set. The programme applies to a range of appliances like air-conditioners, heat pumps, refrigerators, TVs and gas-cooking appliances. For some products, the programme resulted in energy efficiency improvements of over 50%. This programme is supplemented with mandatory appliance energy labels which have the colour red, if the product has not yet reached the Top Runner standard, and green, if it has. The performance of the product relative to that of the Top Runner is also displayed.

2.3 Use of renewables

Buildings themselves and building surfaces can be collectors and transformers of solar energy. Passive solar heating can involve extensive sun-faced glazing, various wall- or roof-mounted solar air collectors and preheating or pre-cooling of ventilation air through buried pipes. Photovoltaic systems may provide electricity and heating demand can be met by solar thermal systems, even in central and northern European countries. The soil, groundwater and ponds may also be used as heat sources or sinks, either directly or by using heat pumps. Furthermore, boosting the efficiency of combined heat and power[5] (CHP) is especially significant for transition countries that still rely heavily on coal, and can result in significant savings.

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[4] Ecodesign means taking into consideration the environmental impact of the product at the earliest stage of product design.

[5] Combined Heat and Power (CHP) is an electricity producing process where also the 'waste' heat is used, e.g. for heating the built environment. This is generally not renewable energy (even though it is more efficient than conventional systems).

The local employment effects of the use of renewables might be substantial, both in the short term (installation) and in the long term (maintenance and replacement). The Employ-RES research project conducted on behalf of the European Commission DG Energy and Transport concludes that:

"Policies that support renewable energy give a significant boost to the economy and the number of jobs in the EU. Improving current policies so that the target of 20% renewable energy in the final energy consumption in 2020 can be achieved and will provide a net effect of about 410,000 additional jobs and 0.24% additional GDP."

The use of renewables could lead to substantial reduction of GHG emissions. The costs of applying renewables are generally still high, particularly in the existing built environment, but in the transition from a fossil to a renewable energy supply, energy from renewable sources is vital.

EU proposal for a directive
In 2008 the European Commission proposed a 'Directive on the promotion of energy from renewable sources' requiring countries to use minimum levels of energy from renewable sources in new or refurbished buildings in their building regulations and codes.

Example: Solar obligation in Spain
In 2006, Spain introduced a new technical code for buildings (Codigo Tecnico de la Edificaion, CTE) whereby all new and renovated buildings are obliged to produce 30-70% of their hot water consumption with solar energy. Exceptions are made for buildings that use other renewable sources and for buildings that do not receive enough sunlight. There is an investment subsidy of up to 40% of the total investment.

2.4 Behaviour measures

Obviously, human behaviour is an important factor in energy consumption. This is illustrated by the fact that energy consumption may easily vary more than a factor of two between identical houses with a similar type of occupation. Altering people's behaviour might thus have a big impact on the total energy consumption in buildings. However, people do not easily change their lifestyles and tend to ignore opportunities for energy conservation. Successful campaigns might result in significant effects, although likely only in the short term. While the employment gains are quite high compared with government expenditure (typically low), the underlying employment and social impact is small.

Our preliminary shopping basket
Our visit to the 'technical measures shop' made clear that:
- insulation and behaviour measures have the highest potential climate effect;
- insulation measures yield the highest social benefits, but also cause inconvenience;
- measures aimed at appliance efficiency and insulation measure are the most cost-effective;
- increasing the use of renewables and insulation measures yield the highest employment effect.

Looking at our wish to optimise the combined effect on the environment, employment and social cohesion, insulation and renewables will be the main products in our shopping basket.

3 The policy instrument mall

In this section, we address the 'how' question. The next purpose of our journey is to find suitable policies to promote and facilitate the large-scale implementation of the selected technical measures. Thus we now head for the 'policy instrument mall'. Here we can find the wide range of policy instruments, varying from regulatory instruments to information-related policies. We will assess the most suitable policies in time to achieve the long-term goal of a completely renewable energy supply.

The mall contains the following types of policy instruments:
- regulatory (mandatory or facilitating frameworks);
- financial (subsidy or fiscal, linked to investments or to actual production);
- innovation (in this case particularly for risky pilot projects);
- organisational (cooperation constructions and new business opportunities);
- information (development, management and transfer of know-how).

We will first describe each category and then draw conclusions on their significance for our purpose.
Policy instruments will be ranked according to their CO_2 effectiveness and their cost effectiveness. In this paper, the latter is related to the costs a **government** has to made for the instrument. Apart from their effectiveness, the affordability for governments of the policy instruments in the longer term is considered to be an important factor. Policy instruments leading to better market conditions for energy efficiency and renewables (that is, offer market actors the opportunity to make a profit without external support) are the most promising.

3.1 Regulatory instruments

Regulatory instruments are potentially effective in the building sector. However, their effect in the short term as well as their cost effectiveness in the long term might be influenced negatively by the generally complex and lengthy preparation procedures and high enforcement costs. To remain effective, the regulatory instruments need to be monitored, evaluated and updated regularly.

Appliance standards are among the most cost-effective and widespread used instruments to reduce GHG emissions while *building codes* are an important driver for improved energy efficiency in new buildings. They also provide good incentives for innovation, training of building officials and inspectors. *Labelling programmes* for existing buildings are much more difficult to implement because of the reasons stated above. The labelling itself in fact serves only as an enabler for efficiency improvement. However, manufacturers tend to respond strongly on labelling programmes, trying to make their products to look as green as possible. When applied to buildings, the labelling could be accompanied by financial stimuli and/or regulations to achieve efficiency improvements in large numbers of buildings. *Consumption obligations* force every building owner that installs or replaces a heating system to use renewable energies to meet a certain share of the annual heat demand.

Table 2 Overview of regulatory policy instruments

Policy Instrument	CO_2 effectiveness	Cost effectiveness
Appliance standards	High	High
Building codes	High	Medium
Consumption obligations	Medium	Medium
Labelling	High	High

Example: Renewable Energies Heat Act in Germany

In January 2009, Germany introduced the Renewable Energies Heat Act (EEWaermeG). It stipulates that in 2020 at least 14% of Germany's heat must come from renewable sources. To achieve this owners of all buildings constructed after 2009 must use renewable energies or take alternative measures (improve insulation, use heat from district heating). The Heat Act also stipulates technological requirements.

3.2 Financial instruments

Energy taxes increase energy consumption prices, which may reduce demand and emissions. The effectiveness of the tax system depends on the impact of the signal and on the availability of alternatives. A differentiated tariff system may be applied to spare low-income households and yet encourage conservation. In such a system, households are charged progressively for the amount of energy consumed, related to specified energy consumption ranges. A special energy tax construction is offered by the so-called *Bonus Model*[6]. Producers of heat from renewable sources receive additional remuneration, paid by the producers and importers of fossil heating fuels. Transaction facilitators pool households that apply for funding. This instrument is cost effective and stimulates long-term infrastructural changes and a stable investment climate by guaranteeing bonuses for renewable heat. *Tax exemptions/reductions* play a valuable and well-known role in stimulating energy-efficiency and renewables in companies and institutions[7].

Subsidies obviously produce an effect, but are generally very costly to society. The subsidies could be focussed on underprivileged households to reduce fuel poverty. There will be a risk of free-riders as well as a low participation of the target group (due to unawareness of the existence of the subsidy or because procedures are too complex or bureaucratic). Subsidies could also promote new innovative technologies. In this case, subsidies are only suited to the leading groups (see figure below). In order to encourage the middle group and laggards, the subsidies need to keep on rising, but this is not ultimately cost effective. This is why subsidies in time need to be gradually replaced by obligatory measures and/or pricing schemes or the like.

6 This is similar to the feed-in tariff for renewable electricity in Germany and could therefore also apply to electricity.

7 Another route is to apply tax diversifications, e.g. in a bonus/malus scheme, which does not have the disadvantage for governments of reduced tax income.

Figure 3 **Different types of instruments for different phases of the energy transition**

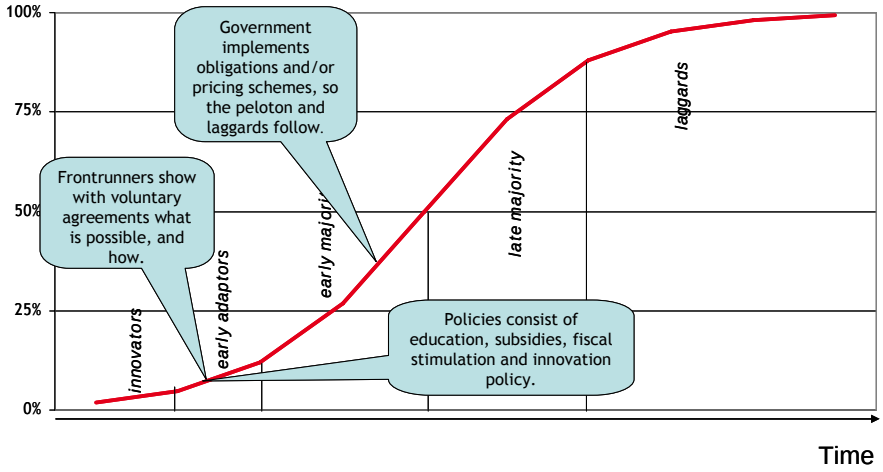


Table 3 **Overview of financial policy instruments**

Policy instrument	CO_2-effectiveness	Cost-effectiveness
Energy taxes	Low	Low
Bonus model	High	High
Tax reductions	High	High
Subsidies	High	High

Example: Livret Développement Durable in France
In France, a € 10 billion fund has been created for low-interest loans for energy conservation projects. The low-interest loan has a maximum of € 6,000 per person with tax-free interest of 2.5% per year. The loans can be used for the purchase and installation of energy-efficient boilers, thermal insulation, heat pumps, equipment to produce energy from renewable sources, etc. An additional measure, the zero-interest loan (Prêt à Taux Zéro), will take effect from September 2009 onwards. These loans are made available for the financing of energy-efficient measures in households, up to a maximum of € 30,000.

Example: Warm Front Scheme in the UK
The Warm Front Scheme (formerly known as the HEES – Home Energy Efficiency Scheme) provides a package of insulation and heating improvements to the privately rented or own houses of low-income households. The aim of this programme is to eliminate fuel poverty, but it has been difficult to identify those most in need. Also, those who are eligible for the grants may see no significant benefit in their fuel costs because there is no link between eligibility and the energy efficiency of their home. (NAO, 2009)
ACE (2000) has estimated that each £ 1 million invested in HEES has created 24 person-years of direct employment and 61 person-years of indirect employment.

Example: Energy inefficiency tax
One suggestion to remove misplaced incentives is to introduce a scheme in which property owners are charged an energy inefficiency tax on their property unless they are able to document that the property complies with certain minimal energy requirements. This scheme would encourage landlords to improve energy efficiency and/or to acquire necessary energy documentation for their property.

3.3 Innovations instruments

Innovation covers a wide field, from basic research and development to pilot projects. For our purpose we are particularly interested in the latter. Targeted subsidies and tender programmes may provide support in the pilot phase of risky new techniques and lead to extra projects. We consider this to be a specific type of financial support, as discussed in paragraph 3.2, and we will thus not elaborate separately on this category of instruments.

3.4 Organisational instruments

Apart from taking action themselves, governments may also stimulate or facilitate others to do so by launching new constructions for mutual cooperation and by creating new business opportunities.
In several countries and sectors Energy Service Companies (ESCOs) are already active and fill gaps in the energy efficiency and renewables market which would otherwise be open. This type of activity can be stimulated in other areas and other sectors as well, if necessary with governmental support in the start-up phase. The services of the ESCOs may include know-how, risk-bearing co-investments and guarantee funds with relatively favourable financing conditions.

3.5 Information-based instruments

Public leadership programmes can be used to demonstrate new technologies and good practice. They can transform markets significantly. *Education and information campaigns* are usually quite cost-effective. Supplementing other policy measures with an information campaign can promote long-term behavioural changes and limit rebound effects. *Detailed billing and disclosure programmes* provide information to consumers about their energy consumption. It has been estimated that these programmes have the potential to save up to 20% of energy and they are mostly cost-effective. Most of these information-based policy instruments can be implemented straightaway, but it could take some time before they are effective.

Table 4 Overview of information-based policy instruments

Policy instrument	CO_2 effectiveness	Cost effectiveness
Public leadership programmes	High	High
Information campaigns	Low/medium	High
Detailed billing	Medium/high	Medium

Example: the Federal Energy Management Program (FEMP) in the US

The Federal Government is the United States' largest energy consumer. The FEMP therefore promotes energy efficiency and the use of renewable energy sources at Federal facilities to save energy and demonstrate Federal leadership. By 2004, FEMP had helped the Federal Government to reduce its energy intensity by 26% relative to a 1985 baseline.

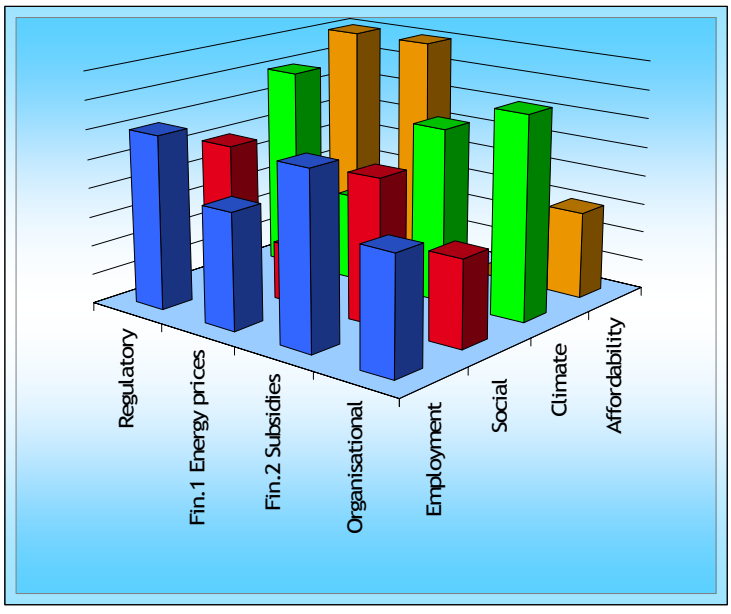
Energy Savings Performance Contracting (ESPC) is part of the programme. An ESPC project is a partnership between the customer and an energy services company (ESCO). The ESCO conducts an energy audit and identifies and implements improvements that will save energy at the facility. The energy cost savings will accrue to the ESCO.

Also part of the FEMP, the Energy Policy Act requires Federal buyers to purchase products that are in the upper 25% of energy efficiency in their class.

Table 5 Overview of relevant policy instruments

		Financial instruments		
	Regulatory instruments	**Energy price increases**	**Subsidy and tax reduction**	**Organisational instruments**
Climate effect				
Short term	+	0/+	++	+
Longer term	++	+	-	+
Employment effect				
Short term	+	0/+	++	0/+
Longer term	+	+	0/+	+
Possibility to improve social cohesion	+	0/-	+	0/+
Affordability for governments	++	++	-	+
Total impression	**+/++**	**0/+**	**0/+**	**0/+**

Figure 4 Graphical visualization of the results of Table 5.



Lessons learnt in the policy instrument shopping mall

Financial injections may lead to fast results. However, this type of support is not affordable in the long term. Other types of instruments - financial and regulatory - will generate more structural effects and are affordable in the long run. These instruments have an impact across the total scope of possible actions (from behaviour adjustment to innovation).

4 Conclusion

The potential for reducing emissions in the built environment is significant. Promising measures include insulation, district heating, efficient appliances and efficient lighting concepts. On top of that, changing consumer behaviour shows great potential. For the long term goal of 100% renewables, all pretexts are necessary.

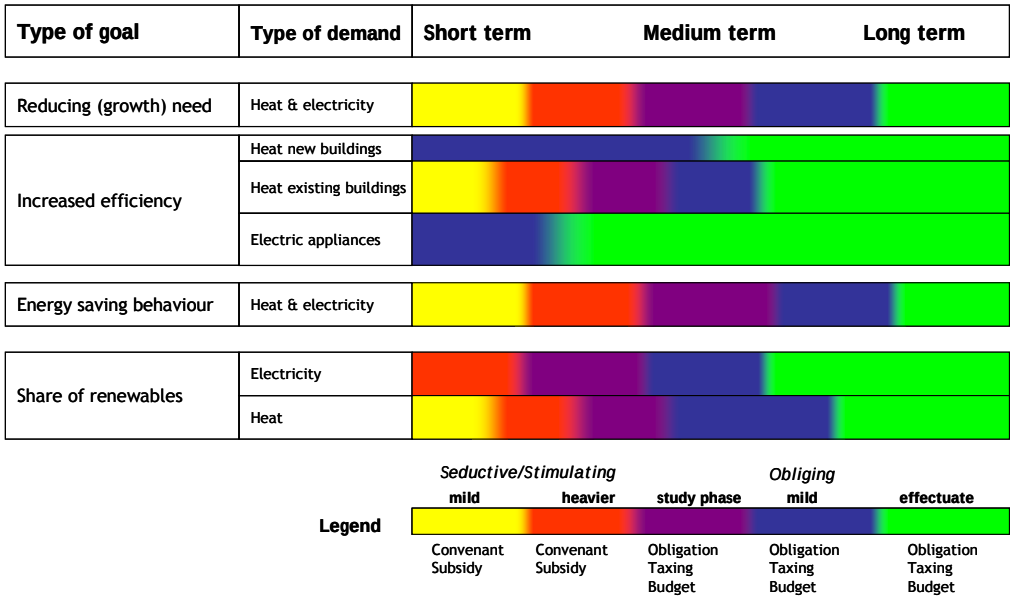
Considering our wish to optimise the combined effects for the environment, employment and social cohesion, insulation and renewables are the most relevant technical measures to aim for. With a warning that policy measures which are designed to serve more than one objective tend to be less effective.

Governmental financial injections, like subsidies and tax exemptions, will generally lead to fast and targeted results. However, this type of financial support will not be affordable for governments in the long run. Other types of financial and regulatory instruments will yield more structural effects and are affordable for society in the long term.

In our current situation a mix of both types of instruments seems to offer the best overall solution. Short-term financial stimuli will have to be combined with regulatory, financial and organisation-related instruments, aimed at results in the longer term. When short-term financial stimuli are applied, they should be considered as the first stage of a longer-term programme. The market changes that result from the short-term financial stimuli should be strengthened and gradually enhanced by the timely introduction of regulatory and/or pricing instruments (see also Figure 5). The efficiency of appliances is already governed by regulations on energy efficiency (ecodesign); these need to be strengthened in the long run. On the other hand, in most EU-countries there are currently only tempting/stimulating policies, like subsidies, in place to increase the share of renewables in the electricity and heat demand. Over time, these will need to shift to obligatory policies and/or pricing schemes with the aim of a completely renewable energy supply in the long run.

Current governmental stimulus packages (see Meyer-Ohlendorf et al., 2009) to tackle the recession heve been substantially aimed at retrofitting of existing buildings and also (but less) at renewable energy. Applied policy instruments are subsidies mainly. This bears the risk of a short term market stimulus only, without creating the context for a self supporting market in the longer run. As argued in this paper, the short term stimuli should be embedded in a longer term framework aimed at self supporting markets for energy efficiency and renewable energy, see Figure 5. Thus, stimulus packages will not only help to tackle the recession, but also support the required energy transition process.

Figure 5 **Long term policy framework for the built environment, applying different types of policy instruments for different phases of the energy transition, for separate types of energy demand**



References

Bürger et al.,2008
V. Bürger, S. Klinski, U. Lehr, U. Leprich, M. Nast, M. Ragwitz
Policies to support renewable energies in the heat market
In : Energy Policy vol. 38 (2008), p. 3150-3159

EC, 2009
Ragwitz et al.
EmployRES : The impact of renewable energy policy on economic growth and employment in the European Union
Brussels : European Commission
DG Energy and Transport, 2009

Golubchikov, 2009
O. Golubchikov
Towards energy-efficient housing : prospects for UNECE member States
An interim unedited draft prepared for the First UNECE Workshop on Energy Efficiency in Housing 21-22 April 2009, Sofia, Bulgaria

Impetus, 2009
The case for including energy efficiency investment in the fiscal stimulus package :
A report for Greenpeace
London : Impetus Consulting Ltd, 2009

Levine et al., 2007
M. Levine, D. Ürge-Vorsatz, K. Blok, L. Geng, D. Harvey, S. Lang, G. Levermore, A. Mongameli Mehlwana, S. Mirasgedis, A. Novikova, J. Rilling, H. Yoshino
Residential and commercial buildings
In: Climate Change 2007: Mitigation.
Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)]
Cambridge ; New York : Cambridge University Press, 2007

Meyer-Ohlendorf et al. 2009
N. Meyer-Ohlendorf, B. Görlach, K. Umpfenbach
Taking advantage of the crisis
Keynote paper for the EU DG EMPL workshop 'Emerging stronger from the recession' hold on 9-9-2009 in Brussels
Berlin : S.n. 2009

Ürge-Vorsatz et al., 2007
D. Ürge-Vorsatz, S. Koeppel, S. Mirasgedis
Appraisal of policy instruments for reducing buildings' CO_2 emissions
In : Building Research & Information, Vol. 35, Iss. 4 (2007); p. 458-477

Wade et al. 2000
J. Wade, V. Wiltshire, I. Scrase
National and Local Employment Impacts of Energy Efficiency Investment Programmes' :
Final report to the Commission
London : Association for the Conservation of Energy, 2000

WWF, 2009
Meera Ghani-Eneland, et al.
Low carbon jobs for Europe : Current Opportunities and Future Prospects
Brussels : WWF European Policy Office, 2009