Assessing the Implementation and Impact of Green Elements of Member States' National Recovery Plans

Final Report for the European Commission (DG Environment)

20 September 2011

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Revision and Authorisation History

Version	Date	Authorised for release by	Description
1.0	21/05/2011	Hector Pollitt	Draft version
2.0	13/06/2011	Sudhir Junankar	Draft final report taking into account DG ENV comments on preliminary draft
3.0	10/08/2011	Hector Pollitt	Final version

This study does not necessarily represent the views of the European Commission.

Executive Summary

Overview

- This report presents the results from an assessment of the green elements of the fiscal stimulus packages that were implemented in response to the economic and financial crisis that began in 2008. The report examines the economic and environmental impacts that the measures have made to date (mid-2011). It provides an overview of the green elements of the recovery plans of each of the EU's Member States (where data are available) and considers the measures in nine countries in more detail. The countries selected were: Belgium, Czech Republic, Estonia, France, Germany, Portugal, Slovakia, Sweden and the UK. Four non-EU countries were also assessed to provide a comparison. These were Australia, China, South Korea and the USA.

Identifying green recovery measures

- The EU's Member States entered the economic crisis in different states of economic health. This constrained the scale of the recovery plans that could be implemented, although not necessarily their green components.
- The economic and environmental objectives of the measures are not necessarily mutually reinforcing. The former is distinctly short-term in focus, while the latter is much more long-term. The main 'green' measures can be summarised as:
  - investment in energy efficiency
  - investment in transport infrastructure
  - vehicle scrappage schemes
  - investment in renewables
  - funds to support eco-innovation
- The vast majority of the green measures focused on energy efficiency and climate change mitigation. Estonia is an exception, where 60% of the funding was spent on water management.
- In the nine countries that were assessed in detail, the green elements made up, in most cases, approximately 10% of the total stimulus package. The Czech Republic and Estonia are notable exceptions, where the green elements made up 20% or more of the total package.
- The range of green measures implemented across Member States varied from quite comprehensive packages (e.g. Germany and France) to ones based on a single instrument (Czech Republic). While some of the policies are particularly tailored to national conditions, for the most part there are considerable similarities in the types of policies implemented in each country.
- The speed with which the announced policies were implemented varies by policy type. It is quicker, for example, to introduce tax changes and vehicle scrappage schemes than it is to implement large-scale investment projects (e.g. high-speed rail). However, from the available information it seems that the majority of all the policies were (and are being) implemented in a timely manner.

Economic, social and environmental assessment of the policies

- The study developed a framework that combined both qualitative and quantitative assessment methodologies with the macroeconometric E3ME model to provide an assessment of the economic and environmental impacts of the green elements of

the recovery plans. This framework was applied to the nine EU countries that were considered in detail and the four non-EU countries.

Economic impacts

- The assessment found that the green elements of the recovery packages made a small short-term contribution to economic recovery, the scale of the impacts being limited by the small share of green measures in the recovery plans. We estimate that the short-term multiplier effects (the ratio of the boost to GDP to the size of spending on the measures) from green investment ranged from around 0.6 to 1.1 at national level, and up to 1.5 at European level.
- The domestic economic impacts of all of the stimulus packages, including the green elements, were (as expected) smaller in countries that are more open to trade. The clearest examples were Belgium and Estonia; these countries have lower domestic multipliers.
- Taken across the EU as a whole, these trade effects benefit other Member States, particularly those that produce capital goods, such as vehicles and machinery. Examples in our analysis include Sweden, Germany and Slovakia, which gained from both their own and other countries' stimulus packages.
- The multiplier effects for green investment are similar to those from any kind of investment. It is typically the same sectors (e.g. construction, design or engineering) that supply the investment goods and services and which therefore see the largest impacts from green investment spending. Again, countries that specialise in production of capital goods tend to benefit most from the investment measures.
- Some of the measures provided an additional short-term boost to economic activity by 'leveraging' private money (that otherwise would have been saved) into current spending. Vehicle scrappage schemes fall into this category; by combining public and private financing, they offer high returns in terms of short-term economic impact per unit of public spending.

Social impacts

- Most policies resulted in a temporary boost to employment as a result of increases in economic activity. Much of the boost no doubt took the form of smaller declines in employment than would otherwise have occurred (jobs 'saved' rather than jobs created), in the construction and engineering sectors. Some of these jobs have quite specific skills requirements and many are in traditionally male-dominated occupations.
- Very few of the policies were explicitly targeted at vulnerable groups and some which required co-financing, including car scrappage schemes, may have excluded them. The main exception found was the Decent Homes Programme in the UK, which allocated around €70m to social housing.

Environmental impacts

- The immediate short-term environmental impacts of the green measures were in the main found to be mostly negative, because higher rates of economic activity increased environmental pressures. This was mainly the result of higher energy and material demands from the construction sector and its suppliers, such as the cement and steel sectors.
- Beyond 2009-10, however, the net environmental effects of the measures were generally found to be more favourable and the long-term benefits of the investments outweighed the short-term environmental costs. For example, in the Czech Republic our results suggest a 0.1% increase in energy demand in 2009 as a

result of the green measures but this is reversed in 2010. Beyond 2010, annual energy consumption and GHG emissions are lower by at least 0.3%.

- The environmental benefits of vehicle scrappage schemes were found to be quite short-lived, and did not persist in the longer term, as many of the vehicles would have been replaced soon anyway.
- Of the other measures, the investments in energy efficiency and renewables capacity have longer lasting environmental effects, although in most cases the benefits are small and are subject to rebound effects (when initial reductions in consumption give way to increases as households and firms spend the money saved by cutting consumption). Investments in R&D and eco-innovation that were prominent in the Swedish recovery plans are unlikely to provide much short-term environmental impact but in the long term provide a foundation for both economic benefits and global environmental improvements.
- The environmental impacts of new rail transport infrastructure are not clear-cut because it is difficult to assess the net impact on commuting and travel patterns. Where new lines are built (e.g. France) there could be a shift from road to rail, but this is less likely when the measures increase capacity on existing routes with fewer road-based alternatives (the UK). As rail investment makes up a large share of France's green measures, these difficulties make assessment of the overall national package more uncertain.
- Very few directly environmentally-harmful measures were found in the countries' stimulus packages. The ones identified were mainly related to road building, in particular in France and the UK. These measures may have short-term benefits in the form of reduced emissions related to congestion, but the long-term outcome is more likely to be an increased number of journeys.
- However, there is a wider range of indirect environmental costs relating to the recovery measures. Many of the measures are highly resource intensive in terms of mineral inputs (e.g. cement or metals for construction) and some, particularly transport infrastructure and the dams built in South Korea, have substantial land-use requirements.

Beyond the EU

- The review of non-EU countries included countries that had very large fiscal stimulus packages (China, USA) and one that had a very large share, of over 75%, of green elements in its stimulus package (South Korea). There could be lessons for the EU, in particular relating to the speed of implementation in investment measures. However, it should also be noted that the selection of packages reflected the economic and political conditions particular to each country.

Overall conclusions

- Although many of the countries assessed had similar policies, the most successful packages in economic terms were tailored to take into account local requirements, domestic sectoral composition (e.g. size of the car industry) and addressed gaps in domestic infrastructure (Estonia's water system, Australia's rail network).
- An optimal recovery package must include a balance between policies that provide short and long-term benefits (both economic and environmental). The short-term benefits are largely economic so could be equally met by non-green policies. However, short-term benefits of some of the green policies could be enhanced by prepared investment plans that could be brought quickly to implementation stage, or by increasing the use of co-financing to benefit from leveraging effects.

- Green measures also bring long-term economic benefits from greater energy efficiency, reduced imports of fossil fuels and reduced exposure to volatile global energy prices. The R&D and innovation measures also offer the potential of long-term economic benefits, although it is much more difficult to quantify the scale of these.
- Speed of implementation was important in aiding economic recovery. Changes to taxation and car scrappage schemes (both major parts of the German package) could be implemented relatively quickly, but investments usually required a longer implementation period. However, many of the Member States were able to start spending the allocated investment funds within weeks of their announcement. By maintaining a list of cost-effective investment measures, national governments could in the future ensure fast implementation without the risk of poor decisions leading to a waste of resources.
- The narrow focus on energy efficiency and climate measures may reflect the importance of these issues, but may also reflect the less developed nature of policy for other resources such as water, material consumption and land use. This possibly suggests a requirement to advance policy in this area more widely.

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1 Introduction

Overview

This final report presents the findings made in the project *Assessing the implementation and impact of green elements of Member States' national recovery plans*. The study analyses the extent to which green elements of national recovery plans have been implemented and examines the environmental and economic impacts that the measures have made to date, and are expected to make in the near term.

The report was produced by teams at Cambridge Econometrics and Ecorys, under the framework agreement managed by COWI.

1.1 Project objectives and structure

Project objectives

The analysis was carried out in early 2011, more than two years since the collapse of Lehman Brothers that signalled the start of the financial crisis. Most (but not all) European economies are recovering from recession, albeit at varying speeds. Member States and the EU set out Recovery Plans to respond to the crisis, including a number of green measures. This was a good time to carry out an assessment of the green measures in these national recovery plans as we have evidence of:

- announced policy
- the degree of implementation of announced policy
- early impacts

Our assessment used a combination of quantitative and qualitative techniques.

The specific objectives of the study are:

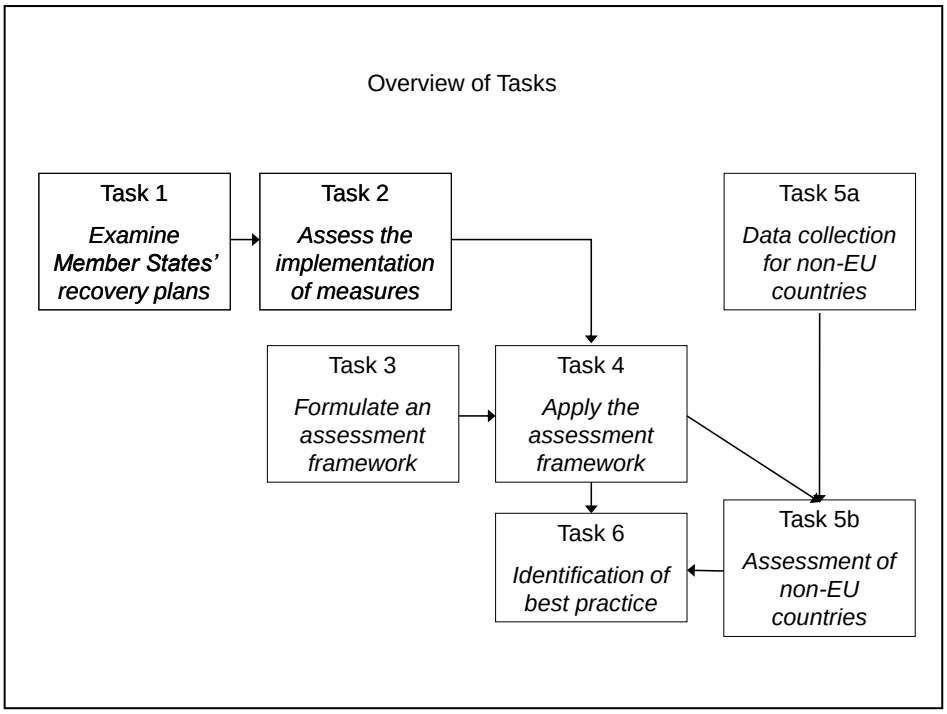
- to compile the latest evidence on the green recovery measures contained in national recovery plans
- to assess the implementation of planned green recovery measures
- to examine the impacts – economic, social and environmental – of the green recovery measures
- to identify best practice in the implementation of, and choice of, green elements in crisis recovery plans

The time horizon of the analysis is in the main ex-post, over 2009-11 when the recovery plans were implemented. However, we also provide some indication of longer-term impacts by projecting results out to 2020. These results also show a basic assessment of how the measures fit into the targets set under the Europe 2020 strategy (European Commission, 2010a).

Project structure

The project was split into six tasks. Figure 1.1 shows how the tasks fit together. Task 5 was split into two sections to reflect the two different parts of the task. There was also some overlap in implementation between Task 1 and the first part of Task 2.

Figure 1.1: Overview of Tasks



1.2 Structure of this report

This report presents our findings from each of the tasks described in Figure 1.1.

Chapter 2 presents the findings from Tasks 1, 2 and 5a of the project, which examined the available evidence of green elements within both EU and non-EU countries' recovery plans and determined the extent to which these measures have been implemented. Chapter 3 then provides an assessment of these measures for selected EU countries. Further to this, the results of the assessment of selected non-EU countries (Task 5b) are given in Chapter 4.

Chapter 5 presents the conclusions of the project and also the findings from the final task of the project; that of identifying best practice, and the lessons learned from the analysis.

In Appendix A the framework that was used for assessing the implemented green recovery measures is discussed, constituting Task 3 of the project. Appendix B gives a more detailed set of results from applying this framework on a policy-by-policy basis.

Appendix C provides an overview of the E3ME model.

2 Member States' Green Recovery Plans

2.1 Introduction

This chapter presents the findings from Tasks 1, 2 and 5a of the project, which examine the available evidence of green recovery measures in the EU Member States, and determine the extent to which these measures have been implemented. A group of selected EU Member States was chosen to go forward to the assessment task, and are examined in more detail in Section 2.2. Section 2.3 provides a brief overview of the green measures from the other EU Member States. Finally, Section 2.4 analyses the national recovery plans from a few non-EU countries.

The information in this chapter is highly reliant on the available information. Where there are gaps this usually relates to missing data (e.g. 2010 data that were not published at the time of writing). The same is true of the details of the individual measures that are presented in this chapter; a blank cell in the table will in most cases signal that the information was not available at the time.

2.2 Green recovery measures from selected EU Member States

In this section we focus on the nine selected countries for which a detailed assessment was carried out. They are:

- Belgium
- Czech Republic
- Estonia
- France
- Germany
- Portugal
- Slovakia
- Sweden
- UK

The countries were selected on the basis of the measures that were announced and implemented, as well as giving a geographical coverage across Europe. To some extent the choice also reflects the level of available information.

For each country there is a brief discussion of the overall stimulus package and economic context, followed by a description of the policies. The countries are discussed in turn below.

Belgium

Table 2.1: Belgium's Stimulus Package

BELGIUM'S STIMULUS PACKAGE	
Size of stimulus package	€1.7bn
As a % of GDP	0.5%
Size of green part	€170m
As a % share of total stimulus package	10%
Implementation period	2009-11

Overview

Due to its high level of trade intensity, the Belgian economy was hit hard by the global financial crisis and economic downturn. After two years with low or even negative growth over 2008-09, the Belgian economy showed better growth in 2010, mostly as a result of the strong recovery in Germany, Belgium's main trading partner[1]. In 2011, growth is likely to slow due to the general slowdown in the euro area. Selected economic indicators are presented in Table 2.2.

Table 2.2: Selected Economic Indicators for Belgium, 2007-10

SELECTED ECONOMIC INDICATORS FOR BELGIUM, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	2.9	1.0	-2.8	2.1
Private consumption (%y/y)	1.8	1.4	-0.3	1.4
Public consumption (%y/y)	2.1	2.3	0.6	1.0
Inflation (%y/y)	1.8	4.5	0.0	2.3
Unemployment rate	7.5	7.0	7.9	8.3
Budget deficit - % change since previous year	-0.5	-1.0	-4.7	1.8
Investments in fixed assets (%y/y)	6.5	2.9	-5.3	-1.6

Source(s): European Commission, Eurostat.

In response to the crisis, the Belgian authorities proposed measures to support the financial sector and to let the automatic fiscal stabilizers operate freely while implementing a moderate stimulus plan. The plan focused on supporting the cash position of companies, increasing consumption and reducing labour costs for companies. The measures included new and accelerated public investment, reductions in social security contributions, a VAT reduction for selected activities, an increase in benefits for temporary unemployment, steps to improve the liquidity position of the enterprise sector, and measures aimed at energy saving in public and private buildings and in public transport. The plan was introduced by the end of 2008 and the law was passed by parliament in March 2009. However, the package as passed by parliament did not include tax measures. As a result, the size of the stimulus package was

[1] For many years, Germany has been Belgium's number one export partner and, in terms of imports, it shares this position with the Netherlands (Source: http://www.abh-ace.be/nl/statistieken/bilaterale_notas/bilaterale_nota_duitsland.jsp?referer=tcm:448-106862-64).

therefore modest but considered appropriate by the IMF given the limited fiscal space in Belgium[2]. The measures will expire by the end of 2011.

The size of the stimulus package amounts to €1.7bn or 0.5% of GDP. This is in addition to income support measures of 0.5% of GDP already included in the 2009 budget. According to the IMF, these measures can be added to the impact of the automatic stabilizers, which are estimated at around 2.5% of GDP in 2009 and 0.75% of GDP in 2010.

From the information available, the share of 'green' measures in the Belgian stimulus package is limited to public investments in energy efficiency[3]. They consist of the following measures (see Table 2.3):

- energy subsidy to households budgeted for €140m[4]
- investments in green technology (€20m)
- enlarging the (existing) fund for energy cost reduction (€10m)

Investments in energy efficiency and renewables by households

The subsidies to households were intended to be used for energy-saving measures. For 2010 and 2011 the benefit of the tax credit was extended to include wall and floor insulation[5].

In addition, a green-loan system was introduced. From 2009 to 2011, households who borrow to finance such investments receive a 1.5% interest bonus from the federal government and remaining interest is eligible for tax credit.

The number of applications was 6,791 in 2009 and 36,673 in 2010. The same study mentioned in footnote 5 puts the reductions in CO_2 emissions at 3.5, 23.0 and 46.5 thousand tonnes for 2009, 2010 and 2011 (and the following years).

Table 2.3: Green Elements in the Belgian Stimulus Package

GREEN ELEMENTS IN THE BELGIAN STIMULUS PACKAGE

Measure	Description	Budget
Energy subsidy to households	Each household receives a voucher worth €30	€140m
Investments in green technology	Households who borrow to finance green investments receive a 1.5% interest bonus from the government and the remaining interest is eligible for tax credit	€20m
Larger fund for energy cost reduction	This represents the budgeted costs for enlarging the (existing) fund	€10m
Total		€ 170m

[2] The total size of this package (including the automatic stabilisers) was estimated at 1% of GDP. As a result, the fiscal balance dropped from -1.2% of GDP in 2008 to -6% in 2009.

[3] It is noted that the EC non-paper (European Commission, 2009c) suggested that there could be investment in new tram lines, but no information was found regarding this project.

[4] Each Belgian household was to receive an energy voucher for €30.

[5] In an unpublished study, the number of benefiting households was estimated at 5,000 for floor insulation and 50,000 for wall insulation (source: personal contact with Federal Ministry of Finance).

Czech Republic

Table 2.4: Czech Republic's Stimulus Package

CZECH REPUBLIC'S STIMULUS PACKAGE	
Size of stimulus package	€2.74bn
As a % of GDP	1.9%
Size of green part	approx: €900m
As a % share of total stimulus package	33%

Table 2.5: Selected Economic Indicators for the Czech Republic, 2007-10

SELECTED ECONOMIC INDICATORS FOR THE CZECH REPUBLIC, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	6.1	2.5	-4.1	2.4
Private consumption (%y/y)	4.9	3.6	-0.3	0.2
Public consumption (%y/y)	0.5	1.1	2.6	0.6
Inflation (%y/y)	2.9	6.3	0.6	1.2
Unemployment rate	5.3	4.4	6.7	7.3
Budget deficit - % change since previous year	1.9	-2.0	-3.1	1.1
Investments in fixed assets (%y/y)	10.8	-1.5	-7.9	-1.8

Source(s): European Commission, Eurostat.

Overview

Initially, the Czech Republic was relatively unaffected by the economic crisis. The national banks were for different reasons not burdened with bad loans and the multinational banks kept a relatively low profile. The situation did not, however, stop the government from taking recovery measures. The National Recovery Plan of the Czech government was announced in February 2009. The total amount of €2,740m (see Table 2.4) represented mainly a decrease in the 'tax burden' (decrease of social insurance rate, extension of some tax exemptions), rather than for public spending or subsidies.

The key green measure in the economic stimulus taken by the government was the decision to sell off 100m Assigned Amount Units (AAUs) under the Kyoto protocol to finance a Green Investment Scheme.

Green Investment Scheme

The Czech Republic's Green Investment Scheme (called the Green Savings programme) began in March 2009 with the sale of 40m AAUs to a Japanese organization. The plan was to allocate around 100m AAUs to the Green Investment Scheme (Tuerk et. al, 2010). On April 22 2009, the Green Savings programme was inaugurated. The plan is to run the programme until mid-2012. Beneficiaries include owners of family houses and apartment buildings. The amount of emission reductions must be proven within the projects' lifetimes of 15 years[6]. Around €960m was collected from selling AAUs by late 2009[7].

Subsidies to owners of family houses and apartment buildings were given in the following areas:

[6] ibid

[7] ibid

- savings of energy for space heating (complete or partial insulation of the building)
- new construction of residential buildings with passive energy standards
- heat production from renewable energy sources in residential buildings

The Green Savings programme was expected to save energy, create jobs and reduce air pollution[8]. It suggested:

- a reduction in CO_2 emissions of 1.1m metric tonnes, or 1% of all Czech CO_2 emissions
- 6.3 PJ energy savings in heating, which represents a large annual saving in household heating costs
- creation or retention of 30,000 jobs
- improvement of housing conditions for 250,000 households receiving the support
- 3.7 PJ increase in heat generation from renewable energy sources
- 2.2m kg reduction of dust particle contamination

It is noted that it had previously been indicated that other measures would be carried out in the Czech Republic, including for example investment in railways and eco-innovation. However, no reference to these measures being carried out was found.

There was a vehicle scrappage scheme in the Czech Republic but it was not implemented until late 2009[9]. The environmental benefits of the scheme are also not clear so we have not included it in the analysis. Nevertheless it should be noted that the motor vehicles industry in the Czech Republic was a major beneficiary of other countries' scrappage schemes.

Table 2.6 gives a more disaggregated description of the measures.

The Green Savings programme could be considered a success. By 25 October 2010 around 50,000 applications for subsidies had been submitted of which 30,000 were accepted[10]. After this the status of the programme was temporarily uncertain, as the Ministry of Environment suspended the programme due to the large amounts of applications and uncertainty on remaining funds. Subsequently, another sale of AAUs was planned which would boost the Green Savings programme and, from February 2011, applications were accepted again.

[8] See http://www.zelenausporam.cz/sekce/582/about-the-green-savings-programme/ (Czech Ministry of Environment)

[9] See http://store.businessmonitor.com/article/302581

[10] See http://www.solarthermalworld.org/node/1471

Table 2.6: Green Savings Programme

GREEN SAVINGS PROGRAMME

Measure	Applicable support [CZK bn]	Reduction of CO_2 emissions within 15 years [m tons]	Estimated average greening (15 years)	Estimated number of projects
Family houses: insulation	9.3	3.9	1:9.4	72,500
Apartment buildings: insulation	6.1	2.1	1:11.5	10,200
Family houses: New construction in passive energy standard	1.1	0.2	1:18.4	4,900
Apartment buildings: New construction in passive energy standard	1.2	0.2	1:21.4	8,700
Family houses: substitute biomass boiler	1.5	5.4	1:1.1	34,100
Apartment buildings: substitute biomass boiler	0.7	2.3	1:1.2	2,900
Family houses: substitute heat pump	0.6	1.1	1:2.2	9,200
Family houses: Solar energy	2.6	0.9	1:11.8	41,000
Apartment buildings: Solar energy	1.2	0.3	1:19.4	3,900

Table 2.7: Green Elements in the Czech Stimulus Package

GREEN ELEMENTS IN THE CZECH STIMULUS PACKAGE

Measure	Description	Budget
The Green Investment Scheme Programme (‘Zelená úsporám’)	Subsidies to owners of family houses and apartment buildings in following areas: A. Savings of energy for space heating (complete or partial insulation of the building) B. New construction of residential buildings with passive energy standards C. Heat production from renewable energy sources in residential buildings	€ 900m[1]

Note(s): 1. This is an estimate since prices for AAUs are not fixed. Up until June 2010 AAUs for about €864m had been sold. Still the government has an estimated 25,000 remaining AAUs.

Estonia

Table 2.8: Estonia's Stimulus Package

ESTONIA'S STIMULUS PACKAGE	
Size of stimulus package	Around €1bn
As a % of GDP	3-4% in 2009
	4-5% in 2010
Size of green part	€248m
As a % share of total stimulus package	Around 20%

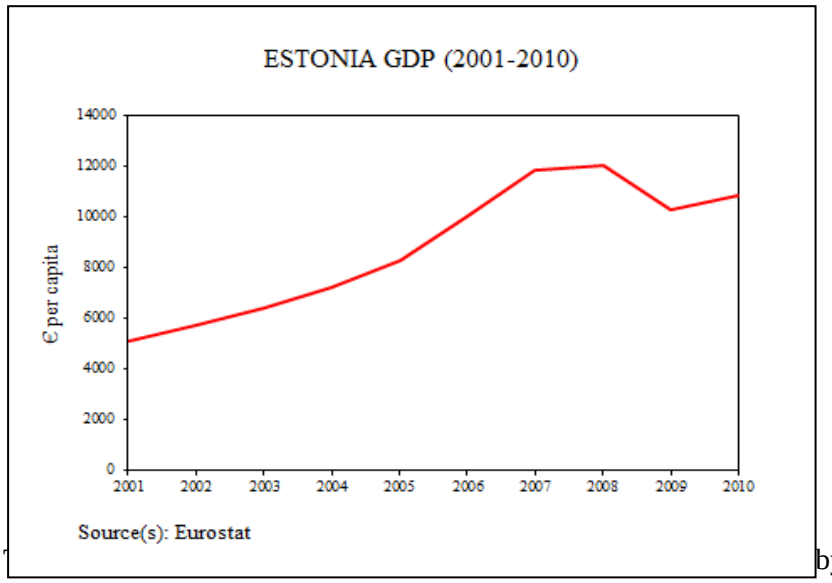
Table 2.9: Selected Economic Indicators for Estonia, 2007-10

SELECTED ECONOMIC INDICATORS FOR ESTONIA, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	6.9	-5.1	-13.9	3.1
Private consumption (%y/y)	8.6	-5.6	-18.8	-1.9
Public consumption (%y/y)	3.9	3.8	0.0	-2.1
Inflation (%y/y)	6.7	10.6	0.2	2.7
Unemployment rate	4.7	5.5	13.8	16.9
Budget deficit - % change since previous year	0.1	-5.3	1.1	1.9
Investments in fixed assets (%y/y)	6.0	-15.0	-32.9	-9.2

Source(s): European Commission, Eurostat.

Overview The Estonian economy is characterized by its relatively small size, fast growth during the past two decades, and high levels of FDI[11]. Sometimes called the Baltic Tiger, Estonia joined the Eurozone in 2011.

Figure 2.1: Estonia GDP 2001-2010



by more than 5% in 2008 and almost 14% further in 2009. Inflation also hit double-digit rates in 2008.

[11] In 2008 FDI represented €8,900 per capita in Estonia, €3,700 in Latvia and €2,900 in Lithuania.

Unemployment increased from 5.5% in 2008 to 13.8% in 2009 and 16.9% in 2010, in part due to the severe austerity measures that were introduced by the government.

Post-crisis the Estonian economy required an infusion of trust and the government presented a stimulus package with three components:

1 Boosting consumer demand and renewing trust in the market

2 Supporting groups at risk of unemployment

3 Speeding up investment to maintain employment levels

The total sum of stimulus funds was 3-4% of GDP in 2009 and 4-5% in 2010[12].

Three green measures have been identified[13]. They are discussed in turn below.

Energy efficiency

In the first half of 2009 new energy-saving measures for housing were started. These were financed by EU Structural Funds (€19m) and state-guaranteed foreign funding via banks (€32m). The total value was thus €51m (0.4% of GDP).

Water management

The Environment Minister announced in November 2008 to increase the total amount approved for water management infrastructure projects from €160m to €313m. This implies that the state's contribution grew by €153m (1.1% of GDP added).

Selling of AAUs to free up investment capital for green projects

The final measure was the increased sale of carbon emission units (AAUs). The sale started in 2009 and is likely to have been given an impetus by the crisis. For example, in June 2010 the government granted two transactions which increased the value of sold AAUs to 1bn kroons in 2010, which was twice as much as was planned in the annual budget (MKM, 2010). The revenue from the sale feeds directly into a Green Investment Scheme which supports measures such as energy efficiency, renewables and electric cars (Tuerk et. al, 2010). Some examples of investments are given below:

- The Estonian Government set a target for 10% of the country's transport sector to run on renewable sources by 2020. In this context, the government bought 500 electric cars from the sale of 10m AAU emission units to the Japanese Mitsubishi Corporation. The remaining funds were planned to be used to create a nationwide network of rapid recharge points (MKM, 2011). Moreover, a grant scheme was set up to support 500 private sales of electric cars.
- Wind energy received €23m in investment, allowing for 25-30 MW of power to be generated on top of earlier support schemes. The investment was expected to reduce CO_2 emissions for electricity production by 1.5m tonnes over 20 years.
- For public transport, €21m was spent in 2010 on more efficient buses to be bought from Spain.
- On energy efficiency the sale of 0.5m AAUs was expected to contribute to energy-efficiency measures in eleven government buildings, three of which are used by the Ministry of Education and Research, six by the Ministry of the Interior and two by the Ministry of Social Affairs (MKM, 2010).

Summary

[12] Personal communication with the Estonian Ministry of Finance.

[13] In collaboration with the Estonian Ministry of Finance. It is noted that the EC non-paper (European Commission, 2009c) reported measures on renewable energy, eco-innovation and waste management but we have been unable to find further information on these measures.

The Estonian economy was hit hard by the economic crisis. The government responded with a package targeting three key areas aiming to regain trust in the economy and to save jobs. The green parts of the package represented 3-5% of GDP and focused on energy efficiency, water management and greening transport. A large part of the funding came from selling carbon credits and funnelling the money into Green Investment Schemes. Even if the sell-off was part of a pre-crisis plan, it appears that the pace and magnitude increased with the crisis.

Table 2.10: Green Elements in the Estonian Stimulus Package

GREEN ELEMENTS IN THE ESTONIAN STIMULUS PACKAGE		
Measure	**Description**	**Budget**
Energy efficiency in housing		€51m
Water management infrastructure		€153m
Green Investment Schemes	Selling of AAUs leads to revenues which are invested via a Green Investment Programme. This includes a multitude of measures, for example support to electric vehicles and energy efficiency.	€44m+
Total		>€248m

France

Table 2.11: France's Stimulus Package

FRANCE'S STIMULUS PACKAGE	
Size of stimulus package	€26bn[14]
As a % of GDP	1.3%
Size of green part	€3.55bn (in the measures we assess, excl. harmful)
As a % share of total stimulus package	8-20% (depending on definitions)
Implementation period	2009-10

Table 2.12: Selected Economic Indicators for France, 2007-10

SELECTED ECONOMIC INDICATORS FOR FRANCE, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	2.4	0.2	-2.6	1.6
Private consumption (%y/y)	2.5	0.5	0.6	1.4
Public consumption (%y/y)	1.5	1.7	2.7	1.5
Inflation (%y/y)	1.6	3.2	0.1	1.7
Unemployment rate	8.4	7.8	9.5	9.7
Budget deficit - % change since previous year	-0.4	-0.6	-4.2	0.5
Investments in fixed assets (%y/y)	6.0	0.5	-7.1	-1.7

Source(s): European Commission, Eurostat.

Overview

France went through a less severe recession than most other advanced economies. This was mostly a result of the country's comparatively low trade openness, a fairly resilient financial sector, the large social safety net, and timely government intervention (see Table 2.12). However, in spite of its relative resilience to the crisis, with a shallower downturn than the rest of Europe, France still faced an unprecedented slowdown. Its GDP contracted by 2.6% in 2009 and recovered only gradually in 2010.

The recovery was mostly driven by private consumption and net exports, as well as a turn in the inventory cycle. Household spending received a significant boost from the government stimulus package, notably the car scrappage scheme. Fiscal stimulus in the region of 1.3% of annual GDP over 2009–10 played an important role in cushioning the downturn.

The share of green measures in the stimulus package is much debated (see Table 2.11). HSBC (2009) argues that 18% is green, but Meyer-Ohlendorf et al (2009) calculates the green expenditures at only one-third of this. The Financial Times reckoned that 20% would go to low-carbon industries (Harvey, 2009). The difficulties in determining the size of the green parts of the French stimulus stem from non-ear-

[14] Plan de relance de l'economie Francaise (2009), http://www.gouvernement.fr/gouvernement/plan-de-relance-de-l-economie-francaise .

marked funds and support for the automotive industry. The following paragraphs describe our interpretation, and are summarised in Table 2.13[15].

Renewables From the money spent on public companies some parts can be considered green. Electricite de France SA (EDF) was given €300m to invest in renewables. This was spent on photovoltaics.

Infrastructure From the Recovery Package, €500m was put into (green) infrastructure and regeneration of regions. This included €320m spent on railways, €100m for flood support (rivers and dams) and €30m to support sustainable agriculture. In addition, the public rail company SNCF received €350m for investments in rail infrastructure, mainly on preparatory work for the Train à Grande Vitesse (TGV), and RATP (the Autonomous Operator of Parisian Transports) received €450m to invest in mass transit. An additional €400m was spent on roads, but this cannot be considered as 'green' investment. The electric grid infrastructure also received a boost through a €600m investment in quality and security of electricity distribution and regional electricity grids. Although the investment should reduce transmission losses, the effects are difficult to quantify.

Energy efficiency Energy efficiency in housing was supported by a €200m 'fonds de lutte contre l'habitat indigne et les dépenses d'énergie', for medium-sized investments to energy-efficiency improvements in private houses. The remainder of the "Social Investment Fund" was spent on support to the unemployed and to finance low-interest mortgages. In addition, €200m was made available for the programme "Etat exemplaire", inter alia for energy-efficiency measures in public buildings.

Car scrappage A car scrappage scheme worth €500m was launched in December 2008. It subsidized the purchase of a new car under the condition that the scrapped car was at least ten years old. The subsidy per car was later raised from €300 to €1,000, and only paid for new cars that emit less than 160g of CO_2 per km. The 'green-ness' of this measure is questionable as 160g per kilometre represents the average emission value of new cars. In total, €500m was allocated to 'scrappage' and the 'bonus malus' scheme in 2009[16]. In addition, an investment fund of €300m was made available for the car industry and €150m for R&D funding for low-carbon vehicles.

Summary The French stimulus package included a series of cash-flow measures to buttress the corporate sector (tax credits on R&D outlays, accelerated reimbursement of VAT credits, and accelerated depreciation of investment); actions to support households (a temporary reduction of the personal income tax in 2009, public expenditures on social housing, and additional unemployment benefits); and public investment by the central government, local authorities, and public enterprises (see Table 2.13). Measures to support the automobile sector, including a car scrappage scheme ('prime à la casse'), were very effective in stimulating consumption. In addition, the government abolished the local business tax ('taxe professionelle').

It is also important to note that France decided to continue, without reduced support, the Grenelle Environnement which was launched in 2007. The Grenelle

[15] No information was found regarding other measures cited in European Commission (2009c), including eco-innovation, clean car aid and waste/water projects. Figures in the table may vary from those in the text as they include spending that had not been explicitly allocated but fell into each category.

[16] Plan de relance de l'economie Francaise (2009), http://www.gouvernement.fr/gouvernement/plan-de-relance-de-l-economie-francaise .

Environnement is a Round Table comprising members from all parts of society with the aim to define governmental policy on ecological and sustainable development issues for the next five years[17].

Possibly harmful measures

Although it is not included in our assessment, it should also be noted that the French package also included €700m in funding for fossil fuel power plants. There are relatively few details about this available (it may have been linked to carbon capture and storage, in which case it could have long-term environmental benefits) but it is likely that the focus was on upgrading existing infrastructure and improving energy security. It was determined as having negative environmental impact by Ecofys and Germanwatch (2009).

As part of the infrastructure measures, the French package also included some measures for road building. Although these may have short-term environmental benefits from reducing congestion, the long-term effects are more likely to be increased journeys and emissions.

Table 2.13: Green Elements in the French Stimulus Package

GREEN ELEMENTS IN THE FRENCH STIMULUS PACKAGE		
Measure	**Description**	**Budget**
Renewables	Investment mainly in photovoltaics.	€300m
Energy Efficiency	Mainly investment in energy efficiency of buildings.	€400m
Regional infrastructure and public transport	Investments in railway infrastructure, flood control and agriculture.	€500m
	Funds for SNCF (€350) and RATP (€450m).	€800m
Support to the car industry	Car scrappage scheme.	€500m
	Funds for R&D on low-carbon cars.	€150m
	Other support to the car industry (green measures).	€300m
Electric grid infrastructure	Investment in quality and security of electricity distribution and regional electricity grids.	€600m
Total		€3,550m

[17] See http://www.legrenelle-environnement.fr/-Version-anglaise-.html

Germany

Table 2.14: Germany's Stimulus Package

GERMANY'S STIMULUS PACKAGE	
Size of stimulus package	€80bn (2008-10)[1]
As a % of GDP	3.2% of GDP in 2008
Size of green part	€10.6bn
As a % share of total stimulus package	13.3%

Note(s): 1. OECD (2009) Green growth: Overcoming the crisis and beyond.

Table 2.15: Selected Economic Indicators for Germany, 2007-10

SELECTED ECONOMIC INDICATORS FOR GERMANY, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	2.7	1.0	-4.7	3.6
Private consumption (%y/y)	-0.3	0.7	-0.3	0.4
Public consumption (%y/y)	1.6	2.3	2.9	2.3
Inflation (%y/y)	2.3	2.8	0.2	1.1
Unemployment rate	8.4	7.3	7.5	6.8
Budget deficit - % change since previous year	1.9	-0.2	-3.1	-0.3
Investments in fixed assets (%y/y)	4.7	2.5	-10.1	6.0

Source(s): European Commission, Eurostat.

The largest economy in Europe entered the economic crisis in a fairly weak position. Germany's GDP growth and consumption levels (both public and private) were modest and some sectors had problems regaining strength from the 2003 recession (Leaman, 2010). Germany is relatively dependent on export revenues (46.9% of GDP in 2007 and annual growth of 7.8%) which made it particularly vulnerable to fluctuations in global trade levels (Leaman, 2010).

The German stimulus package was adopted in two phases in November 2008 and February 2009[18]. The main measures included infrastructure, particularly schools and universities, but also measures to foster broadband networks[19]:

- support to businesses and households to retain employment and overcome the crisis
- training and upgrading grants (raising levels of education)
- fostering innovation and R&D
- green technologies, special measures targeted at the automobile sector in particular[20]

Car scrappage scheme

Part of the second package, a €5bn car scrappage scheme provided owners of cars that were more than nine years old with €2,500 for the purchase of a new car. The initial

[18] Please note that we only consider stimulus packages on a national level. We acknowledge that each federal state has its particular economic crisis programme; however, it is beyond the scope of this study to analyse each state.

[19] No further information was found regarding investment in railways and waterways, which were defined as part of the package in the EC non-paper (European Commission, 2009c).

[20] See http://www.oecd.org/document/50/0,3746,en_2649_34223_43163698_1_1_1_1,00.html

sum for the scheme announced in January 2009 was subsequently raised from €1.5bn to €5bn in April 2009 when the Government realized the large demand. The scheme proved to be a great success with a boost in sales of 28% in August 2009 alone. The €5bn ran out in September 2009 and by that time almost 2m cars had been scrapped and replaced by newer versions[21]. As a tax rebate is given if a new vehicle is Euro 5 or Euro 6, the scheme could be considered to have had a positive impact on CO_2 abatement[22]. According to one estimate, 540,819 tonnes of CO_2 were abated in 2009 as an effect of the scrappage scheme (IHS Global Insight, 2010).

The vehicle tax was also reformed and calculated on the basis of emissions caused. The cost was €1.8bn (OECD, 2009).

Building Refurbishment Programme

The KfW Building Refurbishment Programme received an additional €3.3bn to its budget. The programme is expected to be paid back via reduced energy costs and could lead to 25,000 jobs in the manufacturing and construction sectors (Meyer-Ohlendorf et. al (2009). This was part of a larger measure which includes infrastructure and education. An estimated quota of 33% of the total amount (€3.3bn) was applied to energetic refurbishment of school and university buildings.

Investments in green technology

A total of €500m is intended to support development of hybrid and other clean car technologies (OECD, 2009).

Summary

It is difficult to establish the green part of Germany's stimulus package. Authors estimate its share to depend on final execution and give a range of 5-32% (Khadiavi et. al, 2009). However, bringing in the house refurbishment scheme, the green tax reduction, the green technology investment scheme and the car scrappage scheme, the total green part of the German stimulus package is €10.6bn, equalling 13.3% of the total stimulus package (see Table 2.16).

Table 2.16: Green Elements in the German Stimulus Package

GREEN ELEMENTS IN THE GERMAN STIMULUS PACKAGE		
Measure	**Description**	**Budget**
Housing refurbishment	Funding for energy-efficiency measures, mainly in school and university buildings.	€ 3.3bn
Green tax reduction	R&D targeting alternative mobility concepts (especially electro-mobility).	€ 500m
Car scrappage scheme	A €5bn car scrappage scheme provides owners of cars more than nine years old with €2,500 for the purchase of a new car.	€ 5bn
Green tax reduction II	Revision of motor vehicle tax from 1 July 2009. CO_2-emissions of passenger cars are included in the taxable base.	€ 1.8bn
Total		€ 10.6bn

[21] See http://news.bbc.co.uk/2/hi/business/8233603.stm

[22] Although it is noted that Ecofys and Germanwatch (2009) exclude the car scrappage scheme from their analysis with the reason that the scheme is not focused mainly on the environment and that green credentials are not awarded in the scheme.

Portugal

Table 2.17: Portugal's Stimulus Package

PORTUGAL'S STIMULUS PACKAGE	
Size of stimulus package	
As a % of GDP	
Size of green part	€305m
As a % share of total stimulus package	

Note(s): Information regarding the absolute size of the Portuguese package is missing.

Table 2.18: Selected Economic Indicators for Portugal, 2007-10

SELECTED ECONOMIC INDICATORS FOR PORTUGAL, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross Domestic product (GDP) (%y/y)	2.4	0.0	-2.5	1.3
Private consumption (%y/y)	2.4	1.3	-1.1	2.2
Public consumption (%y/y)	0.5	0.4	3.7	1.8
Inflation (%y/y)	2.4	2.7	-0.9	1.4
Unemployment rate	8.1	7.7	9.6	11.0
Budget deficit – change since previous year (% of GDP)	1.3	-0.1	-6.4	0.9
Investments in fixed assets (%y/y)	2.6	-0.3	-11.2	-5.0

Source(s): European Commission, Eurostat.

Over the last decade, Portugal has experienced a troublesome economic climate. Upon entering the financial and economic crisis, Portugal already had poor GDP growth, high unemployment levels, low education levels and large budget deficits[23]. However, GDP fell by only 2.5% in 2009, which is relatively small compared to other falls in Europe, and the housing market bubble together with sub-prime mortgages have remained absent. Still, market confidence and prospects for growth have declined considerably since the crisis begun (OECD, 2010) and GDP was declining again in early 2011.

Several proposals have been put forward but without considerable success. The possibility of a bail-out scheme (such as in Ireland and Greece), subsequently agreed in May 2011 by other Euro-countries and the IMF, loomed over the economy and credit ratings have continuously being lowered[24].

In summary, Portugal was one of the European countries, along with Italy, Greece and Spain, where the economic downturn hit the hardest[25].

The Portuguese recovery package included four green measures. They were all implemented during 2009.

[23] See http://www.economist.com/node/9009032?story_id=9009032

[24] See http://www.ft.com/cms/s/0/3aef7558-4f5e-11e0-8632-00144feab49a.html#axzz1HYhHd1k4

[25] See http://www.oecd.org/document/59/0,3746,en_2649_34569_46057467_1_1_1_1,00.html

Renewables A tax rebate for installing renewables such as solar power and wind turbines in private homes was introduced, worth €145m.

Energy efficiency and smart meters Energy-efficiency measures were introduced to target both households and private businesses. A €100m scheme focused on private buildings (households and small businesses) while €15m went to installing smart meters in private houses.

Car scrappage The car scrappage scheme differs somewhat from the schemes in other countries. The initiative was taken in 2001 as an End of Life Vehicle programme (IHS Global Insight, 2010). It started to become successful in 2007 but it was not until 2009, when clear environmental standards were incorporated and the requirements for participating cars enlarged, that the benefits of the scheme were fully realised. To stimulate car scrappage, the age limit was lowered to eight years in 2009, and an upper limit of 140 g/km of CO_2 was introduced. In 2009, as a result of the widened scope of the scheme, 42,735 cars were scrapped. The introduction of a CO_2 threshold appears to have significantly improved the energy and carbon efficiency of newly purchased cars, from 135.7g/km in 2007 and 134.7 in 2008, to 126.6g/km in 2009.

Table 2.19: Green Elements in Portugal's Stimulus Package

GREEN ELEMENTS IN PORTUGAL'S STIMULUS PACKAGE

Measure	Description	Budget
Solar, microgeneration wind turbines for private sector	Tax rebate when installing solar or micro generating wind turbines. Aimed at private costumers.	€145m
Improve energy efficiency in private buildings		€100m
Invest in energy meters	Installations of smart meters to promote energy-efficient behaviour in private households.	€15m
Car scrappage scheme	Refund when trading a car of 13 (later 8) years of older for an energy-efficient car.	€45m
Total		€305m

Slovakia

Table 2.20: Slovakia's Stimulus Package

SLOVAKIA'S STIMULUS PACKAGE	
Size of stimulus package	€1.46bn
As a % of GDP	2.3%
Size of green part	€166.8m (our definition used below)
As a % share of total stimulus package	6-12% (depending on definitions)
Implementation period	2009-10

Table 2.21: Selected Economic Indicators for Slovakia, 2007-10

SELECTED ECONOMIC INDICATORS FOR SLOVAKIA, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	10.5	5.8	-4.8	4.0
Private consumption (%y/y)	6.9	6.1	0.2	-0.3
Public consumption (%y/y)	0.1	6.1	5.6	0.1
Inflation (%y/y)	1.9	3.9	0.9	0.7
Unemployment rate	11.1	9.5	12.0	14.4
Budget deficit - % change since previous year	1.4	-0.3	-5.8	0.0
Investments in fixed assets (%y/y)	9.1	1.0	-19.9	3.6

Source(s): European Commission, Eurostat.

During the crisis, the Slovakian economy experienced one of the largest relative declines in GDP among OECD countries (OECD, 2010a). In 2009 GDP shrank by 4.8%, unemployment rose from 11% in 2007 to above 14% in 2010, and the budget deficit increased from 1.9% of GDP to 7.9%[26].

Overview

In response to the economic crisis and in line with the European Economic Recovery Plan from November 2008, the Slovak government adopted a set of measures to support the economy. The measures considered the long-term challenges to the Slovak economy and the aims to create a knowledge-based economy which could sustain growth. Three packages were adopted which were subsequently expanded to include a number of other measures. The individual measures were focused on increasing energy efficiency in the economy, reducing the administration burden on businesses and decreasing tax and social contribution costs of workers, supporting small and medium-sized businesses, promoting research and development, creating job opportunities, maintaining employment and increasing labour market flexibility.

The measures in the recovery package geared towards the environment focus on energy efficiency in public buildings and housing corporations and to some extent market up-take of renewable energy[27].

[26] Ibid.

[27] European Commission (2009c) suggested there were also measures to boost eco-innovation by shifting research funding but we have not been able to find further information about this.

Energy efficiency

In one measure, the Slovakian Government adopted a programme to increase the energy efficiency in public buildings in the Trnavsky and Trenciansky regions. These are the areas where two nuclear plants are being decommissioned. The €10m was channelled from the Bohunice International Decommissioning Support Fund. However, only €0.5m of this was used in 2009 and only slightly more in 2010. The main part of the total €10m was allocated to be used in 2011. It was planned to support 43 projects with total savings of 7.85 GWh annually. Up to date, only four projects have been fully completed[28].

The second project (SLOVSEFF II) aimed to improve energy efficiency by providing loans for private companies and housing corporations. The European Bank for Reconstruction and Development (EBRD) is supporting the measure in cooperation with the Ministry of Economy which launched the Slovak Energy Efficiency and Renewable Energy Finance Facility (SLOVSEFF I, II) in March 2010. Loans between €20,000 and €2.5 million, as well as grants between 7.5% and 15% of the loan (total of €15m), and free technical assistance were made available through local banks for private companies and housing associations implementing energy-efficiency and renewable energy projects. Grant support is provided by the Bohunice International Decommissioning and Support Fund (BIDSF).

In its first phase (ending in 2010) €77.8m was used to invest in 293 projects: 251 in the residential sector, 8 renewable energy projects and 34 industrial energy-efficiency projects. The SLOVSEFF (I, II) programmes appear to have created a triple dividend. The investments led to 1,108,600 m^2 of building space being refurbished; 46,350 people enjoying lowered energy bills; and it created 8,642 jobs. An estimated average of 32% in energy savings was made in the residential sector. Up to date, the second phase has financed 99 projects of which 92 are in the residential sector, two in the renewable sector and five in industrial energy-efficiency investments. The total investment value amounts to €15.6m with €49.2 million remaining.

Renewables

The third measure aims to increase the installation and use of renewables in households. The total allocated amount for solar and biomass equipment was €8m, coming from the state budget. In 2009, 603 projects were supported, with a total value of €0.5m. The corresponding figures for 2010 were 1,801 and €1.85m. Initially it was planned to support 5,000 projects with total value of €32m which, the Slovakian Government argued, could potentially create 350 new jobs.

Car scrappage schemes

The car scrappage scheme of the Slovak government was announced in early 2009 and totalled €55.3 million. The key reason was to support the weakened domestic auto industry. The incentive schemes looked somewhat different over the course of time but generally the car dealer was required to lower the price of the car for the buyer to reap the full benefits of the bonus. The official bonus was set at a maximum of €2,000. Only cars that were older than ten years qualified for the programme and the value of the new car could not exceed €25,000 and must have been M1 registered (IHS Global Insight, 2010a).

The environmental benefits of the scheme come mainly from the cost limit. No environmental requirements were put in place, however, smaller cars benefited from the €25,000 limit.

[28] Although enquiries have been made we have been unable to determine the reason for the low rate of take-up.

Summary

In conclusion, the green part of the Slovak stimulus package focuses heavily on energy efficiency in buildings. Of the money allocated (excluding the car scrappage scheme), energy-efficiency measures accounted for 93.5% of the total. Moreover, it is notable that only €8m is allocated from the state budget. The remaining funds (again excluding vehicle scrappage) come from international financing institutions, mainly the EBRD.

Although exact figures are not available, the general impression is that the speed of the Slovak administration and uptake in society as a whole has been relatively quick.

Table 2.22: Green Elements in the Slovak Stimulus Package

GREEN ELEMENTS IN THE SLOVAK STIMULUS PACKAGE		
Measure	**Description**	**Budget**
Implementation of energy-efficiency measures in public buildings	To increase the energy efficiency of public buildings in Trnavsky and Trenciansky region.	€10m
Increase of energy efficiency (SLOVSEFF I and II)	This project (SLOVSEFF I and II) aims to improve energy efficiency by providing loans for private companies and house corporations.	€93.5m
Car scrappage scheme	Car scrappage bonuses for cars over ten years old to buy cars up to €25,000.	€55.3m
Subsidies for the development of biomass and solar energy production for households	This last measure aims to increase the installation and use of renewables in households.	€8m
Total		€166.8m

Sweden

Table 2.23: Sweden's Stimulus Package

SWEDEN'S STIMULUS PACKAGE	
Size of stimulus package	2009 – 32 + 8.4bn SEK 2010 – 32 + 7bn SEK 2011 – 24bn SEK Total (2009-11): 103.4bn SEK
As a % of GDP	2.9% (2008-10)*
Size of green part	Up to 6.1bn SEK
As a % share of total stimulus package	5-6%
Implementation period	2009-11

Note(s): * Used exchange rate as on 31-12-'08: EUR/SEK=1/10.87.

Table 2.24: Selected Economic Indicators for Sweden, 2007-10

SELECTED ECONOMIC INDICATORS FOR SWEDEN, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	3.3	-0.6	-5.3	5.5
Private consumption (%y/y)	4.0	0.0	-0.6	3.6
Public consumption (%y/y)	0.7	1.0	1.7	2.6
Inflation (%y/y)	1.7	3.3	1.9	1.9
Unemployment rate	6.1	6.2	8.3	8.4
Budget deficit - % change since previous year	1.3	-1.4	-3.1	0.8
Investments in fixed assets (%y/y)	8.9	1.4	-16.3	6.3

Source(s): European Commission, Eurostat.

Overview

The Swedish economy entered the crisis in a relatively strong position. The four largest banks, representing 80% of the Swedish banking market, had solid assets (Jochem, 2010) and the sub-prime mortgage problem was fended off with a cautious lending policy. Nevertheless the Swedish economy is heavily interlinked with both European (around 60% of exports from Sweden targets the EU market)[29] and global markets, and the country normally exports more than it imports[30]. Therefore, even though the Swedish banking system was considered resilient, the economy as a whole was vulnerable to domino effects in other markets.

The financial crisis hit the Swedish production and manufacturing industries hard. The unemployment rate increased from 6.2% in 2008 to 8.3% and 8.4% in 2009 and 2010. Swedish unemployment rates also increased quicker than the EU average of both EU15 and EU12 Member States. In the first six months of 2009, Swedish unemployment increased by 27.8 %, which was the seventh highest rate in the EU[31].

[29] See http://www.tradingeconomics.com/Economics/Balance-of-Trade.aspx?Symbol=SEK

[30] See http://www.scb.se/Pages/PressRelease____285495.aspx

[31] See http://www.dn.se/ekonomi/svensk-arbetsloshet-i-eu-botten-

The Swedish response to the crisis was divided into several budgetary injections. It also involved a multilateral crisis response aiding Latvia and Iceland to cope with the downturns (Jochem, 2010).

Table 2.25 Crisis budgets in Sweden (2009-2010)

CRISIS BUDGETS IN SWEDEN (2009-10)

Year	Source	Amount
2009	The 2009 Budget bill	32bn SEK
2009	The 2009 supplementary budget	8.4bn SEK
2010	The 2009 supplementary budget	7bn SEK
2010	The 2010 Budget bill	32bn SEK
2011	The 2010 Budget bill	24bn SEK
	TOTAL	103.4bn SEK

Source(s): Swedish Ministry of Finance.

The budgets already implemented by 2011 represented around 2.3% of GDP (see Table 2.25).

In January 2009 the Swedish Government presented a 'Climate and energy policy for a sustainable future' bill. The policy aimed to combine ecological sustainability with competitiveness and security of supply, and new actions for more than €273m (3bn SEK) were presented. The key goals of the policy were to:

- Phase out the use of fossil fuels for heating by 2020.
- Create a Swedish fleet of vehicles independent from fossil fuels by 2030.
- Increase the share of other renewable power sources.
- Develop actions involving green procurement. GPP actions aim to increase the use of products and services complying with at least minimum requirements set by Miljostyrningsradet, or other criteria. If criteria do not exist, then Life-Cycle Cost analysis should steer procurement (Olsson, 2009).

To reach these targets the Government is investing heavily, for example keeping the vehicle industry on the front-line of the transition (European Commission, 2009d). In terms of green measures the Swedish Government is focusing on the automotive industry, energy efficiency and R&D.

The automotive industry

Support measures for the automotive industry had the aim of saving jobs, mainly in Trollhättan where most of the large manufacturers are located. These were adopted early by the Swedish government. In an innovative stroke, the funds were (occasionally) coupled with environmental goals. Funds were made available for R&D and a green car debate was launched (Jochem, 2010). Three measures targeted the transport industry directly:

1 The foreseen support for pilot and demonstration projects for 2nd generation biofuels with 145m SEK in 2009, 380m SEK in 2010 and 350m SEK in 2011.

2 In 2008, 3bn SEK was injected into a venture capital company emphasising green technology in the automotive industry.

3 The government also announced 85m SEK of support to developing battery techniques in electric vehicles for 2010 and 2011[32].

Energy efficiency In 2009, a package of measures to improve energy efficiency in different sectors was approved, with values of 300m SEK per year (2010-2014) and an additional 255m SEK in 2012 (Regeringen, 2009). The package concentrates on: local and regional voluntary energy-efficiency agreements; improvements in procurement, information, and counselling; and the reinforcement of governmental work to improve energy efficiency (Regeringen, 2009). Even though the package was introduced in the midst of the crisis, its main aim was to approve an expansion of the energy-efficiency programme and to ensure implementation of the Energy Services Directive.

R&D To improve the market access of products that could benefit climate action, a multi-year aid package was adopted. It specifically aimed to encourage commercialisation of green technologies, such as biogas and solar-cells, and amounted to 100m SEK in 2009, 122m SEK in 2010 and 117m SEK in 2011[33]. Although this is quite a small annual amount and a small share of existing total R&D in Sweden it is highly targeted at a specific objective.

Summary The majority of the share of the green measures is geared towards the support and commercialization of R&D to sustain growth in the Swedish (high-tech) automotive industry. Support for developing biofuels, batteries, electric cars and similar measures made up 65% of the total budget for green measures. In total, 6,054m SEK is considered green by the Swedish Government.

The additionality of the green elements in the stimulus package is difficult to establish as it is often not possible to distinguish it from a business-as-usual budget. The measures are often part of the stimulus package but feed into policy goals related to energy, environment and climate change.

[32] Figures from personal communication with Swedish Ministry of Finance.

[33] See http://www.sweden.gov.se/sb/d/10902/nocache/true/a/110590/dictionary/true

Table 2.26: Green Elements in the Sweden's Stimulus Package

GREEN ELEMENTS IN SWEDEN'S STIMULUS PACKAGE		
Measure	**Description**	**Budget**
Biofuels	Funds that support a pilot and demonstration projects for 2nd generation biofuels.	145m SEK in 2009 380m SEK in 2010 350m SEK in 2011
Green technologies	Creation of a venture capital company emphasising green technology in the automotive industry.	3bn SEK
Batteries for vehicles	Support to developing battery techniques in electric vehicles.	85m SEK
Energy efficiency	A package of measures to improve energy efficiency in different sectors.	300m SEK per year (2010-2014) with an additional 255m in 2012
Commercialization of green technologies	A multi-year aid package to encourage commercialization of green technologies.	100m SEK in 2009, 122m SEK in 2010 117m SEK in 2011
Total		Max 6,054m SEK

United Kingdom

Table 2.27: United Kingdom's Stimulus Package

UNITED KINGDOM'S STIMULUS PACKAGE	
Size of stimulus package[34]	Budget 2009 (implementation 2009-2011): £25.3bn Pre-Budget Report (implementation 2010-2011): £400m
As a % of GDP	1.5%
Size of green part	£1.3bn (2009-2010)
As a % share of total stimulus package	5.1% on our definition (6.9% according to HSBC, and to Strand and Toman from the World Bank)
Implementation period	2009-10

Table 2.28: Selected Economic Indicators for the United Kingdom, 2007-10

SELECTED ECONOMIC INDICATORS FOR THE UNITED KINGDOM, 2007-10				
	2007	**2008**	**2009**	**2010**
Gross domestic product (GDP) (%y/y)	2.7	-0.1	-4.9	1.3
Private consumption (%y/y)	2.2	0.6	-3.3	0.8
Public consumption (%y/y)	1.3	1.6	1.0	0.8
Inflation (%y/y)	2.3	3.6	2.1	3.3
Unemployment rate	5.3	5.6	7.6	7.8
Budget deficit - % change since previous year	0.0	-2.3	-6.4	0.8
Investments in fixed assets (%y/y)	7.8	-5.0	-15.4	3.0

Source(s): European Commission, Eurostat.

In 2007, the UK economy appeared to be stable, experiencing high growth rates mainly driven by the financial sector. However, when entering the crisis in late 2008, it seemed as if the same factors which had previously led economic growth (e.g. increasing dependence on a liberalised financial market), had become the cause of the crisis (Meyer-Ohlendorf, 2010). Additionally, economic factors indicating vulnerability had been ignored in previous years. These included the substantial budget deficit (maintained even in times of continuous economic growth); a high level of debt (particularly among private households); and the dependence of private consumption on rising domestic property prices (Bush, 2010). In combination with the UK's historically-rooted call for liberalization of markets, especially in the financial sector, and its abovementioned economic weaknesses, the country was hit severely in 2009 causing a fall of GDP by 4.9%, a sharp rise in unemployment (from 5.3% in 2007 to 7.6% in 2009) and a sudden jump in the savings rate from nearly 0% (2007) to close to 10% (2009)[35].

The response was formulated in the Pre-Budget Report (PBR) November 2008 and the 2009 Budget released in April. The measures (worth £25.3bn) included:

- a temporary reduction in the VAT rate to 15% (from 17.5%) with effect from 1 December 2008 to 31 December 2009

[34] Source: HSBC (March 2010).

[35] Ibid.

- bringing forward £3bn of capital spending from 2010-11 to 2008-09 and 2009-10, to provide temporary support, targeted on areas where it would have maximum impact

The plan was to boost consumption and push down the savings rate, in addition to measures on energy efficiency, disaster adaptation and infrastructure.

Furthermore, the measures that were taken to support and stabilize the financial system, such as recapitalisation and asset guarantees were initially immense. The Bank of International Settlements (BIS) estimated that it left the UK Government exposed to commitments equalling 50% of 2008 GDP. These largely consisted of asset protection schemes for large banks such as RBS and Lloyds (Bank for International Settlements, 2009).

The fiscal stimulus was complemented by the operation of the automatic stabilisers and targeted support for those most affected by the downturn. Together, through these channels, fiscal support totalled 5% of GDP in 2009-10. Without the automatic stabilisers, the measures amounted to 1.5% of GDP.

It is estimated that in 2009 the UK spent around £150m of its green measures. The total value of the green measures was £1.4bn, described below.

Energy efficiency

Within the first stimulus package, two measures addressed energy efficiency in housing: the Warm Front Programme and the Decent Homes Programme.

The Warm Front Programme aimed to improve energy efficiency in households through subsidising insulation and heating improvements. It targeted people with disabilities or restricted income living in their own property or a rented home from a private landlord. The programme supported installations up to the value of £3,500 (or £6,000 where oil central heating or alternative low-carbon technologies were recommended). The aim of this measure was to improve heating efficiency and effectiveness for people with resource constraints[36]. The stimulus package assigned a total of £150m to the Warm Front Programme, bringing forward £50m and assigning an additional £100m in 2009. The National Audit Office estimated that the average spend per grant recipient was £1,800. The Centre for Sustainable Energy (CSE) estimated that the range of spending needed to eliminate fuel poverty in individual households was between £1,299 and £3,107, although it is unclear whether these estimates include administration costs. A further 16,000 social houses stood to benefit from £60m brought forward under the Decent Homes Programme (Simms, 2009).

According to the 2009 Pre-Budget Report, all of the £100m funding allocated for the Warm Front Programme in 2009-10 has been spent, benefiting almost 38,000 households and saving them each up to £300 in energy bills every year. The 2009 Pre-Budget Report also announced an additional £200m to fund the Warm Front Scheme and the greener boiler incentive scheme in 2010-11.

The Decent Homes Programme had a budget of £60m, and plans to upgrade around 16,000 social houses with energy-efficiency measures in 2011. Funds are distributed to social housing providers in England in order to implement energy-efficiency measures in their properties.

[36] The measure follows a debate on fuel poverty which applies to households where more than 10% of their disposable income is spent on heating fuels (http://www.poverty.org.uk/80/index.shtml).

Finally, the April 2009 budget allocated an additional £365m to improve insulation and to allow poorer households to move to higher energy-efficiency standards of poor homes over 2009-11. It is not clear how much of this was spent over 2009-10.

Disaster adaptation

The Adaptation Measure under the PBR treats the adaptation of 27,000 homes to flood defences, constituting a share of £20m brought forward.

Infrastructure and transport

The largest green measure in terms of funding (£300m) is the extension of the UK's railway networks. Capacity was expected to increase by an additional 200 carriages.

The 2009 Budget brought forward £250m to promote ultra-low-carbon vehicles by giving a reimbursement of £4,500 for every vehicle purchased.

Finally, under the PBR, £5m was planned to be brought forward, to initiate improvement in energy efficiency of the British Waterways Network Infrastructure (Simms, 2009).

Renewables

The 2009 Budget included a £525m budget for the support of offshore wind through Renewables Obligation Certificates (ROC). The ROCs are the principal form of support for UK wind power, providing a significant source of the revenue from wind generation[37].

It should be noted that there were other new and ongoing measures in this area at the time (see European Commission, 2009c) but they were not financed from the stimulus packages and so are not included in the assessment.

Summary

In conclusion, the green elements in the UK stimulus package focused heavily on transport and energy efficiency in buildings.

In addition to the PBR, the 2009 Budget indicated an increased attention for environmental topics. The focus on renewable energy and the automotive industry combines the UK's efforts to enhance industrial performance while initiating 'green' projects.

Measures not directly targeting green elements that could be beneficial for the environment have been omitted in our review. An example is the 2.5pp cut in VAT that could have benefitted the spread of energy-saving technologies (HSBC, 2009a). However, given the methodological challenges and uncertainty of the 'greenness' of such measures, they have been omitted from the analysis.

For specific schemes some aspects preclude them from the analysis. For example similar to car scrappage schemes in Germany and France, the UK announced its own initiative, assigning a £2,000 grant to each respective person replacing their old vehicle by a new, fuel-efficient one. However, there are no regulations governing the required fuel efficiency or type of vehicle that qualified for the subsidy; consequently the measure created no incentive for the purchase of low-carbon vehicles. Furthermore, the total budget, £600m is much smaller than the budgets by France or Germany (Meyer-Ohlendorf et. al, 2009) . The car scrappage scheme was therefore not included among the green measures in this analysis due to the absence of green requirements in the scheme.

Finally, schemes where guarantees to unlock loans for energy or environment-related actions have been omitted. For example the automotive industry received a £1.3bn

[37] See http://www.ofgem.gov.uk/Sustainability/Environment/RenewablObl/Documents1/Annual%20Report%202008-09.pdf

support package, financed by the EIB, guaranteeing to unlock loans. The government added a £1bn budget for a lower-carbon initiative. These measures were given to industry in order to enhance 'green' development, but it is not feasible to measure their green impacts.

Table 2.29: Green Elements in the UK Stimulus Package

GREEN ELEMENTS IN THE UK STIMULUS PACKAGE		
Measure	**Description**	**Budget**
The Warm Front Programme	The Warm Front Programme aimed to improve energy efficiency in households through subsidising insulation and heating improvements.	£150m
The Decent Homes Programme	The Decent Homes Programme, with a budget of £60m, initially planned to upgrade around 16,000 social houses with energy-efficiency measures in 2011.	£60m
The Adaptation Measure	The adaptation of 27,000 homes for flood defences, constituting a share of £20m brought forward.	£20m
Extension of the UK's railway networks	By adding an additional 200 carriages, the railway network increased its capacity, thereby being able to transport more people and expanding its reach.	£300m
Ultra-low carbon vehicles premium	To promote ultra-low carbon vehicles by giving a reimbursement of £4,500 for every vehicle purchased.	£250m
British Waterways Network	To initiate the improvement and energy efficiency of the British Waterways Network Infrastructure.	£5m
Renewables Obligation Certificates (ROC)	Support of offshore wind through Renewables Obligation Certificates (ROC). The ROCs are the principal form of support for UK wind power, providing a significant source of the revenue from wind generation.	£525m
Total		£1.31bn

2.3 Green recovery measures from the other EU Member States

This section provides a summary of the green recovery measures that were implemented in the other Member States. In most cases the information that has been gathered is of announced measures, without any judgement on implementation. Where there are gaps this reflects areas where we are unable to find sufficient information.

We were unable to find information for the following countries so they are excluded:

- Bulgaria
- Greece
- Ireland
- Luxembourg
- Malta
- Romania

Austria

GDP: €283bn

Total stimulus package: €1.9bn

Total amount dedicated to green measures: €1.07bn

Environmentally harmful investments: None found.

Table 2.30: Green Elements in Austria's Stimulus Package

GREEN ELEMENTS IN AUSTRIA'S STIMULUS PACKAGE			
Green measure	**Implemented**	**Value (€m)**	**Description**
Global loan environmental projects	2009-2010	100	Global loan of €100m in 2009 and 2010 for energy-efficiency projects, emission and waste reduction projects and environmental technology projects.
Thermal improvements		100	For private interests and companies, for thermal renovations of max €5,000.
Thermal renovations public buildings		126	Investment on thermal renovation of public buildings: Measures for school and university buildings are performed earlier; the legal basis is an agreement between BIG and the responsible federal Ministry; the measures are funded through payments of rents (duration: 10 years) and savings of energy costs over 20 years.
Additional railway infrastructure investments	2009-2012	700	Railway infrastructure investments in addition to the regular ÖBB-Rail-Investment Framework Programme 2009-14. In 2009 €360m was spent. The rest was expected to be spent once the period was up.
Vehicle scrappage scheme	2009	45	Lasted from April to July 2009 and offered €1,500 for each car older than 15 years. In total €45m of the total budget was spent. The mitigation efforts amount to an estimated 34,000 tonnes of GHG/year.
Total		1,071	

The Austrian package also included an additional motor fuel tax from 2011 (5 cents for diesel and 4 cents for petrol), an additional tax for air travel (€8-15) and green public procurement measures. However, the total values for these are not known.

Cyprus

GDP: €17.3bn

Total stimulus package: €0.5bn

Total amount dedicated to green measures: €0.03bn

Environmentally harmful investments: None found.

Table 2.31: Green Elements in Cyprus's Stimulus Package

GREEN ELEMENTS IN CYPRUS'S STIMULUS PACKAGE			
Green measure	**Implemented**	**Value (€m)**	**Description**
Energy supply sources		8	Diversification of energy supply sources. Establishment of the Vassilikos Energy Centre in order to decrease the dependency on imported oil and increase energy efficiency of the country's energy sector, reduce greenhouse gases and other emissions.
Promotion of clean vehicles			New provision of incentives for the purchase of low-carbon vehicles up to 120 g/Km.
Photovoltaic systems			Increase of the subsidised capacity of photovoltaic systems from 5KW to 20KW.
Adoption of energy-saving measures			Subsidy Scheme for enterprises, households and government services to adopt energy-saving measures.
Vehicle scrappage scheme		25.5	Subsidy scheme for the withdrawal of old cars and their replacement with new ones.
Total		33.5	

Denmark

GDP: €233.5bn

Total stimulus package:

Total amount dedicated to green measures: €15.6bn

Environmentally harmful investments: None found.

Table 2.32: Green Elements in Denmark's Stimulus Package

GREEN ELEMENTS IN DENMARKS'S STIMULUS PACKAGE			
Green measure	**Implemented**	**Value (€m)**	**Description**
Green transportation policy		12,500	Agreement on a green transport policy, including both a scheme for infrastructure investments and an agreement on transportation policies. The aims of the policy were to reduce CO_2 and air-borne emissions as well as noise pollution from transportation, less congestion, more and better public transportation, better conditions for bicycles, promotion of green transportation technologies and increased consideration for nature in the planning of infrastructure projects. The policy also contained initiatives on green car taxation, the main one being the introduction of road pricing throughout Denmark.
Green tax reform		2,900	A tax reform and additional measures were agreed upon to stimulate activity in the Danish economy. The tax reform continues in the direction set out in the Spring Package from 2004 and the agreement on Lower tax on earned income from 2007 by reducing markedly the tax on work, including marginal income taxes. The tax reform implies that income taxes (including the 'green check') are reduced by more than 28bn DKK (1½% of GDP) (long-term, permanent effect). On the other hand, taxes on pollution and energy consumption are raised.
Renovation subsidy scheme		200	Funds amounting to 1½bn DKK (0.1% of GDP) were set aside for subsidies for maintenance and construction works, including energy savings, in owner-occupied housing. The main aim of the subsidy was to increase employment in the construction sector. There was a maximum of one application per dwelling, and the subsidy can only be received on improvements. The programme gave 40% subsidy on wages, including VAT, though with a maximum of 15,000 DKK (€2,000) per project, and 20% on

GREEN ELEMENTS IN DENMARKS'S STIMULUS PACKAGE

Green measure	Implemented	Value (€m)	Description
			materials for specified energy-saving investments, though with a maximum of 10,000 DKK (€1,300). Applications could be submitted until the end of 2009 and the projects for which subsidy is given had to be finished at the latest six months after receiving the assurance of subsidy.
Total		15,600	

Finland

GDP: € 184.6bn

Total stimulus package:

Total amount dedicated to green measures: €0.2bn

Environmentally harmful investments: None found.

Table 2.33: Green Elements in Finland's Stimulus Package

GREEN ELEMENTS IN FINLANDS'S STIMULUS PACKAGE			
Green measure	**Implemented**	**Value (€m)**	**Description**
Basic rail maintenance		35.3	The allocation was planned to be used in the improvement of several railway sections and in enhancement and alteration of certain railway yard activities.
Basic road maintenance		40.9	Basic green road maintenance projects included improvements for the prerequisites of public transport, the construction of pedestrian and bicycle paths and improving protection against noise.
Additional budget Technology and Innovation Energy and Environment sectors		15	Additional budget authority for the Finnish Funding Agency for Technology and Innovation (Tekes) concerning the energy and environment sector.
Energy subsidies		69	Additional budget authority for energy subsidies. The measure contributed to executing the National Climate and Energy Strategy. A major part of the funding was directed to wind energy projects. The rest of the funding was allocated to promote use of other renewable energy sources and energy efficiency.
Water supply and sewerage projects + waste water projects		19.2	An additional €6.2m, including a state subsidy, was granted for the Lake Vesijärvi project.
Increase of subsidies for the energy renovation projects promoting use of renewable energy and energy efficiency		10	The subsidies were directed at housing companies and one-family houses.
Renovation subsidy (10%) for housing companies	2009	25	For projects launched between the beginning of February and the end of December 2009, it was estimated that 20% of the total subsidy of €125m was directed to green measures improving energy

GREEN ELEMENTS IN FINLANDS'S STIMULUS PACKAGE

Green measure	Implemented	Value (€m)	Description
			efficiency (€25m).
Refurbishment of the oil-combating vessel Halli		7	
Total		221.4	

Hungary

GDP: €106.4bn

Total stimulus package:

Total amount dedicated to green measures:

Environmentally harmful investments: None found

Table 2.34: Green Elements in Hungary's Stimulus Package

GREEN ELEMENTS IN HUNGARY'S STIMULUS PACKAGE

Green measure	Implemented	Value	Description
New Széchenyi Plan. Development Strategy of Recovery and Progress.	2011-2013 (Prepared and consulted in autumn 2010 and launched by the Government in January 2011).	2,000bn Ft	One of the seven priority areas of the New Széchenyi Plan is dedicated to green economic development: • Development of e-environment in the public administration. • Enhancing sustainable patterns of living, raising public awareness, education and training. • Energy efficiency of buildings with wider use of RES. • Production of electricity from RES, combined heating and biomethane. • Recultivation of regional municipal solid waste disposal sites. • Regional development programmes based on RES. • Heat and electricity production based on geothermal energy. • Reconstruction of the district heating system.

Italy

GDP: €1567.8bn

Total stimulus package: €65.5bn

Total amount dedicated to green measures: €3.8bn

Environmentally harmful investments: None found.

Table 2.35: Green Elements in Italy's Stimulus Package

GREEN ELEMENTS IN ITALY'S STIMULUS PACKAGE

Green measure	Implemented	Value (€m)	Description
Feed-in tariff for electricity generated by small renewable energy plants	2009		Feed-in tariffs is a support system based on providing a fixed price for renewable energy installations based on the electricity supplied to the grid. This rate is applicable only to facilities of less than 1 MW (200 kW for wind power) and includes both the incentive and the remuneration for the energy fed into the grid. The rate is all-encompassing differentiated by technology and is recognized for a period of 15 years.
Feed-in tariffs for electricity generated by thermodynamic solar plants	2008		This provides constant compensation for electricity produced by solar thermodynamic for a fixed period of 25 years through a tariff for all energy produced by the plants.
Tax deduction for building renovations	2007-2020	1,744.8	This allows both companies and individuals to deduct from income tax 55% of the total expenditure incurred for operations of heating and cooling of buildings that use renewable energy and energy efficiency. This reduction remains fixed for all technologies. Between 2007 and 2010 an estimated 5,479 GWh was saved.
Car replacement scheme	2009-2011	527	The scheme provided a €1,500-3,000 'eco-premium' for purchase of a Euro 4-5 car (below 130 gCO_2/Km if diesel, below 140 if petrol) and at the same time scrapping of vehicle older than ten years. The incentive was increased to €2,500-6,500 'eco-premium' for the purchase of new LCVs if at the same time scrapping a Euro 0-1-2 LCV registered before 31st December 1999. Furthermore, a bonus of €1,500 was offered for the purchase of an ecologic car (methane/ electric/ hydrogen) without scrapping. Ecologic cars with particularly low CO_2 emissions could reach a bonus of €3,500, and up to €4,000 for the purchase (without scrapping) of innovative new vehicles (methane/electric/hydrogen). Incentives can be cumulated with scrapping. Between 2007 and 2010 about 2,908 GWh was saved.

GREEN ELEMENTS IN ITALY'S STIMULUS PACKAGE

Green measure	Implemented	Value (€m)	Description
Public transport infrastructure	2009-2011	1,440	This comprised railway infrastructure investments. New resources (€480m for each year of the 2009-2011 period) were allocated to the rail network.
Installation of antiparticulate devices on public transport vehicles		55	This included extraordinary financing (€55m, €44m of which was drawn from higher VAT revenue) of contributions for the installation of particulate emissions abatement devices for exhausted gases by local public transport companies, in cooperation with the Ministry of Environment and Regions. 25% of the cost was reimbursed with a maximum of €1,000 per vehicle.
Total		3,766.8	

Lithuania

GDP: €32.3bn

Total stimulus package: €1.5bn

Total amount dedicated to green measures: €0.3bn

Environmentally harmful investments: None found.

Table 2.36: Green Elements in Lithuania's Stimulus Package

GREEN ELEMENTS IN LITHUANIA'S STIMULUS PACKAGE

Green measure	Implemented	Value (€m)	Description
Programme for modernization of Multifamily Buildings		290	The Programme for the modernization of Multifamily Buildings was approved by resolution No. 1213 of the Government of the Republic of Lithuania on 23 September 2004. Amendments of this program were approved on 21 June 2005 and on 5 March 2008. The overall goal of the programme was to promote and help home owners modernise multifamily buildings, improve efficiency of energy consumption and reduce CO_2 consumption. The Government provided state grants (15%, 30%, 50% - depending on implemented energy-efficiency measures) to buildings constructed before 1993. Some extra support was provided for low-income families as well. The financing for the programme came from the European Investment Bank (€87m) and European Structural Funds (€203m).

Latvia

GDP: €23bn

Total stimulus package:

Total amount dedicated to green measures: €0.8bn

Environmentally harmful investments: None found.

Table 2.37: Green Elements in Latvia's Stimulus Package

GREEN ELEMENTS IN LATVIA'S STIMULUS PACKAGE			
Green measure	**Implemented**	**Value (€m)**	**Description**
Energy efficiency		60	Energy efficiency in production and distribution of heat.
Residential buildings		57	Renovation of residential buildings.
Public buildings		35	Renovation of public buildings including social buildings.
Biomass		24	Development of biomass co-generation electro stations.
Biogas		20	Promotion of biogas production.
Green procurement		24	Promotion of green procurement.
Eco-technologies		588	Promotion of eco-technologies and eco-innovations.
Total		808	

Netherlands

GDP: €596.2bn

Total stimulus package: €17.3bn

Total amount dedicated to green measures: €2.9bn

Environmentally harmful investments: None found.

Table 2.38: Green Elements in the Netherlands' Stimulus Package

GREEN ELEMENTS IN THE NETHERLANDS' STIMULUS PACKAGE			
Green measure	**Implemented**	**Value (€m)**	**Description**
Car scrappage scheme		80*	A subsidy for scrapping old cars when buying a newer, less polluting one. There were no environmental requirements when the scheme was introduced. However, a few months later CO2 emissions for new cars had to be below 140 g/km and for new vans below 160 g/km.
Wind energy at sea		2,415	Intensification of short-term programme for off-shore wind energy from 450 MW to 950 MW; decision making on licensing and subsidies to be finished in 2010.
Green tax allowance		60	More funding for existing schemes for tax allowances for companies investing in sustainable production facilities (VAMIL/MIA). The tax allowance was given to companies that invested in technologies that were demonstrably at the top-end of sustainability. The extra funding was used to increase the tax allowance (deductible percentage) on the one hand and raise awareness of the programme on the other hand.
Rewarding sustainability		60	A package of green measures: in general the package included no new measures but extra budget for existing instruments (guarantees, loans, subsidies) with a focus on sustainable production.
Electric cars		65	To encourage the development of electric vehicles via three measures: 1) investing in production of car parts; 2) acting as a launching customer (government); 3) investing in infrastructure (charging stations etc).
Energy saving in houses		227.5	Promoting energy saving in houses, by giving fiscal stimuli to housing corporations. Housing corporations build and rent out social housing in the Netherlands. The tax cut aimed to stimulate upgrading the energy efficiency of rental properties by two steps in the Dutch

GREEN ELEMENTS IN THE NETHERLANDS' STIMULUS PACKAGE

Green measure	Implemented	Value (€m)	Description
			classification system for energy efficiency of residential housing.
Total		2,907.5	

Note(s): * The exact value of the scrappage scheme is difficult to determine as it includes inputs from both government and industry.

Slovenia

GDP: €36.1bn

Total stimulus package: €1.3bn

Total amount dedicated to green measures: €0.2bn

Environmentally harmful investments: None found

Table 2.39: Green Elements in Slovenia's Stimulus Package

GREEN ELEMENTS IN SLOVENIA'S STIMULUS PACKAGE			
Green measure	**Implemented**	**Value (€m)**	**Description**
Support to the strategic projects in the field of clean and technologically advanced industry	Energy efficiency, Resource efficiency, Green products, Green transport	100	The measure aimed to provide financial support to the strategic projects of the companies in fields of pure and technologically advanced industry (such as the car industry) by ensuring favourable loans for further investments in research and development. Priority fields for intensified investment in R&D were: environment and efficient use of energy, safety, comfort and new materials and technologies for the first three fields, including the investments in technological and non-technological innovations.
Energy rehabilitation of buildings in public ownership	Energy efficiency, GPP	20	With a view to encouraging a sustainable use of energy, contributing to commitments arising from the energy-climate package, reducing material costs of energy, promoting public investments and reviving construction works, the programme for energy rehabilitation of buildings in public ownership was carried out, up to the estimated value of €20m, financed with resources of the Cohesion Fund.
Reforming and extending programmes for public works in 2010 and 2011		100	This was a measure aimed to increase social inclusion of the long-term unemployed, especially in the areas with typical underdevelopment as compared to the EU averages (i.e. education services, different social security services, environmental protection, stimulating social entrepreneurship) – financing was

GREEN ELEMENTS IN SLOVENIA'S STIMULUS PACKAGE

Green measure	Implemented	Value (€m)	Description
			provided within the heading of active labour market policies up to €50m pa.
Gradual introduction of 'green tax reform'	Tax reform		
Total		220	

Spain

Table 2.40: Green Elements in Spain's Stimulus Package

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE								
MEASURES ADOPTED IN 2008	**Description**	**Objective**	**Quantified objectives (if established)**	**Timing**	**Budget**	**Instruments**	**Beneficiaries**	**Situation in 2011**
PLAN DE AHORRO Y EFICIENCIA ENERGÉTICA	This Plan included 31 measures grouped around three actions: mobility, buildings and electricity saving	✓ Renewable energy ✓ Green products ✓ Energy efficiency	*Environmental:* ✓ Saving of primary energy of 6,000 ktep /year. ✓ emission reductions per year:16MtCO_2 *General:* ✓ €4.104m in savings costs ✓ Reduction of oil imports by 10% in 2011	2008 - 2011 (linked to the Plan implemented in 2011)	€245m	• Direct public expenditure • Lower taxes or social contribution • Subsidy • Loans • Others	General	• 17 of the 31 measures have been implemented, 7% of the savings have been provided • Many of the measures pending are reflected in the Plan 2011

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PLAN ESPAÑOL DE DINAMIZACIÓN DE LA ECONOMÍA Y EL EMPLEO (I): APOYO A I+D	This Plan included 80 economic, financial and fiscal measures. It set out three areas of action for R & D: (a) Health, with actions aimed at increasing the competitiveness and the capacity of research and development of companies and institutions that operate in the health sector. (b) Energy: measures aimed at ensuring the energy supply, increasing the contribution of renewable energies and emerging energy technologies. (c) International excellence, with actions to promote the creation of new technology-based companies and to strengthen international cooperation in sustainable actions of excellence.	✓ Renewable energy ✓ Green products ✓ Technologies ✓ Infrastructure		2009	€490m	• Loans	Agents of the sector of health and energy	Implemented

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PLAN ESPAÑOL DE DINAMIZACIÓN DE LA ECONOMÍA Y EL EMPLEO (II): ACCIONES MEDIOAMBIENTALES	The Plan included 80 economic, financial and fiscal measures. This plan set out the following environmental actions: (a) programmes of water: infrastructure management of water, water quality, better management of water for irrigation. (b) actions on the coast: protection, defence and preservation of the sea and land public domain, performance in guarantee of coastal protection. (c) actions in rural areas: conservation of heritage and natural resources in rural areas. (d) forest policy actions.	✓ Green products ✓ Infrastructure ✓ Resource efficiency		2009	€575m	• Direct	General	Implemented

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PLAN DE COMPETITIVIDAD DEL SECTOR DEL AUTOMÓVIL	This aimed to improve the competitiveness of the motor vehicle sector in the segment of low emission vehicles, hybrid and electric vehicles	✓ Energy efficiency ✓ Green products ✓ Environmental friendly vehicles ✓ Technologies		2009-2011	€1,015m	• Subsidy	Agents for the automotive sector	Implemented
PROGRAMA DE VEHÍCULOS ECOLÓGICOS (I). PLAN VIVE	Line of financing to encourage car scrapping	✓ Energy efficiency ✓ Green products ✓ Environmental friendly vehicles ✓ Technologies	240,000 vehicles	2008-2009	€700m	• Subsidy	Agents for the automotive sector	Implemented

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PROGRAMA DE VEHÍCULOS ECOLÓGICOS (II). PLAN 2000E	Line of financing to encourage car scrapping	✓ Energy efficiency ✓ Green, products ✓ Environmental friendly vehicles ✓ Technologies	Provide funding to 480,000 vehicles (€240m/€500 vehicle)	2009-2010	€240m	• Subsidy	Agents for the automotive sector	Implemented
PROGRAMA DE VEHÍCULOS ECOLÓGICOS (III) PROJECT MOVELE	Line of financing to facilitate the acquisition of electric vehicles.	✓ Energy efficiency ✓ Green products ✓ Environmental friendly vehicles ✓ Technologies		2009-2011	€8m	• Subsidy	Agents for the automotive sector	Implemented

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PLAN RENOVE VIVIENDA	This plan was incorporated in the Plan Estatal de Vivienda y Rehabilitación 2009-2012, which provided 996,000 measures to allow citizens access to purchase and, especially in rental housing, promote the urbanisation of soil for social housing and improve the current housing stock. Refurbishment became part of the name of the Plan as a sign of the importance that it acquires in the scheme, which also incorporates the aid Renove for improving energy efficiency and accessibility	✓ Energy efficiency ✓ Protection of the environment in buildings and homes ✓ Use of renewable energy	Promote the refurbishment of 400,000 homes	2009-2012	Within the budget of the State Plan for housing and rehabilitation	• Buildings: agreed loans. • Housing: grants. • Loans	The construction sector	Within the budget of the State Plan for housing and rehabilitation
PLAN RENOVE TURISMO	The goal of this plan was to promote investments aimed at improving systems to promote energy and water savings, conservation and improvement of environment (e.g. recycled waste) improved security against fires and several other measures.	✓ Environmental infrastructure		2009	€400m		Agents in the tourism sector	Implemented. It supported 1,091 lending operations, which accounted for an induced investment of more than €800m and supported the creation of over 15,000 jobs.

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
LINE ICO-VIVE BUS 2009-2010	Line of financing for the improvement of the conditions of safety, environment, energy efficiency and accessibility of the bus system.	✓ Public transport ✓ Energy efficiency		2010	€236m	• Lending/leasing	Passenger transport companies	Implemented
LINE ICO FUTUR-E 2009	Line of financing of the tourism sector leading to an improvement in corporate sustainability indices. Actions that improve the energy efficiency of tourism facilities, involve savings of energy and/or water, as well as the introduction of new technologies and quality systems were funded.	✓ Energy efficiency ✓ Technologies		2009	€500m	• Loans	Tourism sector	Implemented. The final disbursement was €393.5m, which supported 1,426 operations.
ICO TURISMO FOMIT	Financial Fund of the State for the modernization of tourist infrastructures (FOMIT) grant loans with longer repayment terms, including periods of no return and low interest rates.	✓ Environmental infrastructure		2008-2010	€464m	• Loans	Tourism sector	From 2008 to 2010 the final disbursement was €353.1m, which supported 142 operations.

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PLAN DE IMPULSO AL TRANSPORTE DE MERCANCÍAS POR FERROCARRIL (This plan, which was introduced in 2010, develops the promotion PLAN DE IMPULSO AL TRANSPORTE DE MERCANCÍAS POR FERROCARRIL 2008, which is the one reflected in the previous questionnaire).	This plan aimed to increase the transport of goods by rail to improve intermodality and sustainability of the transport system. Specifically, the plan highlighted the role of the nodes of the rail network and connection to the trans-European networks. It was composed of more than 100 measures grouped into ten programmes and 44 actions, grouped in three strategic lines: new model of management system, quality of services and efficiency, and improvement of rail infrastructure.	✓ Energy efficiency ✓ Public transport	*Environmental.* Expected: ✓ €252m-€370m/ year of environmental benefit ✓ 375,000-525,000 T/yr of CO_2 savings ✓ heavy vehicles 19,000-27,000 equivalents/year ✓ 5-8 million trips per year *General:* ✓ Expected a reduction of up to 13% in operating costs as a result of the electrification of trains and up to	2010-2020	€7, 512m •€300m for the new model of management of the system • €100m for the quality of service and efficiency R & D; • €7,112m improve rail infrastructure	• Direct public expenditure		In 2011, this was already launched: -signing of a protocol with the Spanish Association of manufacturers of cars and trucks to develop a specific plan for the automotive sector, in order to double its share in the railway and putting it on 50% by 2020; -Design of a new model of organization in the area of goods of RENFE - operator; - reinforcement of the regulatory body and proceedings in the infrastructure to

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE								
MEASURES ADOPTED IN 2008	**Description**	**Objective**	**Quantified objectives (if established)**	**Timing**	**Budget**	**Instruments**	**Beneficiaries**	**Situation in 2011**
			40% by the lengthening of trains ✓ Reach a maximum of 77-100Mt in 2020. ✓ Reach an increase of the modal share of rail freight transport from the current 4.1% up to 8-10% in 2020.					allow trains of 750 meters and new railway access in ports.

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
FONDO DE ECONOMÍA SOSTENIBLE	This Fund financed investments in projects related to the environment and to knowledge and innovation. This Fund specifically could finance infrastructures aimed at improving energy efficiency, water management, eco-innovation, treatment and waste management, sustainable mobility, renewable energy the rehabilitation of housing, energy and climate change plus several other projects.	✓ Energy efficiency ✓ Infrastructure ✓ Environmentally friendly vehicles ✓ Housing		2010-2011	€10,000m	• Venture capital investment to finance infrastructure and energy (€1,000m) • (€300m) venture capital fund • Program of co-financing of the ICO and financiers • Loans for small and medium-sized enterprises (€8,700m)		The use in 2010 was €3,778.65m

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
LINEA ICO FUTUR-E 2010	Line of financing of the tourism sector leading to an improvement in corporate sustainability indices. Actions that improved the energy efficiency of tourism facilities, involved savings of energy and/or water, as well as the introduction of new technologies and quality systems were funded.	✓ Energy efficiency ✓ Technologies		2010	€400m		Tourism sector	1,426 Operations were conducted, and achieved an induced reversal of €176,000m. The hospitality industry was the largest applicant (75% of the total).
PLAN DE AHORRO Y EFICIENCIA ENERGÉTICA 2011	20 measures, which aimed to intensify efforts in three sectors: transport and mobility, building, lighting and electricity consumption	Strengthen the savings in these three sectors	*Environmental:* ✓ 3.2 Toe/year savings ✓ Reduction in 12.5 Mt/year CO_2 emissions *General*: ✓ Saving of €2,300m/ year	Some measures were implemented immediately, others in the medium and long term	€1,157m	• Direct public expenditure • Lower taxes or social contribution • Subsidy • Loans • Others	General	The Plan is of very recent adoption.

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PLAN DE AHORRO, EFICIENCIA ENERGÉTICA Y REDUCCIÓN DE EMISIONES EN EL TRANSPORTE Y LA VIVIENDA	This aimed to contribute to the economic recovery, increase energy efficiency, reduce CO2 emissions, reduce foreign energy dependence and promote the sustainability of the network of transport and housing.	✓ Administrative buildings ✓ Energy efficiency in transport ✓ Housing	*Environmental:* ✓ Reduction of CO_2 emissions	2011-2020	€805m	• Direct public expenditure		The Plan has just been adopted, but some of the measures are being implemented. In particular, of the 100 operational measures, 71 are new implementation and the 29 remaining, already in force, are reinforced by this plan.
LINE ICO FUTUR-E 2011	Line of financing of the tourism sector leading to an improvement in corporate sustainability indices. Actions that improve the energy efficiency of tourism facilities, involve savings of energy and/or water, as well as the introduction of new technologies and quality systems will be funded.	✓ Energy efficiency ✓ Technologies		2011	€300m	• Loans	Tourism sector	Being implemented

GREEN ELEMENTS IN SPAIN'S STIMULUS PACKAGE

MEASURES ADOPTED IN 2008	Description	Objective	Quantified objectives (if established)	Timing	Budget	Instruments	Beneficiaries	Situation in 2011
PLAN INTEGRAL DE IMPULSO AL VEHICULO ELÉCTRICO DE ESPAÑA	Within this plan is the comprehensive strategy to promote the electric vehicle in Spain		Achieve a stock of electric vehicles of 250,000 for 2014 (1% of the total number of vehicles in 2008)	2010-2012	€240m	• Subsidies		The disbursement for 2011 (€72m) has been approved.

2.4 Green recovery measures from selected non-EU countries

This section provides a summary of the green recovery measures that were implemented in the non-EU countries that were analysed. We cover four countries:

- Australia
- China
- South Korea
- USA

They are discussed in turn below.

Australia

Table 2.41: Australia's Stimulus Package

AUSTRALIA'S STIMULUS PACKAGE	
Size of stimulus package	€25.2bn (Jan 2008 exchange rates)
As a % of GDP	16% (GDP 260.6bn AUD in Q1.2008)
Size of green part	5.2bn AUD
As a % share of total stimulus package	10-13% (depending on definition)
Implementation period	2009-2012

Australia was one of the few countries that did not enter into a recession as a result of the economic crisis. In fact, in the second quarter of 2010, GDP was 3.8% higher than its pre-crisis level and domestic demand did not weaken much during 2009. Growth has picked up strongly since. Much of this is due to Australia's strong economic ties to Asia, where the crisis was much shorter and less severe compared to most OECD countries.

Australia benefited from its proximity to Asia, but a sound policy environment also prepared it to face external shocks. Monetary and fiscal policies reacted swiftly and strongly to the crisis. The structural reforms in competition, product and labour markets introduced in the 1990s made the economy more resilient, and a flexible exchange rate acted as a shock absorber, shielding the country from some of the swings in external prices and demand. More importantly, reforms to banking regulation in the 1990s and early 2000s, and strengthening of financial supervision and caution in bank lending, made the banking sector less vulnerable to the global financial turmoil. Also in terms of fiscal position, the country was in good shape prior to the crisis. Surpluses were about 1% of GDP, on average, between 1998 and 2008, and the general government held net assets equivalent to 7.5% of GDP at the end of 2008.

Legislation and budget

Australia responded to the crisis with two packages in October 2008 and March 2009. In 2009 the packages were combined under one name; Nation Building – Economic Stimulus Plan (The Plan). To speed up the implementation of the Plan, a special meeting of the Council of Australian Governments endorsed a National Partnership Agreement on the Nation Building and Jobs Plan: Building prosperity for the future and supporting jobs now, which requires the Commonwealth, State and Territory Coordinators-General to report regularly to the Council of Australian Governments

meetings[38]. In January 2011, two years after the Plan was put in place, almost 50,000 projects were delivered, 98% of approved projects were started, and 75% of major infrastructure projects were completed (Australian Government, 2011).

Energy efficiency Almost €2.4bn of the Australian stimulus package is devoted to The Energy Efficiency home package. The main part of this is used to provide free ceiling insulation to 2.7m homes in Australia (HSBC, 2009b).

Around 23% of Australian household emissions come from water heating. In the Plan, a Renewable Energy Bonus Scheme (REBS) was set up to assist households in reducing their energy bills and carbon footprint. The rebate included a 1,000 AUD for solar hot water system or 600 AUD for a heat-pump system.

Rail A total of 1.189bn AUD was allocated for the Australian Rail Transport Corporation (ARTC) to fund 17 rail projects. The projects focused specifically on *the interstate rail network, reducing transit times between major cities and annual maintenance costs by millions, improving ride quality, and raising line capacity through increasing travelling speeds in hot weather and axle loads*[39]. By January 2011, all the projects had been approved, 15 had started, and eleven projects were completed. The Plan has created a national single standard gauge freight rail network which connects all mainland states, improving the efficiency and competitiveness of freight rail[40].

Summary Australia has decided to invest substantial sums into energy efficiency in housing. This is understandable when considering the large losses in energy due to insufficient insulation and inefficient heating/cooling devices. The rail investments are also a large investment and are expected to significantly improve the competitiveness of rail freight and reduce road haulage. Australia's recovery package, however, does not include much funding for renewable energy, water or environmental management. It should be mentioned that the Australian government launched a 4.5bn AUD Clean Energy Initiative (CEI) in the 2009-2010 budget. This initiative has, however, not been included in the analysis since it was taken outside the recovery package.

Table 2.42: Australian Spending on Green Funds

AUSTRALIAN SPENDING ON GREEN FUNDS (BN AUD)						
Package	**Funds planned**	**Green**	**Period**	**Funds spent**	**Energy efficiency**	**Rail**
Nation Building – Economic Stimulus Plan	42	5.2	2009-2012		4	1.2
Total	**42**	**5.2**				

[38] See http://www.economicstimulusplan.gov.au/pages/theplan.aspx

[39] See http://www.economicstimulusplan.gov.au/road_rail/pages/default.aspx

[40] See http://www.economicstimulusplan.gov.au/infocus/pages/if_190310_artc.aspx

China

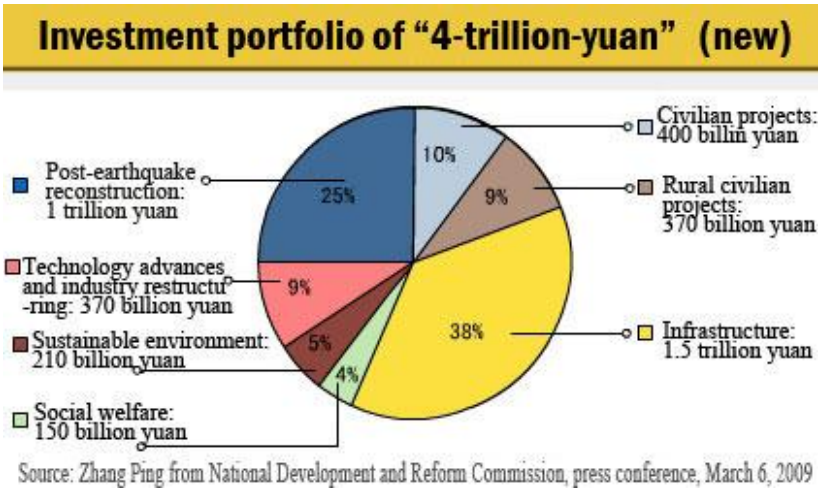
Table 2.43: China's Stimulus Package

CHINA'S STIMULUS PACKAGE	
Size of stimulus package	$648bn (HSBC 2010)
As a % of GDP	~ 13%
Size of green part	$214bn
As a % share of total stimulus package	33%
Implementation period	2008-2010

China is a somewhat Janus-faced country in terms of green stimulus and green recovery. On the one hand, China is competing for the title as the world's largest emitter of GHGs and sustaining heavy industry and rapid economic growth exacerbate environmental problems. On the other hand, China is investing large amounts into green measures, such as energy efficiency and environmental management. In more recent years, China has also actively sought innovative financial solutions to environmental problems such as green insurance, green tax and security systems (Aizawa and Yang, 2010).

When the crisis hit China, it responded rapidly with immediate plans to boost financial security equalling 2-4% of GDP over 2009 and 2010. China, together with US, has by far the largest stimulus packages and green parts thereof. The main green investments were found in rail, electricity grids and water related actions (HSBC, 2009a). When announcing the stimulus package, the minister of the National Development and Reform Commission, Zhang Ping, claimed that none of the RMB4 trillion programme would go to resource and energy-intensive industries or major polluters[41]. Figure 2.2 shows a slide that was presented by Mr. Zhang.

Figure 2.2: China's Investment Portfolio



The following measures have been identified.

[41] See http://www.chinadaily.com.cn/bizchina/2008-11/27/content_7246713.htm

Energy efficiency

The Chinese sustainable development strategy is very dependent on gains made in energy efficiency. Consequently, most of the funds are spent on energy-efficiency projects. If one includes the grid and rail as energy-efficiency measures, the total amount represents 84% of the green parts in the stimulus package, or about $179bn (Barbier, 2011).

Regarding railways, a major part of the Chinese stimulus package went to investments in infrastructure. Between 2009 and 2010, the goal was to build 16,000 km of railways and invest RMB600bn by the end of 2009 (HSBC, 2009a).

The second largest part of infrastructure investment was allocated for more sophisticated grids enabling better take-up of renewables and cutting transmission losses (HSBC, 2009a). Over 2009-2011, RMB 1.1 trillion has been designated to grid improvements.

Car scrappage

In a plan for the car sector introduced in January 2009, China made a 5% reduction in sales tax on cars with an engine size less than 1.6 litres. It also announced a $1.5bn subsidy package in alternative energy for cars, keeping in mind the aim to mass-produce electric cars (HSBC, 2009a). The rebates were set between $450 and $900 and the government aimed to retire 2.9m more heavily polluting cars by the end of the programme in May 2010. Rural areas were particularly targeted with incentives for farmers to buy cars, trucks and motorcycles[42].

Nature protection

According to China Daily, the Chinese government aimed to spend RMB350bn on environmental improvements and cleaning up pollution[43]. This was later reduced to RMB210, equalling roughly $30bn.

Summary

The greenness of the Chinese recovery package depends heavily on the definition of green. There are major investments on energy-efficiency measures, such as rail and grid development (rail somewhere around $100bn) which are included in the analysis. It is also remarkable that no funds went to renewables. It is unclear, however, to what extent banking guarantees and loans have trickled down to renewable energy projects.

Table 2.44: Green Elements in China's Stimulus Package

GREEN ELEMENTS IN CHINA'S STIMULUS PACKAGE		
Measure	**Description**	**Budget**
Car scrappage	China made a 5% reduction in sales tax on new cars with engine sizes less than 1.6 litres	$400m
R&D for alternative energy vehicles		$1.5bn
Energy efficiency (Mainly grid and rail)	2009-2010	~ $179bn
Nature conservation/management		$30bn
TOTAL		**$214bn**

[42] See http://freegovreports.com/index.php/auto/245-comparison-of-qcash-for-clunkersq-to-programs-in-other-major-industrial-countries

[43] See http://www.chinadaily.com.cn/bizchina/2008-11/27/content_7246713.htm

South Korea

Table 2.45: South Korea's Stimulus Package

SOUTH KOREA'S STIMULUS PACKAGE	
Size of stimulus packages	US$76.1bn
As a % of GDP	5% (Based on 2010 estimated GDP)
Size of green part	US$59.9bn
As a % share of total stimulus package	78.7%
Implementation period	2009-2012 (Green New Deal)

South Korea was one of the G20 economies hit hardest by the financial and economic crisis, largely due to its large export share. GDP shrank by 3.4% in Q4 2008, pushing the economy toward its first recession since the Asian Crisis in 1997. The won had depreciated by 24.5% in October 2008 compared to the beginning of the year. The stock market dropped 31.4% over the same period. Exports fell by almost 34% in January 2009 on a year-to-year basis.

However, thanks to low levels of government debt and an efficient, top-down government execution style, South Korea was able to quickly set up a deficit-financed stimulus package and implement it in a short period of time (Werner Pascha, 2010).

Legislation and budget

The total size of South Korea's stimulus packages is $76.1bn. It is composed of two main stimulus packages that were introduced in December 2008 and January 2009, plus some subsequent plans. The first stimulus package, equivalent to US$26bn in value, was called the '2009 Budget and Public Fund Operation Plan to Overcome Economic Difficulties' and aimed at infrastructure, including the projects to advance the metropolitan economy and provincial traffic network expansion. The second stimulus package, equivalent to $38.1bn in value, was called the 'Green New Deal Job Creation Plan' (Green New Deal), and was highly focused on climate-related investment themes.

Within all the stimulus packages, projects related to green-schemes amounted to $59.9bn, or around 79% of the total value. This is a significantly high portion of total stimulus budget in comparison with rest of the countries considered in this report.

Furthermore, South Korea later outlined a strategy to develop the short-term green stimulus plan into a long-term programme. In July 2009 the Korean government expanded the Green New Deal into a mid to long-term plan called the 'Five-Year Plan for Green Growth'. Under the plan, US$83.6bn was committed to spend in the area of climate change and energy, sustainable transportation, and the development of green technologies, over a period from 2009 to 2013 (UNEP, 2010).

Regarding the actual spending of the green stimulus, South Korea was particularly efficient, with almost 20% of funds being allocated during the first half of 2009. It is estimated that $26bn was disbursed in 2010 (HSBC, 2010).

Low-carbon power

Approximately $30.9bn, including $15bn in the Green New Deal and another $15.9bn in the subsequent Five-Year Plan, was designated to spend on low-carbon power. It accounts for 52% of the green elements of Korea's green stimulus packages.

Energy efficiency

In total, $15.2bn, equivalent to 25% of total green stimulus package, was committed to spending on energy efficiency. It includes projects for building energy efficiency in

villages and schools, fuel-efficient vehicles, and low-carbon mass transit, such as low-carbon railways, bicycle tracks, and other transport systems (HSBC, 2009).

Water and waste Water

Water and waste water projects are an important part of the Green New Deal, amounting to $13.8bn in spending, i.e. the remaining 23% of the green stimulus package. The major components of this part are river and forest restoration, small and medium-sized dams, resource recycling, and national green information infrastructure. A large portion of early stimulus package expenditures was related to the Four Major Rivers Restoration Project. The project includes the restoration of four major rivers (Han, Nakdong, Geum, and Yeeongsan) and a number of related projects on tributaries. It includes measures to tackle water scarcity issues by building 16 weirs and three small and medium-sized multipurpose dams (UNEP, 2010).

Summary

South Korea responded quickly to the economic downturn with two main stimulus packages. Among them, green stimulus plans accounted for 78.7% of total spending, a significantly large portion of the total packages. Low-carbon power, energy efficiency, as well as water and waste water are three key areas that were selected to receive investments under the Green New Deal. This has subsequently been extended in the Five-Year Plan.

Table 2.46: Green Elements in the South Korea Stimulus Package (US$59.9bn)

GREEN ELEMENTS IN THE SOUTH KOREA STIMULUS PACKAGE (US$59.9bn)			
	Green New Deal	**Subsequent Five-Year Plan**	**Total Green Stimulus**
Low-Carbon Power	15.0	15.9	30.9
Energy Efficiency	1.9	13.3	15.2
Water and Waste Water	13.8	0.0	13.8
Total	30.7	29.2	59.9

USA

Table 2.47: The USA's Stimulus Package

THE USA'S STIMULUS PACKAGE	
Size of stimulus package	US$976.9bn (EESA $185bn, ARRA $787bn and Budget 2010 $4.9bn)
As a % of GDP	7%
Size of green part	US$117.7bn (EESA $18.7bn, ARRA $94.1bn and Budget 2010 $4.9bn)
As a % share of total stimulus package	12%
Implementation period	2009-2019 (EESA 2009-2018, ARRA 2009-2018 and Budget 2010)

Legislation and budget

In the US, direct fiscal stimulus came through Public Law 110-343 of October 2008 (the so called 'troubled assets' law), the American Recovery and Reinvestment Act of 2009, and other legislation with stimulative effects.

The troubled assets law has three divisions: Division A (the Emergency Economic Stabilization Act of 2008 which includes the Troubled Asset Relief Program); Division B (the Energy Improvement and Extension Act of 2008); and Division C (the Tax Extenders and Alternative Minimum Tax Relief Act of 2008).

The American Recovery and Reinvestment Act, hereafter ARRA, (Public Law 111-5) was signed into law in February of 2009. It authorized $288bn for Federal tax cuts and $499bn in Federal government spending. The policies were to be phased in over time, with $200bn occurring in the fiscal year 2009, $404bn occurring in the fiscal year 2010, and the remainder occurring in the fiscal year 2011 or afterwards.

In addition, the proposed federal budget for 2010 included $4.9bn to be allocated to a high-speed rail state grant, the Environmental Protection Agency's Clean Water State Revolving Fund and the Drinking Water State Revolving Fund.

The total stimulus package was estimated at $977bn, or roughly 5.8% of GDP, and was to be spread over a ten-year span. In 2010, the Congressional Budget Office (CBO) revised its estimates for the total cost of the stimulus up by $75bn due to rising costs for programmes like food stamps and unemployment insurance (Council of the Economic Advisors, 2010).

According to the CBO $120bn would be spent in the first year and by 2010, 70% of the stimulus package would be spent. The tax provisions were to extend over ten years. HSBC estimates that the green share of the combined measures amount to $117.7bn, or 12% of the total stimulus package.

EESA 2008

The Emergency Economic Stabilization Act of 2008 includes numerous federal tax breaks for energy-related expenditures and activities, such as:

- A new business and personal tax credit for plug-in electric vehicles. This tax credit for plug-in electric vehicles applies to qualifying new cars that are purchased by individuals and businesses. The minimum credit is $2,500 for a vehicle powered by a traction battery with capacity of at least 4 kilowatt hours. An additional credit of $417 is allowed for each additional kilowatt hour of traction battery capacity until the applicable credit cap is reached. The cap is $7,500 for lighter vehicles. However, for heavy vehicles with gross vehicle weight ratings (GVWRs) in excess

of 10,000 pounds, the cap is $10,000, $12,500, or $15,000 depending on the GVWR.

- An extended and expanded Business Energy Tax Credit, which extends the business energy tax credit for qualifying solar, fuel cell, micro-turbine, and geothermal energy equipment for eight more years, to cover property placed in service through 2016. Examples are i) increased credit for fuel cell equipment placed in service after October 3, 2008; ii) qualified wind energy equipment, geothermal heat pump systems, and combined heat and power system equipment placed in service in tax years ending after October 3, 2008 are made eligible for the credit; and iii) public utility property placed in service in tax years ending after February 13, 2008 is also made eligible for the credit.
- Credit up to 2016 (extended from 2008) for residential energy-saving expenditures, including solar and wind equipment.
- A separate credit for installing energy-efficient insulation, windows, doors, roofs, and heating and cooling equipment in houses which expired in 2007 was restored (with some minor changes) for 2009 while skipping over 2008 entirely.
- The deduction for making commercial buildings energy efficient was extended. This new law extended the provision allowing deductions (instead of capitalization) for the cost of qualified energy-saving improvements to commercial buildings in the US for five more years, to cover property placed in service through 2013.
- The business and personal tax credit for alternative fuel vehicle refuelling property was extended and expanded. The tax credit for up to 30% of the cost of installing non-hydrogen alternative fuel vehicle refuelling property for one more year, to cover property placed in service was extended through 2010. This credit could be claimed for a gas station's expenditures to install ethanol, compressed natural gas, or hydrogen refuelling pumps (among other types of alternative fuel refuelling equipment). An individual can claim a non-business credit based on 30% of the cost of installing such equipment at his or her principal residence. The new law added electricity to the list of 'clean burning fuels' for purposes of the credit. So the cost of installing equipment to recharge batteries in electric-powered cars will now qualify for the credit, effective for equipment placed in service after October 3, 2008.
- The contractor tax credit for building energy-efficient homes was extended for one more year, through 2009. The new law applied to the $2,000 per-home contractor tax credit for building new energy-efficient homes in the U.S. (including manufactured homes). The credit could also be claimed for substantially reconstructing and rehabilitating an existing home and making it more energy-efficient. Manufactured homes that don't fully meet the energy-efficiency standards could qualify for a reduced $1,000 credit. To qualify, a home must have been sold by December 31, 2009 for use as a residence.
- The tax credit for manufacturing energy-efficient appliances was extended and modified for producing energy-efficient dishwashers, clothes washers, and refrigerators in the US for three more years, to cover appliances manufactured through 2010. For 2008 to 2010, the per-appliance credit amounts ranged between $45 and $250 depending on the year, the type of appliance, and the degree of energy efficiency.
- A new employee fringe benefit for bicycle commuters created a tax-free fringe benefit for employees who commute to work on bikes. This change was effective

for tax years beginning in 2009 and beyond. Under the new provision, an employer could give employees tax-free reimbursements to cover reasonable expenses to buy, improve, repair, or store bicycles regularly used for commuting to work. However, the tax-free reimbursements were limited to $20 for each month of bicycle commuting. So the maximum annual tax-free reimbursement was $240.

EESA extended the Production Tax Credit for wind, which was scheduled to expire at the end of 2008, through 2009. The Recovery Act further extended the credit through 2012. The Act also introduced the 1603 Energy Cash Assistance grants, which allow businesses to apply for a grant equal to 30% of the cost of the investment instead of claiming the production tax credit. In the tight credit conditions that prevailed during much of 2009, the 1603 grants allowed firms to receive up-front financing for projects. To date, firms have received more than $4bn through the 1603 grant programme, about 90% of which has gone to wind producers[44].

With these programmes in place, more than 10,000MW of summer wind capacity was installed in 2009, an annual growth rate of 40%. Assuming that a January 2009 production tax credit expiration would have had the same 27 percentage point growth impact as in the early 2000s, the growth rate would have been 13%, and the level of wind energy capacity in 2009 would have been nearly 20% lower. Thus, it appears that government support was responsible for about 6,000MW of wind capacity installation that might not otherwise have occurred. Moreover, the challenging credit conditions during 2009 and the introduction of the 1603 grant programme in the Recovery Act suggest that the overall effect on wind capacity installation may have been even larger.

The American Council for an Energy Efficient Economy (ACEEE) estimates that over 2006-20, the extended tax incentives could reduce consumer energy bills by $27bn, prevent more than 51m metric tons of carbon emissions, and reduce capacity required for peak electric demand by more than 6,000 MW (equivalent to the capacity of 20 medium power plants). According to Alliance analysis, based on scoring by the Joint Committee on Taxation, the extensions will have a ten-year cost to the Treasury of around $2.1bn and the new incentives will cost another $2bn.

By making new energy-efficient technologies more affordable, these tax incentives can not only lower energy prices by reducing demand, but can also generate innovative new industries with new jobs, improve the reliability of the electricity system, and reduce air pollution and greenhouse gas emissions.

This Act includes $100bn in tax breaks for businesses and the middle class, plus a provision to raise the cap on federal deposit insurance from $100,000 to $250,000.

ARRA 2009

The purpose of ARRA was to preserve/create jobs and promote recovery, assist those most hurt by the recession, invest in infrastructure, and stabilize state and local government budgets. ARRA authorized purchases of goods and services by the federal government, transfers to state and local governments, payments to individuals, and temporary tax reductions for individuals and businesses. In total, these initiatives were expected to provide $150bn in economic benefits for the American economy and speed the path to recovery. Nine programmes were defined under ARRA of which programmes five and nine contain green elements:

[44] See White House website http://www.whitehouse.gov/administration/eop/cea/factsheets-reports/economic-impact-arra-4th-quarterly-report/section-5 accessed on 20/05/2011

1 Community Development Financial Institutions (CDFI) Program

2 Native American CDFI Assistance (NACA) Program

3 New Markets Tax Credit (NMTC) Program

4 Economic Recovery Act Payments

5 Tax Provisions Program

6 Health Insurance Tax Credit Administration Program

7 Tax Provision Oversight*

8 Cash Assistance to States in Lieu of Low-Income Housing Tax Credits

9 Cash Assistance for Specified Energy Property in Lieu of Tax Credits

Under the Tax Provisions Program, 30 specific tax provisions were aimed at providing $288bn in tax relief to households and businesses intending to reduce the tax burden during a time of economic stress and spur economic growth. The provisions ranged from individual credits to renewable energy and energy conservation incentives, tax incentives for businesses and tax benefits for specified state and local government bonds. Provisions with a 'green' element were:

- *Energy Efficiency and Renewable Energy Incentives*. Energy users and producers who utilize renewable energy sources or improve energy efficiency may be eligible for tax incentives.
- *Money Back for New Vehicle Purchases.* Taxpayers who buy certain new vehicles in 2009 could deduct the state and local sales taxes they paid.
- Build America Bonds. State and local governments would be more readily able to finance school construction, energy and other public projects through issuance of tax exempt bonds.

Under the measure *Cash Assistance for Specified Energy Property in Lieu of Tax Credits*, taxpayers were allowed to claim a production tax credit for electricity produced by certain renewable energy facilities and an investment tax credit for certain renewable energy property. These tax credits were designed to help attract private capital to invest in renewable energy projects. This funding operated like the current-law investment tax credit. The Treasury Department issues a funding in an amount equal to 30% of the cost of the renewable energy facility within sixty days of the facility being placed in service, or within sixty days of receiving an eligible application.

According to the US Council of Economic Advisers (CEA), the ARRA boosted GDP by around 2% in 2009. The CEA estimates that the clean-energy segments of the ARRA saved or created around 52,000 clean-energy jobs and supported another 11,000 jobs throughout the US. It is expected that more than 60% to 70% of spending on green stimulus will have come in 2010 and 2011.

As of May 2011, payments under ARRA amounted to $643.8bn of the total $787bn (82%). This is divided over three categories: $259.9bn in tax benefits, $183bn as entitlements and the rest ($200.9bn) on contracts, grants and loans. Assuming that the share of the funding defined as 'green stimulus' calculated in the HSBC document 'Delivering the green stimulus', we arrive at $77.3bn in green stimulus. We use the same sub-divisions as used in that paper,

Renewable energy

Structural policies were pursued through an extension of a tax credit for renewable energy production ($13.1bn), as well as funds for investment in new energy transmission networks and health information technology ($25.1bn). Infrastructure spending amounts to $120bn, as well as an additional $40bn for investments in energy infrastructure (particularly so-called smart grid technology).

Some 9.9 GW of wind installations were added in the US in 2009, a record high. This increased installed wind capacity to 35 GW and raised the five-year CAGR to 39% from 32% between 2003 and 2008. According to the Department of Energy (DoE), the stimulus in the renewable sector will leverage $43bn of private capital by 2012.

Created under Section 1603 of the Recovery Act, the Treasury grant programme was designed to give cash grants of up to 30% of project cost in lieu of a tax credit. Up to mid-2010, $2.5bn had been awarded, supporting projects worth $8.2bn. No limit has been set on spending; all projects submitting applications before the deadline of 1 October 2011 qualify for the grant. The DoE estimates suggest this could support $10bn to $14bn of renewable-energy investments. Wind accounts for 85% of the grants. All these grants support 2.43 GW of new wind power in 2009/10, which is expected to reach 15 GW by the end of 2011.

Energy efficiency

The much-anticipated loan guarantees for commercial renewable projects under the ARRA have started to stimulate renewable-energy investments. The Weatherization Assistance Program appropriated $6bn, but has spent only $0.5bn. The Energy Efficiency and Conservation Block Grant programme has spent just $85m of the $2.3bn appropriated for US states. Historically, the State Energy Program has saved more than $7 in energy costs and leverages private investment of $10 for every dollar of federal investment. To date, the Department of Transportation has awarded $8bn to high-speed rail. A further $2.8bn has been awarded under the Smart Grid Investment Grant Program, but actual spending is only $5.4m. Eventually, the $4bn stimulus for smart grid is expected to leverage $5.5bn from the private sector. Finally, the Department of Defence has appropriated $355m for energy-efficiency measures.

Carbon capture and storage

The ARRA provides $3.4bn for CCS research and deployment and is designed to attract $7bn in private capital. Some $0.96bn has been awarded, of which $7.7m has been spent, focussing on industrial CCS applications.

Table 2.48: Selected Economic Indicators, USA (2007-10)

SELECTED ECONOMIC INDICATORS, USA (2007-10)				
	2007	**2008**	**2009**	**2010**
Change in real GDP growth rate from previous year (pp)	-0.8	-1.9	-2.7	5.6
Inflation (annual change in consumer prices)	2.9	3.8	-0.9	1.6
Gov't deficit (% of GDP)	-2.9	-6.3	-11.3	-10.5
Current account balance % of GDP)	-5.1	-4.7	-2.7	-3.4
Unemployment (% of working population)	4.6	5.8	9.3	9.7

Source(s): OECD.

Table 2.49: US Spending on Green Funds

US SPENDING ON GREEN FUNDS ($BN)							
Package	**Funds Planned**	**Green**	**Period**	**Funds Spent**	**Low Carbon Power**	**Energy Efficiency**	**Water/ Waste**
EESA	185	18.7 (10.1%)	'08-'17	185	0.3	0.9	0.5
ARRA	787	94.4 (12.0%)	'09-'18	644	21.8	42.7	12.8
Federal budget '10 –'11	3,550*	4.9 (1.4%)	…	…	..	…	...
Total	982	118	…	829	22.1	43.6	23.3

Note(s): * included for illustrative purpose only (not included in the total).

3 Assessment of Member States' Green Recovery Plans

3.1 Introduction

Task 4 of the project aimed to analyse the macroeconomic and environmental impacts of the identified green recovery measures, using the assessment framework described in the following section. This chapter presents the results from the assessment that was carried out and is split into a section for each of the countries included.

The general structure for the presentation of results is to give a summary of the economic and environmental impacts of all the green measures for each country combined. A description of the assessment methodology used and an overview table based on the assessment criteria are also provided for each country.

Additional results on a policy-by-policy basis are presented in Appendix A.

3.2 The assessment framework

With a broad range of implemented policies to evaluate, and a similarly broad range of output indicators to consider (see Figure 3.1, for the criteria taken from European Commission (2009c)[45]), a flexible and general assessment framework is required. This is described in detail in Appendix B but can be summarised as a combination of the following:

- macroeconomic modelling
- flexible quantitative analysis
- qualitative assessment

The list is in a rough order of preference. However, no policy or indicator could be addressed exclusively using a single approach.

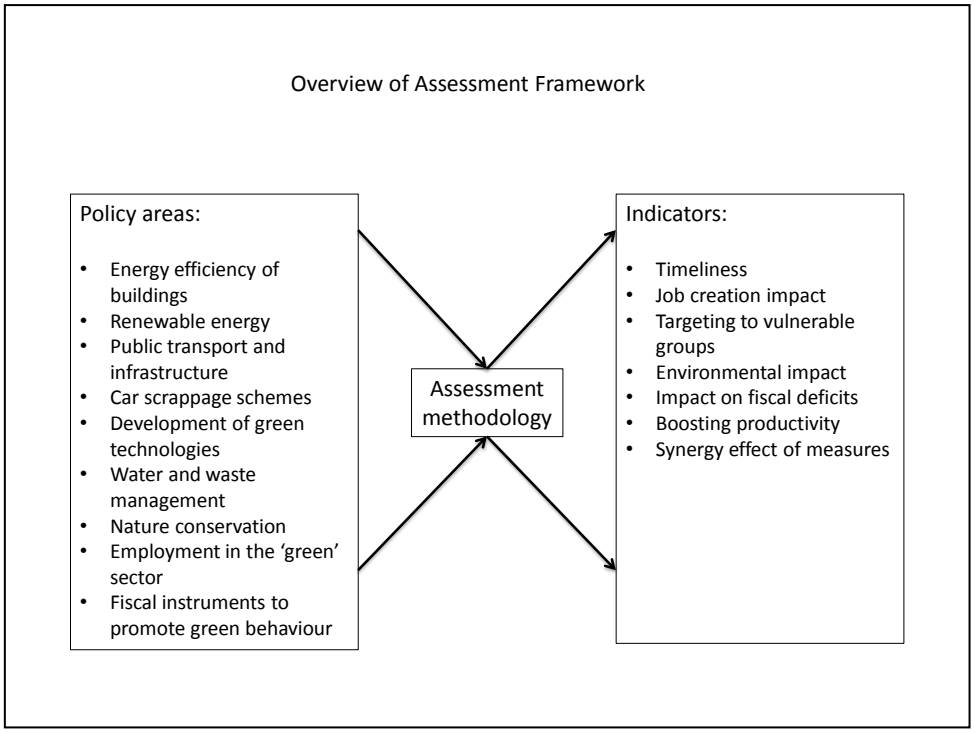
For the macroeconomic modelling the E3ME model was used. It is described in more detail in Appendix C or at www.e3me.com.

For many policies there is a strong interaction between the different assessment methodologies. For example, when considering investment in energy efficiency (see next section) an initial basic quantitative assessment is carried out to estimate direct impacts. This is then used as the basis for a model run to determine indirect impacts on a sectoral and macroeconomic basis.

[45] The impact on fiscal deficits has been added to that list. The assessment of policy synergies has been removed from the final list as it is more relevant to the non-green elements and is therefore beyond the scope of this assessment.

The assessment framework is described in more detail in Appendix A.

Figure 3.1: Overview of Assessment Framework



3.3 Assessment approaches to common policies

There are some policies that were implemented in several Member States and can therefore be assessed using similar methodologies. To avoid repeating the methodology in later sections, the most common ones are outlined here. They are:

- investment in energy efficiency
- car scrappage schemes
- investment in renewable energy

The assessment methodology for each one is described below.

Investment in energy efficiency

To model investment in energy efficiency, the following are required:

- the level of spending
- the area of spending (e.g. buildings, transport, industry)
- the impact on energy consumption
- timing

The value of the investment (in millions, or billions, of euros) and where it was made can be obtained directly from the national recovery plans, but the resulting increase in energy efficiency must be estimated. The calculation for the reduction in energy consumption is based on the findings from the *World Economic Outlook* (IEA, 2010), which suggests how much additional investment is required from the buildings, transport and industry sectors to achieve a certain reduction in energy consumption by 2035. This reduction is based on the difference between energy consumption in the Current Policies scenario, a baseline scenario in which policies already formally

adopted and implemented are taken into account, and the 450ppm scenario, in which the global increase in temperatures is (hopefully) limited to 2°C.

Using the additional investment and energy reduction figures from the WEO, we are able to estimate the percentage reduction in energy consumption for a €1m investment in each of the sectors. We can then multiply this by the investment figures we have from the national recovery plans to estimate a reduction in energy use that can be used as an input to the E3ME model.

Clearly this gives a rough indication and for each policy it is necessary to consider specific factors that may affect this ratio. However, it gives a rough indication and provides a consistent basis for carrying out the assessment.

Additionality

Throughout the assessment, we have assumed that the investment (apart from vehicles, see below) is additional. For buildings this is probably reasonable at least in the short term, as this type of investment largely stopped during the recession. Looking further ahead it is possible that some of the benefits could be lost (e.g. if the building is knocked down or the measures would have been taken anyway) but the evidence shows that these investments have not been made in the past, even when cost effective.

For investment in efficient industrial processes (which was a much smaller part of the packages) the same arguments largely hold. Although the lifespan of industrial equipment is shorter than buildings, the figures from WEO suggest that energy savings can be made more cheaply in industry than in buildings.

In summary, the assumption is reasonable in the short term recession period, but the longer-term impacts of the investment may be slightly overstated.

Car scrappage schemes

Car scrappage schemes formed a key part of the stimulus packages that were announced in several European countries. Whether they can be classified as green measures depends on the restrictions that were placed on the choices of new types of cars.

Possible modelling approaches

With some preliminary calculations, it is possible to model car scrappage schemes and other measures aimed at encouraging consumers to purchase low-carbon vehicles. However, although E3ME is able to give an estimate of economic and labour market impacts, a transport model such as TREMOVE would be much better suited to assessing the environmental impacts. The reason is that TREMOVE includes details of fleet composition, use and efficiency, while E3ME includes only aggregate energy consumption by road transport; reductions in fuel consumption must therefore be estimated outside the E3ME framework.

A combined approach would be ideal and, although that is not feasible in this study, we can incorporate the results published in a paper by the OECD (OECD, 2011) for France and Germany (and the US). For other countries (Portugal and Slovakia, and also an initiative by the UK government which involved providing a £4,500 subsidy for every electric or hybrid vehicle purchased) we have adopted similar assumptions.

Forming model inputs

The model inputs needed for the E3ME analysis are:

- the initial investment
- the amount of additional spending on motor vehicles
- the resulting reduction in fuel used
- timing

The following paragraphs describe the methodology that was used to calculate figures for the reduction in fuel use in each country. The UK was a slightly different case in that no scrappage of an old car was required for the subsidy, so this is described separately in Section 3.12.

1 To obtain the number of cars included in the schemes, the total value of the scheme was divided by the subsidy per car. For the scrappage scheme in France we were able to obtain the actual numbers of cars bought under the scheme. Average figures for gCO_2/km for a new car in 2010 were obtained from research carried out by JATO (JATO, 2011). These were compared with figures for average emissions of all cars on the road (calculated using time-series data for average emissions for new cars[46] and the number of cars of each age[47]). This difference in gCO_2/km was then divided by 1,000 to give the figures in $kgCO_2$/km.

2 The national shares of cars with petrol engines and the share of cars with diesel engines were obtained from Eurostat for France and Germany. There were no data for Portugal so figures were obtained from The Spanish Automobile Association (Anfac, 2010). A European average figure published by the European Commission (European Commission, 2010d) was used as a proxy for Slovakia since no other data were available.

3 Using these national shares, the weighted average of the difference in $kgCO_2$/km was divided by the respective conversion factors for petrol and diesel (0.24 and 0.25 respectively), to obtain a figure in kWh/km. This figure was divided by a conversion factor of 11,630 to obtain the figure in tonnes of oil equivalent (toe)/km.

4 The national average annual distance travelled by a car was obtained from national sources for each country.

5 This average annual distance was multiplied by the number of cars included in the scheme (calculated in step 2) and by the figure calculated for toe/km in step 3 to give total energy saved in toe. This calculation provides figures for the direct impact on energy use and emissions. These figures can then be inserted into the E3ME model, along with the investment figures, to give indirect and whole-economy effects.

The results were compared with those from the OECD study (OECD, 2011) for France and Germany in the first year of the scheme. Despite using a much simpler methodology, the reductions in energy use and CO_2 emissions were fairly similar in magnitude. We thus apply the same approach to other countries. Beyond the first year of impact, we incorporate the pattern of the TREMOVE results based on fleet composition to get a benefit that declines over time (i.e. as the new cars become old themselves).

[46] See European Commission (2010b), European Commission (2010d).

[47] See Anfac (2010).

The additional consumer spending on vehicles is calculated by multiplying the number of cars included in the scheme by the average price of a new car in each country[48]. This is then also entered into the model as an increase in household spending.

Key assumptions

It is recognised that several assumptions have been made in order to carry out the analysis of the scrappage schemes and the results should only be considered as approximations. Some of the main assumptions are outlined below; these points go beyond the scope of our study, but are issues that could be further explored.

First, there is the issue of how much of the household consumption entered into the model is actually additional. For instance, some consumers may have purchased new cars anyway, regardless of whether the scheme existed or not. Others may have brought spending forward from a future period, while others may have bought a used car but instead decided to buy a new car. In this analysis we assume all the spending on new cars is additional, on the basis that spending on cars had fallen to very low volumes in the recession. We are also assuming that the additional spending comes from households only, as opposed to households and businesses. Furthermore, we assume that the money spent by households on cars is from savings and not from spending less on other things.

This is broadly consistent with the findings described by IHS Global Insight which suggest that the substitution effects would be small and spread over several years (IHS Global Insight, 2010). However, it should be noted that this is a key assumption; if the spending was diverted from elsewhere, the net economic impact of the car schemes would be close to zero and our results would overstate benefits. This is discussed further in the Chinese case in Section 4.3, where the assumption is less likely to hold.

Second, we assume that the fleet of cars in the forecast period is only changed due to the transactions directly related to the scrappage scheme, thereby excluding any impacts of the scheme on car sales before or after. For example, new car sales in the years immediately after the end of the scheme are likely to be low, as a disproportionate number of new cars have already been bought. The emissions (and fuel consumption) profile has been imposed to be similar to that found in OECD (2011); Germany has been used as a proxy for countries that were not included in that study.

The calculations performed in Step 1 above enables us to work around the problem of not knowing the average age of the cars scrapped in each scheme. The Anfac data available provides the number of cars of ages up to ten years old (i.e. one year old, two years old etc.). The data series is extrapolated after this up to 1995. Using time series of emissions for new cars in each year, we are able to obtain the average emission level of all cars on the road. This average can then be used as a proxy for the cars scrapped in each scheme.

We have assumed that average annual mileage remains the same before and after the scheme, however, this figure is likely to increase after the scrappage scheme. This is because the new fleet of cars is more reliable and fuel-efficient; therefore drivers are likely to use them more frequently. In keeping the average distance constant we are thereby assuming that the scrapped car was used just as frequently as the new car will be. OECD (2011) discusses this further.

[48] The average price is calculated by taking an average of all the prices listed in the most recent Car Price report published by the European Commission (see European Commission, 2010c).

It is worth noting that we have assumed the shares of petrol vs. diesel engines remain the same before and after the scheme. This may not be the case in reality, however. For example, the car scrappage scheme in France included a requirement that the new car must have emissions of less than 160 gCO_2/km. This led to a large number of diesel cars being purchased since they have low fuel consumption and low CO_2 emissions. OECD (2011) is able to take this into account with the more detailed data available.

Investment in renewables

Some of the green measures identified in the national recovery plans include investment in renewable energy sources, such as wind and solar energy. These measures were all assessed using E3ME and, in particular, its energy technology model (see Barker et al, 2007). The model inputs required are the initial investment in monetary terms which can be converted to investment measured in megawatts of capacity.

In order to calculate the investment in additional capacity, the following average investment costs were used, originally produced by the University of Cambridge. These were compared to the latest equivalent figures from the IEA (IEA et al, 2010), which were found to be similar.

- biomass – 2,300 USD/kW
- onshore wind – 1,378 USD/kW
- offshore wind – 2,200 USD/kW
- solar – 6,000 USD/kW
- small hydro – 5,000 USD/kW

The investment in monetary terms is then divided by these figures (after conversion to the correct price base and currency) to give the investment in units of electricity generation capacity. This is added to the model as an input, and will either displace existing fossil-fuel capacity, or future construction of renewables, depending on relative costs and market conditions (see Barker et al, 2007).

3.4 Belgium

Introduction

The Belgian national recovery plan includes three green recovery measures. Policy areas covered include energy efficiency and fiscal instruments.

Policies

The policies are as follows:

- €140m investment in improving energy efficiency of housing by providing households with a voucher worth €30 to spend on energy-saving measures such as better insulation.
- €20m investment in green technology. Households who borrow to finance green investments for their homes receive a 1.5% interest bonus from the government. The above-mentioned voucher can be put towards any remaining interest they may have to pay.
- The fund for energy cost reduction was enlarged by €10m.

Assessment methodology

Two of the green recovery measures for Belgium could be assessed using the E3ME model. The first of these is the measure to improve energy efficiency in buildings. This was assessed using the methodology outlined in Section 3.3 under the heading *investment in energy efficiency*. There is no obvious reason to suggest that a different energy savings ratio should be used.

The green technologies measure was also assessed using the E3ME model. The €20m was entered into the model as an increase in household non-wage income, representing a lump-sum payment to households. No environmental inputs were considered in the modelling, but will be discussed in the following sub-section.

Due to a lack of information on the specific nature of the remaining green measure (enlarging the energy cost reduction fund), this was assessed qualitatively, and is discussed below along with the modelling results.

Summary of results

As Table 3.1 shows, the green measures have a very small impact on GDP and employment in Belgium in the short term. Even given the small scale of the investment, the impacts are quite small (our estimate of the domestic multiplier is around 0.6) although this reflects the open nature of the Belgian economy (i.e. more of the money is spent on imports) rather than the specific policies. Although the table does not include all the measures, it is unlikely that the other ones would have a major impact as they are smaller in scale.

From 2011 onwards there is a small negative impact as the investment is removed, due to lagged labour market effects. This soon becomes zero, however. The environmental impacts, although small, are more permanent, with both energy consumption and CO_2 emissions reduced for the entirety of the forecast period by 0.01-0.03%.

As previously mentioned, no environmental components were used as inputs to the model for the investment financing. However, the value of this measure is so small it is unlikely that it would change the environmental impacts much. Nevertheless, it would be expected to reduce energy consumption and emissions further, although the scale means that this should not be large. Similarly, we can say with confidence that the final green measure included in the stimulus package (fund for energy cost reduction) is so small in value that it would not materially change the results seen in Table 3.1.

Table 3.1: Summary of Results, Belgium

SUMMARY OF RESULTS, BELGIUM						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.02	0.02	-0.01	-0.01	0.00	0.00
Employment	0.00	0.01	0.01	0.00	0.00	0.00
Household spending	0.00	-0.01	-0.02	-0.02	-0.01	0.00
Investment	0.09	0.10	0.01	0.00	0.00	0.01
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.01	0.00	0.03
CO_2 emissions	-0.01	-0.02	-0.03	-0.03	-0.03	-0.02
Energy consumption	-0.01	-0.03	-0.03	-0.03	-0.03	-0.03

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

Conclusions from the Belgian package

The green part of the stimulus package in Belgium was modest in scale (averaging around €16 per person, the lowest out of the countries we assessed) and almost completely targeted at households. It is therefore unsurprising that the economic impacts of the policies, even when taken together, are small. The construction industry and related activities may have received a small boost from the energy-saving vouchers, but even this would only have been in the region of 0.1%.

Transition to a low-carbon and resource-efficient economy?

From an environmental perspective, the policies were narrowly focused on energy efficiency, mainly in housing, so we would not expect to see any benefits (or costs) in other areas. They could lead to lower future energy bills for Belgian households. However, again the small scale of the measures meant that even these benefits were likely to have been very small when considered at the macro level.

In summary the green parts of the Belgian stimulus package may have had some small localised impacts, but at the macro level it is difficult to discern any significant economic, social or environmental costs or benefits.

Feasibility for introduction in other countries

There is no reason that these measures could not be implemented in other countries, and they are not dissimilar to some of the measures that we have seen in other countries. However, on this type of scale the measures are likely to have a very limited impact in any country.

Table 3.2: Overview by Assessment Criteria, Belgium

OVERVIEW BY ASSESSMENT CRITERIA, BELGIUM

Assessment criteria	Results
Timeliness	The timeliness of the green measures included in Belgium's stimulus package can be determined by the change in GDP they generate. The results show that GDP is increased by a small amount compared to the baseline in the years in which the investment takes place, suggesting that the measures are timely to some degree. However, the positive economic impact is short-lived.
Job creation impact	The impact of the green measures on employment is similar to the impact on GDP, albeit smaller. Since none of the green measures directly target employment, the increase in jobs is purely a result of slightly higher economic activity. Additional jobs could be expected to be mostly in the construction sector.
Targeting to vulnerable groups	None of the green measures specifically target vulnerable groups such as low-income households or the retired. The model results show that the impact on incomes is similar across all groups from 2010 onwards. However, in 2009 the unemployed, retired and inactive groups, which can all be considered to be vulnerable, observe smaller increases or even decreases in income compared to all other groups. These groups are unlikely to benefit from the green measures since they involve spending on home energy improvements, something these groups may not have the disposable income to do, even with the support measures.
Environmental impact	The green measures included in Belgium's stimulus package lead to favourable environmental outcomes in the long run. Both energy consumption and GHG emissions are reduced, although these declines are likely to be very small, even when all the measures are considered together. In the short term a small increase is observed. This is purely caused by the increase in energy used by the construction sector outweighing any initial improvements in energy-efficiency in buildings.
Fiscal deficits	The national debt of Belgium becomes larger in the short to medium term but only by 0.04% of GDP. Some of this is later recouped through higher economic output. Belgium has a relatively high national debt, which may have limited the size of the stimulus package.
Productivity and innovation	There are very small productivity benefits from the energy-efficiency measures. There are no obvious effects on innovation.

Source(s): Cambridge Econometrics, E3ME.

3.5 Czech Republic

Introduction

The Czech national recovery plan only included one green measure, to improve energy efficiency in residential buildings. However, this represented 33% of the total stimulus package.

Policies

The policy was:

- €900m investment in improving energy efficiency in residential buildings. Specifically, subsidies were provided to home-owners in the following areas: Savings of energy for space heating, new construction of residential buildings with passive energy standards and heat production from renewable energy sources.

Assessment methodology

The sole green recovery measure for the Czech Republic was assessed using the methodology set out for *investment in energy efficiency* in Section 3.3. As far as we are aware there is no reason to suggest that the energy savings ratio should differ dramatically from WEO. This is discussed further below.

Summary of results

In the years in which the investment takes place (2009-10) GDP is increased moderately, by around 0.4% compared to the baseline. This increase is partly driven by the investment itself and is also boosted by the indirect effect of multipliers. From 2011, GDP reduces to comparable levels with the baseline. Despite this, other economic benefits are seen, such as higher employment throughout the period (although, again, these changes are very small). Employment increases by around 30,000, as expected in the programme. The bulk of the jobs are likely to have been in construction and related activities.

The environmental benefits of the energy-efficiency programme are realised in the long term. Increases in energy consumption and GHG emissions in 2009 are caused by the effects of higher economic activity (i.e. mainly in construction) outweighing any improvements in energy efficiency in these years. After this, persistent reductions are observed. Furthermore, these reductions are larger than the economic impacts in percentage terms, but are quite a lot less than the 1% reductions suggested in the programme (see Section 2.2).

Table 3.3: Summary of Results, Czech Republic

SUMMARY OF RESULTS, CZECH REPUBLIC

	2009	2010	2011	2012	2013	2020
GDP	0.36	0.35	-0.01	0.02	0.01	0.05
Employment	0.05	0.11	0.10	0.06	0.04	0.05
Household spending	0.03	0.09	0.05	0.06	0.05	0.14
Investment	1.54	1.51	-0.01	-0.01	-0.02	-0.02
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.17	0.20	0.03	0.01	0.01	0.02
Prices	-0.01	0.00	0.03	-0.01	-0.03	-0.15
CO_2 emissions	0.03	-0.05	-0.21	-0.29	-0.28	-0.27
Energy consumption	0.12	-0.10	-0.37	-0.47	-0.40	-0.31

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

Table 3.4: Overview by Assessment Criteria, Czech Republic

OVERVIEW BY ASSESSMENT CRITERIA, CZECH REPUBLIC

Assessment criteria	Results
Timeliness	The single green measure included in the Czech Republic's stimulus package can be considered timely, as it was implemented quickly and increases GDP in the years of its implementation. It therefore helped to aid the recovery in the Czech Republic.
Job creation impact	The impact of the buildings efficiency measure is positive for employment. This is especially the case in the short term, but the impacts become much smaller over time. While the measure does not specifically target employment, jobs in the construction sector are likely to be most affected as households carry out energy-efficiency improvements. Employment in other sectors will be further boosted by the increase in economic output in the years the investment is implemented.
Targeting to vulnerable groups	The energy-efficiency measure does not specifically target vulnerable groups in society such as the retired or unemployed. The model results show that the impact on incomes is positive for all socio-economic groups between 2009 and 2013. A fairly large proportion of the additional jobs are likely to have been manual.
Environmental impact	The environmental benefits of the energy-efficiency programme are realised in the long term. Increases in energy consumption and GHG emissions in 2009 are caused by the effects of higher economic activity outweighing any improvements in energy efficiency in these years. After this, persistent reductions are observed, but our results imply not as large as originally suggested.
Fiscal deficits	The one green measure implemented in the Czech Republic is relatively large in value, representing a third of the total stimulus package. Although the Czech Republic's national debt is relatively small, deficits during the crisis were quite large. The green measures, at 0.6% of GDP, would have been a contributing factor. However, some of this would have been recouped through higher taxes.
Productivity and innovation	The energy-efficiency measure will lead to improvements in energy and carbon productivity for most of the forecast period. There are no direct effects on innovation.

Source(s): Cambridge Econometrics, E3ME.

Conclusions from the Czech package

The green part of the stimulus package in the Czech Republic consisted of a single measure that was worth around €900m, or 0.6% of GDP. This aimed to improve the energy efficiency of existing and new buildings, mainly housing. The scheme was implemented quickly and effectively, meaning that it contributed to national output over 2009-10.

Our results show that the scheme boosted GDP by around 0.4% pa (i.e. roughly the value of the original investment) in this period, and created around 30,000 jobs, as was originally claimed, mainly in the construction industry and related activities, which were particularly affected by the crisis. In economic terms it could thus be considered a success.

Transition to a low-carbon and resource-efficient economy?

The longer-term impacts are expected to be a reduction in energy consumption and CO_2 emissions. Here our results differ substantially from those suggested in the original programme. This is partly because our results include temporary energy use resulting from the construction work (which was probably not included in the initial estimates) and we see some rebound effects.

Even so, the difference is still double, suggesting quite a large difference between our estimate of energy savings per unit of investment and the one used by the Czech government. This could be because:

- there are some 'low-hanging fruit' in the Czech Republic where savings can be made relatively easily in the short term
- the cost of investment in the Czech Republic is lower than in the rest of the EU, for example due to lower labour costs
- the savings were implicitly linked to the closure or reduced output of a coal power station (our modelling links to gas as a higher-cost fuel)

On the other hand it is possible that the 1% figure was a high (and round) estimate that was provided to help to sell the policy. We suggest that the true figure may lie between the two estimates.

Feasibility for introduction in other countries

The tight focus on buildings and energy efficiency identified an area where significant energy savings could be made in the Czech Republic. These measures are still relevant to other countries (many of which implemented similar policies) but the sole focus is probably less appropriate to apply elsewhere.

3.6 Estonia

Introduction

Three green measures were included in Estonia's national recovery plan. These included measures targeting energy efficiency, renewable energy and public transport.

Policies

The green measures are as follows:

- €51m investment in improving energy efficiency in housing.
- €153m investment in improving water management infrastructure.
- €44m funding for green investment schemes. This investment will be funded by the selling of emissions permits. The €44m is split between investment in wind energy, investment in new buses and investment in the energy efficiency of a handful of government buildings.

Assessment methodology

The methodology described in Section 3.3 for investment in energy efficiency was used for assessing the first green measure listed above.

The investment in improving water management was assessed via a straight forward modelling exercise. The only input required was an exogenous investment in the land transport sector, which includes waterways infrastructure such as locks and harbours.

The final green measure included modelling investment in wind energy, modelling improvements in the energy efficiency of public buses and modelling improvements in the energy efficiency of public buildings (all using the respective methodologies described in Section 3.3). It is assumed that the environmental benefits of the new buses is not realised until at least 2011, as this is when the vehicles are planned to go on the road.

Summary of results

The crisis was felt severely in Estonia and our results suggest that the Estonian package gave an immediate boost to activity, with GDP increasing by around 0.5% in 2008-09. Our results suggest that Estonia had the largest (per capita) green stimulus package out of the countries assessed, at €185 per person. This is led by increases in public investment but its overall impact on GDP was limited by the open nature of Estonia's economy (i.e. a large share of the package was spent on imports). There is a small long-term benefit to GDP, due to reductions in the imports of fossil fuels.

The largest of the measures, accounting for 60% of the total value of the green stimulus package, was designed to improve water management. We would thus expect to see the largest improvement in this area, which is one where there is ongoing development that is supported by EU funds (but which could also make an ex-post assessment difficult if the stimulus spending cannot be separated from other ongoing projects).

The other two policies are mainly focused on energy efficiency but include a share of funds that is allocated to renewables. Our results show a small long-term increase in energy efficiency from the policies, although the stimulus measures are likely to have increased energy consumption in 2008-09.

However, in most years we see an increase in CO_2 emissions. The reason for this is that most of the reductions in energy consumption are assumed to be of natural gas. Estonia's unique energy composition means that this does not translate into CO_2 reductions as developments in other sectors, including electricity demand, is more important. In 2020, the slight increase in GDP leads to higher electricity demand and higher emissions, despite falls in gas consumption. Essentially this is suggesting that there is the possibility of a large rebound effect.

Table 3.5: Summary of Results, Estonia

SUMMARY OF RESULTS, ESTONIA						
	2008	**2009**	**2010**	**2011**	**2012**	**2020**
GDP	0.42	0.60	0.10	-0.04	-0.01	0.08
Employment	0.08	0.16	0.08	0.03	0.01	-0.01
Household spending	0.04	0.04	0.02	0.01	0.01	0.02
Investment	1.94	3.40	0.71	-0.03	-0.03	-0.03
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.35	0.62	0.17	0.05	0.01	-0.10
Prices	-0.10	-0.07	0.00	0.02	0.01	-0.04
CO_2 emissions	0.13	0.14	0.04	-0.05	-0.08	0.05
Energy consumption	0.12	0.18	-0.01	-0.16	-0.17	-0.13

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

Conclusions from the Estonian package

The severity of the crisis in Estonia required a rapid and large-scale response. Green measures accounted for a reasonably large part of this response. All of the measures were in the form of additional investment, with the largest measure being directed at additional improvements to water management. It is not clear how quickly the measures were implemented but their early announcement suggests there was some urgency in taking action.

The economic benefits are limited due to the open nature of Estonia's economy, in particular a high imports ratio, but our results suggest a temporary boost to GDP of 1% (our results suggest split over 2008-09 although this is dependent on the timing of the water investment). There is also a small temporary increase in employment over the same period.

Transition to a low-carbon and resource-efficient economy?

Estonia is the only country in Europe where the green measures have not focused on energy efficiency and CO_2 reduction. The main benefit from the measures is in the area of water management where there are other ongoing developments.

Our results suggest that the smaller measures will lead to a reduction in energy demand, although not in CO_2 emissions, due to Estonia's energy mix. There is likely to be a small additional demand for material and land resources.

Feasibility for introduction in other countries

The measures for Estonia were fairly specific to its requirements, namely a long-term programme to upgrade infrastructure relating to the management of wastewater. The environmental outcomes are quite clear, but would not be realised in a country that already has modern infrastructure.

The other policies are quite similar to the ones that were implemented across Europe.

Table 3.6: Overview by Assessment Criteria, Estonia

OVERVIEW BY ASSESSMENT CRITERIA, ESTONIA	
Assessment criteria	**Results**
Timeliness	The largest part of the stimulus package was announced in 2008. We have assumed that half of the funds from this spending were released in 2008 (no evidence was found to support or contradict this), meaning that there was an immediate effect. Even if this was not the case, however, much of the investment is still likely to have been made in 2009, so the effects would have been reasonably fast.
Job creation impact	None of the measures created jobs directly, but they did create jobs indirectly through higher levels of activity in sectors that were particularly affected by the crisis. Our results show a small increase in the period when the investment was made, but the effects are temporary. The jobs that were created were mainly in the construction and engineering sectors.
Targeting to vulnerable groups	There is unlikely to have been any particular impact on vulnerable groups from the measures.
Environmental impact	The main impact was in the area of water treatment and management through the additional investment. The ongoing investment programmes, including EU support, suggest that there is a requirement for improvement in this area although this also makes it difficult to assess improvements that directly relate to the measures. There is a small and permanent reduction in energy consumption due to the efficiency measures, but an increase in CO_2 emissions, as none of the measures really tackle the issue of Estonia's fuel sources. The measures are also likely to have been fairly material-intensive (and likely also to some extent land-intensive) in nature, involving large construction projects.
Fiscal deficits	The green recovery measures accounted for a reasonable share of GDP (almost 2%) so could have had a substantial impact on deficits. Some of this would have been recouped through higher tax receipts, although perhaps not as much as in other countries (due to import shares). However, it should also be noted that the smallest of the three measures was funded by the sale of AAUs so would not have affected gross debt levels. It should also be noted that Estonia has one of the lowest debt levels in Europe.
Productivity and innovation	Our results show a small long-term increase in energy productivity, which boosts GDP overall. It is not clear if the investment in water management could also boost productivity although it is likely that the environmental benefits are greater. There are no direct effects on innovation.

Source(s): Cambridge Econometrics, E3ME.

3.7 France

Introduction

In total there were six green measures included as part of the national recovery plan for France. The measures are varied in nature and cover policy areas outlined in the

EC's Non-Paper (European Commission, 2009c) such as renewable energy, energy efficiency and car scrappage. Within the recovery plan there were also potentially environmentally harmful measures, including road building. Another was €700m of support for fossil fuel power plants.

Policies

The green policies were:

- €400m investment in improving energy efficiency of buildings.
- €600m investment in the electricity grid infrastructure, improving the quality and security of electricity distribution and regional electricity grids.
- €1.3bn investment in transport and railway infrastructure.
- €300m investment in renewable solar energy.
- €500m car scrappage scheme which provided a bonus of €1,000 - €2,000 in 2009 for scrapping a car which was at least ten years old for the purchase of a new fuel-efficient car. This subsidy fell to €700 in 2010H1 and €500 in 2010H2. Reports show that 600,000 bonuses were paid in 2009 and 500,000 in 2010. Based on an average bonus of €1,500 in 2009 and €600 in 2010 the scheme would actually have cost the French government around €1.2bn rather than the initial figure planned.
- €450m support for the car industry through low-carbon R&D funding and other measures.

Assessment methodology

All of the green measures identified in France's national recovery plan were assessed (at least in economic terms) using the E3ME model. Most involved a straight-forward increase in exogenous investment in the relevant sector, for example investment in the electricity grid infrastructure was represented by an increase in investment made by the electricity sector.

Three of the measures required further calculations: investment in solar energy, investment in energy efficiency in buildings and the car scrappage scheme. The methodologies used for these calculations are all described in Section 3.3.

Summary of results

The results given in Table 3.7 show that the green measures included in France's stimulus package had a positive impact on GDP and employment during 2009-11. This is mainly driven by the increased household spending that the car scrappage scheme generates. However, spending is lower than in the baseline for 2013, since it has been effectively brought forward from later years.

Environmental benefits

The environmental impacts of the measures mainly focus on energy efficiency and CO_2 reductions. In the longer term the model results in the table show little overall benefit although they do not include possible benefits from investment in transport infrastructure or electricity grids, which make up a large share of the French package. In the longer term there are also slightly higher activity rates and the impacts of the car scrappage scheme have ebbed, so there is little overall impact on energy demand.

The measure could increase some other environmental pressures. Many of them would have been quite intensive in use of materials, and the transport measures may have increased land use.

The environmental impacts of some of the green measures relating to transport and electricity grids are not represented in the modelling results, as they were difficult to define or quantify. These additional benefits are discussed here.

Transport infrastructure

The largest single measure makes investment in transport infrastructure with a focus on expanding the rail network. If this leads to a reduction in the number of journeys made by road it would have a positive benefit on CO_2 emissions. However, without

the use of a detailed transport model it is difficult to provide an estimate of the number of trips saved or the expected reduction in emissions, minus any rebound effects.

Electricity grid improvements

Another policy that has not been modelled (in environmental terms) is the improvements to the electricity grid infrastructure. The measures included €600m for improvements.

These could have an immediate effect through a reduction in transmission losses, although the amount of energy that would be saved is unclear. The longer-term impacts of allowing better access for renewable connections have no impact on their own, but mean that there is the possibility for a future increase in renewable capacity; there could thus be long-term indirect benefits.

Possible harmful measures

France's stimulus package included road-building measures. The projects are aimed at easing congestion on existing routes and therefore may have short-term benefits from reducing the emissions associated with congestion. However, if the outcome of this is an increase in the number of trips made the result will be a higher level of emissions from road transport. At this stage it is not possible to make a judgment as to which of these effects will be stronger. It is noted, however, that the scale of the investment is quite small so large changes should not be expected at the macro level.

The summary table below also does not include the additional funding (€700m) for fossil-fuel-based power generation. This is partly because it was not one of the green measures but also reflects some uncertainty over the possible impacts. Most obviously the fuel used will affect emission levels but also whether the plant is expected to provide base-load (e.g. replacing existing capacity) or back-up capacity. For example, if nuclear plants (or renewables) are on stream they would usually take priority as their marginal cost is lower. The magnitude of the effects is unclear but it can be assumed that there would be increases in CO_2 emissions, although these could be linked to future CCS facilities.

Conclusions from the French package

France entered the recession in a relatively strong position thanks to its large public sector and relatively low exposure to international trade. However, the French government was able to implement a stimulus package with a fairly large green component (although this is partly dependent on what is defined as 'green'. This focused on:

- transport
- energy production
- energy efficiency

Economic impacts

These measures account for around 0.2% of GDP, but the economic impact of the package was much larger, due to the 'leveraging' effect of the vehicle scrappage scheme, which effectively reduced the household savings rate. The package also led to a reasonable boost to employment, mainly in motor vehicles and equipment suppliers.

Almost all of the policies focus on energy use and emissions, although it should also be noted that there will be some negative impacts on land use from new transport infrastructure and a small temporary increase in material inputs.

There is quite a large range of uncertainty around the outcomes for energy consumption. This is partly because policies such as the car scrappage scheme are quite complex to assess, and the car scrappage scheme is likely to dominate short and medium-term impacts.

Transition to a low-carbon and resource-efficient economy?

However, there is also uncertainty in the long-term environmental impacts because there are some policies where it is difficult to gauge the effects without specific local knowledge. These include investments in rail as we do not know how many road journeys are replaced.

It must also be noted that the additional investment in new fossil fuel plants could have harmful effects on emission levels (but could also replace existing nuclear capacity).

In summary some of the policies in France have had or will have clear environmental benefits and others (in particular the road building and investment in fossil fuel plants) that are likely to have costs. For the other policies, it is probably too early to assess the environmental costs or benefits.

Feasibility for introduction in other countries

France adopted a balanced range of measures, most of which could have been (and in many cases were) applied in any European country. The main factor specific to France is the large share of nuclear in the energy mix; this can complement renewables by providing a base load but the French package also included funding for fossil-fuel-based generation.

Table 3.7: Summary of Results, France

SUMMARY OF RESULTS, FRANCE

	2009	2010	2011	2012	2013	2020
GDP	0.50	0.50	0.02	-0.04	-0.06	0.11
Employment	0.15	0.18	0.00	-0.06	-0.09	0.09
Household spending	1.20	1.13	0.04	-0.03	-0.08	0.12
Investment	0.29	0.29	-0.03	-0.06	-0.02	0.05
Exports	0.01	0.02	0.01	0.02	0.02	0.09
Imports	0.99	0.87	0.00	0.04	0.02	-0.01
Prices	-0.13	-0.29	-0.21	-0.07	0.06	-0.06
CO_2 emissions	0.18	0.04	-0.08	0.01	0.04	0.05
Energy consumption	0.34	0.25	-0.03	-0.02	-0.02	0.04

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

Table 3.8: Overview by Assessment Criteria, France

OVERVIEW BY ASSESSMENT CRITERIA, FRANCE	
Assessment criteria	**Results**
Timeliness	The timeliness of the green recovery measures can be considered good since GDP increased in 2009 and 2010, therefore aiding the French economy during recession. Although it is not clear that all policies were fully implemented (but it should be noted that fast implementation was stressed[49]) over this period, the car scrappage scheme, which had the largest economic effect, was.
Job creation impact	The impact on employment of the green measures is also positive in 2009 and 2010. None of the measures specifically target job creation, but the high-skilled and labour-intensive motor vehicles sector was one of the main beneficiaries. Construction workers are also likely to have benefitted.
Targeting to vulnerable groups	None of the green measures are specifically aimed at vulnerable socio-economic groups. The modelling results show that the impacts on incomes of the measures are uniform across all groups in society, meaning there is no change in income distribution. Incomes are increased in 2009-2011, when there are increases in GDP and employment, after which small falls are seen (following the pattern in economic activity).
Environmental impact	Following initial increases in emissions and energy consumption (due to the increase in GDP) in 2009, energy consumption and CO_2 emissions fall as a result of the green measures. In the longer term, however, there is little impact as the effects of the car scrappage scheme become almost zero. There could be an increase in emissions if there is an increase in electricity generated from fossil fuels. The measures were quite material-intensive, putting additional pressure on mineral resources. The new transport infrastructure will have made demands on available land.
Fiscal deficits	Although the green measures in France are relatively large in value (totalling €3.55bn), they are only worth the equivalent of a small percentage of French GDP. The impact on the fiscal deficit is therefore quite small. Although there is a small increase in national debt, this is unlikely to have any noticeable economic impact.
Productivity and innovation	There were likely to have been some productivity gains as a result of the measures. The measure that aimed to increase energy efficiency in buildings will have had a positive but small effect. The new transport infrastructure will have shortened some journey times, even if the environmental benefits are unclear. The improvements to the electricity grid will also have reduced some transmission losses. Any innovation effects are likely to be through the grid-based measures.

Source(s): Cambridge Econometrics, E3ME.

[49] Plan de relance de l'economie Francaise (2009), http://www.gouvernement.fr/gouvernement/plan-de-relance-de-l-economie-francaise .

3.8 Germany

Introduction

There were four green measures included in Germany's national recovery plan. The measures cover a range of policy areas including energy efficiency, eco-technologies and innovation, car scrappage and fiscal instruments. Overall, the green part of the German stimulus package was quite large, averaging €129 per capita.

Policies

The four policies are:

- €3.3bn investment for improving energy efficiency in public buildings, primarily school and university buildings.
- €500m of support for R&D of hybrid and other clean car technologies.
- €5bn car scrappage scheme which provided owners of cars more than nine years old with a subsidy of €2,500 for the purchase of a new fuel-efficient car. Based on the 682,961 applications we now know were received, the scheme would only have cost €1.7bn rather than the €5bn originally planned.
- Motor vehicle tax in Germany was revised from 1 July 2009 onwards so that CO_2 emissions of passenger cars are included in the taxable base. The revision cost the government €1.8bn.

Assessment methodology

All but one of the green measures included in Germany's national recovery plan could be assessed to some extent using modelling techniques. The model inputs for the energy-efficiency and car scrappage measures were calculated using the methodologies for *investment in energy efficiency* and *car scrappage schemes* outlined in Section 3.3, respectively. There is no evidence to suggest that the energy savings ratio in Germany should differ from the EU average used.

The measure for support for clean car technologies was modelled using a straight-forward increase in exogenous investment in the motor vehicles sector. Although this could lead to future environmental benefits we have assumed that these would accrue after 2020, beyond the horizon of our analysis.

The amendment to the motor vehicles tax was modelled via an increase in aggregate household incomes, representing a lump-sum payment. It was assumed that this payment occurred for every year beyond 2009. No environmental impacts were considered in the modelling, but this is analysed along with the modelling results in the next sub-section.

Summary of results

The package of green measures included in Germany's stimulus plan lead to positive economic outcomes immediately following their implementation (2009-12), when GDP increases compared to the baseline. This is not only a direct impact of the increase in investment itself but also a result of multiplier effects. The increase in GDP is much larger than the size of the stimulus package due to the co-financing involved in the car scrappage scheme, which effectively converts savings to spending.

GDP, employment and household spending are marginally below the baseline by the end of the forecast period. This is due to the shift in spending associated with the vehicle scrappage scheme; by bringing spending forward there are short-term benefits but these have some longer-term costs to the car sector due to changing inventory patterns.

The green measures in Germany specifically focus on improving energy efficiency and reducing fuel consumption. The results show that energy consumption and GHG emissions are indeed reduced throughout the whole forecast period.

As previously mentioned no environmental impacts of the revision to car tax are shown in the modelling results. This measure could also contribute to the reductions in energy consumption and CO_2 emissions between 2009 and 2020. Since the measure involves including the CO_2 emissions of passenger cars in the taxable base, this should lead to more fuel-efficient cars being purchased, including smaller cars or alternatively fuelled cars such as hybrids or electric vehicles. However, it is also noted that an overall reduction in car tax could increase ownership rates, so the overall impacts are unclear.

Similarly, no specific model inputs were used to reflect the environmental impact of the development of clean car technologies. The results in Table 3.9 do not therefore include these impacts. This measure is the smallest of all the green measures included in Germany's stimulus package, meaning the results produced by the modelling assessment would not be changed by much if the environmental benefits were taken into account. Nevertheless, if the research is successful we could expect reductions in energy consumption and GHG emissions in the long term (after 2020) as new, greener technologies become commercialised.

Table 3.9: Summary of Results, Germany

SUMMARY OF RESULTS, GERMANY

	2008	**2009**	**2010**	**2011**	**2012**	**2020**
GDP	0.00	0.62	0.05	-0.01	0.02	-0.01
Employment	0.00	0.12	0.06	0.01	0.02	0.00
Household spending	0.00	1.06	0.03	0.03	0.02	-0.02
Investment	0.00	0.60	0.40	0.07	0.07	0.00
Exports	0.00	0.13	0.01	-0.02	0.00	-0.01
Imports	0.00	0.45	0.18	0.08	0.03	-0.01
Prices	0.00	-0.07	0.04	0.02	0.04	0.06
CO_2 emissions	0.00	-0.06	-0.14	-0.14	-0.13	-0.09
Energy consumption	0.00	-0.10	-0.21	-0.22	-0.19	-0.14

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

Table 3.10: Overview by Assessment Criteria, Germany

OVERVIEW BY ASSESSMENT CRITERIA, GERMANY

Assessment criteria	Results
Timeliness	The modelling results show that the green measures included in Germany's stimulus package were timely with the car scrappage scheme and changes to vehicle taxation having a strong short-term effect. GDP is increased moderately compared to the baseline in the years during and immediately after the investments (2008-12) but particularly in 2009-10 during the recession.
Job creation impact	The impact of the green measures on job creation was positive. Employment increases compared to the baseline across the whole forecast period. This is partially a result of increases in demand directly caused by the measures, in particular an increase in demand in the motor vehicles sector. It is also a result of multiplier effects, as economic activity is increased in general.
Targeting to vulnerable groups	The green recovery measures in Germany do not specifically target vulnerable groups in any way. The car scrappage scheme and vehicle taxes could have excluded the poorest groups in society who do not own cars.
Environmental impact	The environmental impact of the green measures is expected to be favourable, both in the short and the long term. The results show moderate reductions in both energy consumption and CO_2 emissions throughout the forecast period, which would be slightly larger when considering the benefits of the measures that did not include exogenous inputs for changes in fuel use. There is also possible long-term (global) benefits from transport R&D.
Fiscal deficits	With a high savings ratio Germany was (and is) in a particularly strong position regarding fiscal deficits. There was therefore ample scope for a relatively large stimulus package, including a large green element. The initial cost was around 0.3% of GDP although some of this will have been recouped through higher tax receipts.
Productivity and innovation	The energy-efficiency measures will lead to short-term and persistent improvements in energy and carbon productivity, although these are quite small. The German package included direct support for transport R&D which could provide long-term benefits.

Source(s): Cambridge Econometrics, E3ME.

Conclusions from the German package

The green parts of the German stimulus package were split fairly evenly (in terms of public financing) between energy efficiency in public buildings and transport. However, when the increase in private spending, due to the car scrappage scheme, is taken into account the focus is much more on transport.

Economic impacts

Two of the three transport policies (the scrappage scheme and the vehicle tax changes) had an immediate impact on the German economy in 2009, increasing GDP by more than 0.6%. The other transport policy has a much more long-term focus on the development of efficient vehicles. The investment in energy efficiency in public buildings will have taken slightly longer to implement but still had an impact on rates of economic activity.

The policies clearly target specific sectors that were particularly affected by the recession, including vehicles, engineering and construction. Our results show that the policies are likely to have saved or created a significant number of jobs.

Transition to a low-carbon and resource-efficient economy?

In terms of environmental outcomes, the benefits are almost entirely in reduced energy consumption and lower emissions. The car scrappage scheme will have had a short-term impact that is likely to reduce over time (as fleets would have been updated anyway). On the other hand, the changes to vehicle taxation could have more lasting effects and the R&D may provide improvements in efficiency post-2020. The improvements to efficiency in public buildings should provide steady and permanent reductions in energy consumption.

In conclusion, the green elements of the German stimulus package provide a balance of both short and long-term positive impacts. The package included a cost-effective way of stimulating short-term demand in the motor vehicles sector, while also including elements that are likely to boost longer-term efficiency. The downside of the package is that it only focuses on transport and public buildings and does not include environmental factors beyond energy use and emissions reduction.

Feasibility for introduction in other countries

In most cases the policies are little different to those that were implemented in other European countries and the German car scrappage scheme was used as a template for the schemes introduced in other countries.

The one policy that is different is the revision to car taxes. This could also be applied in other European countries if they do not already have such a system in place.

3.9 Portugal

Introduction

The green recovery measures included in Portugal's national recovery plan address policy issues such as renewable energy, energy efficiency and car scrappage.

Policies

The national recovery plan for Portugal included several green measures:

- €145m investment in renewable energy technologies. Specifically, a tax rebate to private customers who install solar or microgenerating wind turbines.
- €100m investment in improving energy efficiency of private buildings (households and small businesses).
- €15m investment in improving energy efficiency in housing by installing smart meters with the aim to promote energy-efficient behaviour.
- €45m car scrappage scheme providing a refund of €1,000 for purchasing a new fuel-efficient car and scrapping a car that is over ten years old, rising to €1,500 for scrappage of a car over 15 years old.

Assessment methodology

All of the green measures were assessed using E3ME. Each of them required some initial calculations so that the correct inputs could be entered into the model. The methodologies for carrying out these calculations are described in Section 3.3.

The buildings efficiency measure required slightly more initial calculations in Portugal's case than for other countries. This is because the measure is aimed at households as well as small businesses, meaning figures for energy reductions were required not only for households but for other relevant fuel users. Using Eurostat data we are able to verify in which sectors the majority of small businesses exist. This enabled us to determine how to share the energy reduction among the relevant groups. Similar energy-savings ratios were estimated from WEO for industry. Portugal is often considered as energy-intensive (which could suggest a lower cost per unit of energy saved) but we have used an EU average value.

We did not include an assessment of the environmental impact of smart meter installation due to a lack of consensus of the effects on energy consumption. However, the calculation in Appendix B suggests the impacts would in any case be very small.

Summary of results

Table 3.11 provides the economic and environmental impacts of all the green measures included in Portugal's stimulus package combined. The results show that the measures lead to a small increase in GDP in the short term. The increase in GDP is led by investment and household spending. These fall back in later years due to the cyclical effects introduced by the car scrappage scheme.

Environmental impacts

The environmental impact of Portugal's package of green measures is small but consistently favourable. Decreases in energy consumption and GHG emissions occur throughout the forecast period, following an initial increase in 2009 that is due to the higher rates of economic activity. Specifically, in the longer term it is the private building energy-efficiency scheme which is the main contributor to the decrease in energy consumption.

Table 3.11: Summary of Results, Portugal

SUMMARY OF RESULTS, PORTUGAL						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.23	0.09	-0.03	-0.01	-0.01	0.01
Employment	0.06	0.04	-0.03	-0.02	-0.02	0.00
Household spending	0.67	0.04	-0.06	-0.04	-0.03	0.00
Investment	0.30	0.31	-0.03	-0.07	-0.11	-0.05
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.52	0.02	-0.04	-0.08	-0.08	-0.05
Prices	-0.06	0.01	0.00	0.00	-0.01	-0.01
CO_2 emissions	0.04	-0.08	-0.13	-0.14	-0.15	-0.10
Energy consumption	0.06	-0.04	-0.10	-0.10	-0.10	-0.09

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

Conclusions from the Portuguese package

The green elements of the Portuguese stimulus package accounted for 0.2% of GDP, which is not large, but must be considered in the light of subsequent financial events. Our results show that it had a positive effect on GDP growth over 2009-10 but this was quite modest compared to the impacts from other economic factors. The nature of the policies was in some ways similar to Germany's with a short-term vehicle scrappage scheme backed up by efficiency improvements in buildings. There was also a tax rebate for renewables (Portugal's geographical location means it could benefit from wind, solar and possibly marine power). However, the green parts of the stimulus did not contribute to helping the country's structural problems of low skills and a lack of competitiveness, which were a major factor in the bail-out request.

Transition to a low-carbon and resource-efficient economy?

Overall the green parts of the stimulus package were small in scale, with the car scrappage scheme providing much of the economic impact. From an environmental perspective the focus is purely on energy and CO_2 emissions with no mention of other resources. The measures are likely to have reduced energy consumption and CO_2 emissions slightly but the effects are expected to be modest.

Feasibility for introduction in other countries

Portugal's green measures included a broad coverage of policies that were similar to those introduced in other European countries. There is therefore not much additional information from the Portuguese package.

Table 3.12: Overview by Assessment Criteria, Portugal

OVERVIEW BY ASSESSMENT CRITERIA, PORTUGAL	
Assessment criteria	**Results**
Timeliness	The green recovery measures are indeed timely, as they provide a boost to GDP in the short term, therefore aiding the economic recovery in Portugal. The details of how much of the investment stimulus was spent over 2009-10 are not completely clear, but the car scrappage scheme had an immediate impact.
Job creation impact	None of the green measures specifically target job creation. However, many will have an impact on employment. For example, the car scrappage scheme leads to greater demand in the motor vehicles sector and so leads to more car manufacturing and sales jobs. The buildings efficiency measures will lead to more jobs in construction. This creates further jobs through multiplier effects.
Targeting to vulnerable groups	The green measures included in Portugal's stimulus package do not target vulnerable groups in society. It is not surprising that the modelling results show that the impacts on income for all socio-economic groups are generally similar in magnitude. Any distributional results are likely to be driven by the car scrappage scheme, which focused on owners of old cars.
Environmental impact	The measures focus on energy efficiency and CO_2 reduction. Although the boost to economic activity results in higher rates of energy use and emissions in 2009, there are permanent benefits after this year. As with other car scrappage schemes there will be additional demand for metals but few other environmental impacts.
Fiscal deficits	This is clearly a key issue for Portugal, which has subsequently requested and been granted European financing for its high levels of public debt. Our estimate is that the green measures cost just under 0.2% of GDP so were unlikely to have been a significant factor in this outcome.
Productivity and innovation	Energy and carbon productivity increases in line with the falls in energy consumption and GHG emissions throughout the forecast period. There are no direct innovation effects.

Source(s): Cambridge Econometrics, E3ME.

3.10 Slovakia

Introduction

Four green measures were identified in Slovakia's national recovery plan. The measures cover a variety of areas identified in the EC's Non-Paper *Green Elements from Member States' Recovery Plans* (European Commission, 2009c), including energy efficiency, renewable energy and car scrappage.

Policies

The policies are as follows:

- €10m of investment to improve energy efficiency in public buildings in the Trnavsky and Trenciansky regions
- €8m investment to encourage the installation and use of renewables in households, specifically biomass and solar energy production
- €93.5m of funding to support industrial energy-efficiency projects, renewable-energy projects and energy-efficiency projects in the residential sector, as part of the SLOVSEFF II initiative
- €55.3 car scrappage scheme. Providing owners of a car with a €2,000 bonus for scrapping their old car and purchasing a new one for under €25,000. Enforcing a cost limit to the new car meant larger, fuel-inefficient cars did not benefit from the scheme.

Assessment methodology

The first green measure, improving energy efficiency in public buildings, was assessed via the E3ME model, using the methodology described in Section 3.3 for assessing *investment in energy efficiency*. It is noted that we used EU average values to estimate the reductions in energy consumption. In the Czech Republic this produced savings that were substantially smaller than national estimates; if we were underestimating energy savings in the Czech Republic, it is also likely that we are underestimating savings in Slovakia. However, as we do not have alternative figures to compare to we have kept the EU ratio for the analysis.

The second green measure involved investment in renewable energy technologies. This was also assessed via the model, using the assessment methodology for *investment in renewables* outlined in Section 3.3.

The SLOVSEFF II initiative includes a number of individual measures. The E3ME model was used to assess the policy as a whole, using individual methodologies for energy-efficient investment in industry, energy efficiency in buildings and investment in renewables (mainly hydro and biomass), as set out in Section 3.3. Since there is a lack of information regarding how much of the originally allocated €105m was used for each of the three individual measures, we assumed an equal split between them (summing to the €93.5m that we found was spent). Furthermore, we assumed the energy consumption reduction due to the industrial energy efficiency was split between the industry fuel users in E3ME according to their share of total energy use.

The car scrappage scheme in Slovakia was modelled using the methodology explained in Section 3.3.

Summary of results

The green measures included in Slovakia's national recovery plan led to an increase in GDP in 2009, the year of the additional investment, but have no major impact after 2010. This is not unexpected since the €167m of investment in green measures is small (representing around 6-8% of the total stimulus package) and temporary (see Table 3.13).

The positive effects on employment generally decline over the forecast period. The increases are caused by some direct impacts of the measures, such as greater demand in the motor vehicles sector, and also indirectly through greater economic output in general. None of the measures affect employment beyond stimulating economic output.

Environmental impacts

The majority of the green measures in Slovakia's stimulus package address energy efficiency. For this reason, energy consumption and emissions reductions are observed between 2011 and 2020. However, in 2009 and 2010 a small increase in energy consumption and emissions are seen since the increase in economic activity outweighs any early benefits of the measures.

In 2011, there is a reduction in energy consumption of around 0.1%. This becomes smaller over time (mainly as the temporary boost from the car scrappage scheme becomes less) but there is a long-term reduction in both energy consumption and CO_2 emissions. This is mainly a result of the energy-efficiency measures.

Table 3.13: Summary of Results, Slovakia

SUMMARY OF RESULTS, SLOVAKIA						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.52	0.47	-0.01	-0.02	0.00	0.01
Employment	0.23	0.10	0.02	0.01	0.00	0.01
Household spending	1.14	0.80	0.02	0.03	0.03	0.05
Investment	0.01	0.76	0.18	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.19	0.22	0.08	0.04	0.03	0.01
Prices	-0.43	-0.28	-0.01	-0.03	-0.06	-0.08
CO_2 emissions	0.06	0.01	-0.05	-0.06	-0.08	-0.08
Energy consumption	0.09	0.02	-0.10	-0.10	-0.09	-0.07

Source(s): Cambridge Econometrics, E3ME.

Table 3.14 presents an overview of the results based on the key assessment criteria that are defined in Appendix A.

Table 3.14: Overview by Assessment Criteria, Slovakia

OVERVIEW BY ASSESSMENT CRITERIA, SLOVAKIA	
Assessment criteria	**Results**
Timeliness	The car scrappage scheme provided an immediate and large boost to the Slovakian economy, which has a large domestic car industry. The evidence suggests that the efficiency improvements were implemented relatively quickly.
Job creation impact	The green measures have a reasonable impact on employment in the years in which the investment was made. The job creation is likely to be focused in a limited number of sectors and for limited skill-sets, but these include the sectors that were most affected by the crisis.
Targeting to vulnerable groups	None of the green measures are specifically targeted at any particular socio-economic groups. Nevertheless, the modelling results show that the two lowest income quintiles could benefit if efficiency improvements affect their residences. As in other countries the car scrappage scheme benefitted owners of old cars.
Environmental impact	CO_2 and other GHG emissions increase slightly in 2009 and 2010, as the environmental benefits of the green measures have not yet been realized and a general increase in economic activity boosts energy consumption. However, from 2011 onwards there are consistent reductions in energy consumption and emissions compared to the baseline.
Fiscal deficits	The fiscal position of the Slovakian government declines from 2010 onwards as a result of the green measures. However, the impact is relatively small as the green spending amounts to only 6-8% of the total stimulus package. Furthermore, some of the outlay is recouped through higher tax receipts (resulting from multiplier effects). The small increase in national debt as a result of the green measures is unlikely to have any noticeable economic impact.
Productivity and innovation	Since many of the green measures included in Slovakia's national recovery plan address energy efficiency, improvements in energy and carbon productivity are observed in 2011. Furthermore, these improvements persist in the long run. Only very minor changes in labour productivity are observed since none of the green measures directly affect employment. There are no direct innovation effects.

Source(s): Cambridge Econometrics, E3ME.

Conclusions from the Slovakian package

Similarly to Germany the green part of the Slovakian package focused on a combination of energy efficiency and vehicle scrappage. The car scrappage scheme is likely to have provided an immediate boost to the large Slovakian car industry (suggesting that a lower share of the package went on imports than in other countries' schemes) and wider economy. This meant that despite the overall scale of the green recovery package being quite small (around 0.2% of GDP), the economic impact was reasonably large, particularly in 2009.

Transition to a low-carbon and resource-efficient economy?

Like many other European countries, the Slovakian measures focused solely on energy efficiency and greenhouse gas emissions and did not include any elements relating to other environmental factors. Our results suggest that the measures probably have resulted in modest reductions in long-term energy consumption and emissions (although with short-term increases due to higher rates of activity).

It should also be noted that, unlike many other European countries, the energy-efficiency measures have included sectors that are subject to international competition (in contrast to households or the public sector) and that this may yield some small competitiveness benefits.

In summary, the Slovakian measures appear to have been reasonably successful by giving a short-term boost to economic activity and also improving energy efficiency in the long run. This has been achieved through the combination of a car scrappage scheme that particularly benefits domestic industry and efficiency improvements in industry and in buildings.

Feasibility for introduction in other countries

For the most part the measures that were introduced in Slovakia were similar in nature to those that were implemented in other countries. The focus on industrial energy efficiency as well as efficiency in buildings is perhaps a distinction that could be applied in other countries (subject to state aid rules) as there are benefits to industrial competitiveness.

3.11 Sweden

Introduction

Five green recovery measures were identified in Sweden's national recovery plan. Most of the measures involve investment in eco-technologies or green innovation, one of the policy areas identified in the EC's Non-Paper (European Commission, 2009c). Energy efficiency is another policy area covered.

Policies

The five policies are:

- €13.7m worth of funds available in 2009, €39.8m in 2010 and €36.4m in 2011to support projects for 2nd generation biofuels. This was represented in E3ME as increases in exogenous investment in the manufactured fuels sector.
- €307m invested in the creation of a venture capital company to support green technology development in the motor vehicles sector. This was also represented in the modelling by an increase in exogenous investment in the relevant sector.
- €8.7m of support to the development of new batteries for electric vehicles. Modelled via an increase in exogenous investment in the motor vehicles sector.
- €182.8m of support to improve energy efficiency in different sectors spread over 2010-14. The package concentrates on local and regional voluntary energy-efficiency agreements, improvements in procurement, information and counselling and the reinforcement of governmental work to improve energy efficiency.
- A package of investments across three years to encourage the commercialisation of green technologies such as biogas and solar cells. This includes €9.4m of investment in 2009, €12.8m in 2010 and €12.2m in 2011, represented by increases in exogenous investment in the electrical engineering sector in E3ME.

It should be noted that in absolute terms, the investments are very small, so we would not expect to see large economic impacts. The stimulus package was worth 2.3% of annual GDP, of which the green elements contributed just 5%. This was spread over a three-year period.

Assessment methodology

The economic impacts of all of the green recovery measures for Sweden could be assessed using E3ME. As described above, most of the measures could be implemented in the model as a straight forward increase in (exogenous) investment in the sectors concerned.

It is much more difficult to assess the environmental outcomes, which are almost exclusively in the field of energy use and GHG emissions. This is due to the long-term nature of the research projects that are being supported, and the large amount of uncertainty in their outcomes. Our assessment is based on the following:

- these projects have not yet yielded results
- it is too early to tell if they will yield results in the longer term

We have therefore not imposed any outcomes (e.g. new types of bio-fuels) in the results. The exception to this is the measure to improve energy efficiency in industry, in which energy efficiency rises in response to increases in investment in existing technologies; a corresponding reduction in energy consumption was entered into the model, based on the methodology for *investment in energy efficiency* described in Section 3.3. This uses the EU average energy savings ratio for Sweden.

When modelling this measure, exogenous investment was entered into the public sector. Since we do not yet know which sectors benefitted the most from the measures to improve energy efficiency, the reduction in energy was shared out according to the

sectoral share of total fuel use. For example, the calculation assumes a sector such as road transport (which is a large energy user) receives a larger share of government support than, say, the textiles industry (a relatively low energy user), and therefore the reduction in energy from road transport is correspondingly higher.

Summary of results

Given these assumptions, the green policy measures implemented in Sweden generally lead to small but positive economic outcomes. The main results are presented in Table 3.15 as a percentage difference from baseline.

Table 3.15: Summary of Results, Sweden

SUMMARY OF RESULTS, SWEDEN

	2008	2009	2010	2011	2012	2020
GDP	0.01	0.02	0.04	0.04	0.03	0.00
Employment	0.00	0.00	0.01	0.01	0.01	0.00
Household spending	0.00	0.01	0.01	0.01	0.01	0.00
Investment	0.08	0.11	0.21	0.20	0.17	-0.01
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.02	0.03	0.03	0.03	0.00
Prices	0.00	-0.01	-0.01	-0.02	-0.01	0.01
CO_2 emissions	0.00	0.00	-0.01	-0.02	-0.04	-0.11
Energy consumption	0.00	-0.01	-0.01	-0.01	-0.02	-0.05

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

As shown in Table 3.15, the largest short-term impacts are an increase in investment, as a direct result of the public stimulus. The aggregate effects on GDP and employment are very small and are only temporary, as by 2020 results are effectively identical to the baseline. However, with a multiplier larger than one (as Sweden produces many of the investment goods internally) the short-term effects are quite big given the scale of the spending.

Since the measures specifically target energy efficiency (over the period 2010-14, no information about implementation so far has been found), production costs will decrease and so too will prices. This provides a further boost to household spending, which already experiences a positive impact from the increase in employment. However, the overall change is very small.

Environmental impacts

There are clear environmental benefits of the measures included in Sweden's national recovery plan. In 2010, energy consumption is reduced, as are CO_2 and other GHG emissions.

Some of the environmental impacts of the measures are not represented by the modelling. There are several measures included in the package which address eco-innovation in sectors such as manufactured fuels (developing biofuels), motor vehicles (developing clean car technologies) and electrical engineering (developing biogas and solar cells). While these are modelled as straight-forward increases in exogenous investment, there are environmental impacts too. All measures aim to reduce the consumption of fossil fuels and therefore reduce GHG emissions. The environmental benefits of eco-innovations like these are likely to be observed more in the long term, as the development and commercialisation of new technologies takes time.

Table 3.16: Overview by Assessment Criteria, Sweden

OVERVIEW BY ASSESSMENT CRITERIA, SWEDEN	
Assessment criteria	**Results**
Timeliness	This is dependent on the investment being made promptly. In our results it is assumed that payments are made in the specified years. As long as this holds, the GDP impacts are mostly in 2008-10 and the timeliness of the measures is therefore good. However, the economic impacts (including job creation and impacts on vulnerable groups discussed below) from the green measures will be small compared to the rest of the stimulus package.
Job creation impact	There is almost no impact on employment, with only very small increases in 2010. This is due to higher economic activity; from the policies there are no direct employment effects. It should also be noted that many of the new jobs are likely to be in fairly high-skilled research-based organisations, in contrast to the sectors that reduced employment in the recession. There is thus the possibility of skills mismatches.
Targeting to vulnerable groups	The green recovery measures do not specifically target vulnerable groups. The modelling results show that the impacts are uniform across all income quintiles. The government could introduce measures such as energy efficiency in social housing if it wished to target green measures specifically at vulnerable groups.
Environmental impact	The results show that CO_2 and GHG emissions fall slightly compared to the baseline in the short term. However, the longer-term impacts are highly uncertain because they depend on the outcomes of the supported research projects. All the measures focus on energy and GHG emissions so we should not expect major impacts on consumption of other resources. There are no measures that would be obviously harmful to the environment.
Fiscal deficits	The green measures are quite modest in nature so the impact on fiscal deficits is quite small. Some of this is recouped through higher tax receipts (resulting from multiplier effects) but it should also be noted that there will be a loss of revenues from fuel excise duties (which are high in Sweden). Overall, however, the green package amounted to only 0.1% of GDP and Swedish national debt is not particularly high, so a small increase in debt is unlikely to have any noticeable economic impact.
Productivity and innovation	The energy-efficiency measures will lead to short-term and persistent improvements in energy and carbon productivity, although these are quite small. There is a large emphasis on long-term R&D and innovation which could provide a platform for future growth.

Source(s): Cambridge Econometrics, E3ME.

Conclusions from the Swedish package

The impact of the economic crisis on Sweden was quite modest compared to some other European countries and the size of the response was also modest in size but well-suited to Sweden's strengths. The share of the green part of the total package was small (and in environmental terms focused only on energy and greenhouse gas emissions), although it should be noted that Sweden was already ahead of most of Europe in developing environmental policy. In summary, unlike many other European countries, Sweden was able to focus much more on long-term investments that may not see an immediate return.

Transition to a low-carbon and resource-efficient economy?

In the short term, investment in energy efficiency will have helped to increase transition to a low-carbon economy, but the effects are very modest. It is the potential longer-term impacts that are more interesting, although unfortunately very uncertain in nature. They include potential innovation in:

- new generation bio-fuels
- development of new batteries and other green technologies for vehicles
- commercialisation of green technologies such as solar cells and biogas

It is too early to tell if these research projects will lead to the development and deployment of new technologies but there is the potential that they could lead to significant reductions in carbon emissions in Sweden and other countries in the future. If this was the case there would also be likely long-term economic benefits to Sweden.

There were no policies concerning the use of other resources.

Feasibility for introduction in other countries

The key constraint on implementing these measures is that it is necessary to have the infrastructure available to carry out the research. In particular, a workforce with the right mix of skills must be available and the ability to turn research outputs into marketable products must also exist (one of the policies looked at this topic in particular).

3.12 United Kingdom

Introduction

There are numerous green recovery measures in the UK's national recovery plan. These measures cover a variety of the policy areas outlined in the EC's Non-Paper (European Commission, 2009c), namely energy efficiency, public transport, and renewable energy.

Policies

There are eight policies included in the UK's national recovery plan, which could be considered to be 'green':

- The Warm Front Programme is a £150m initiative to improve energy efficiency in households through subsidising insulation and heating upgrades.
- The Decent Homes Programme is another policy aimed at improving energy efficiency in buildings. The programme aims to upgrade around 16,000 social houses with energy-efficiency measures in 2011, investing £60m in total.
- £20m investment to provide flood defences for 27,000 homes.
- £300m investment to extend the capacity of the railway network by adding an additional 200 carriages.
- £5m investment to improve the energy efficiency of the British Waterways Network infrastructure.
- £525m of support to offshore wind development via Renewables Obligation Certificates (ROCs).
- £250m scheme aimed at promoting ultra-low-carbon vehicles such as electric plug-ins and hybrids. A reimbursement of £4,500 is given for each vehicle purchased.

The plans also included a possibly environmentally harmful measure, the expansion of the A46 road. This is not included in the results below.

Assessment methodology

All of the green measures included in the UK's national recovery plan could be assessed at least partially using modelling techniques. For some this meant a straight forward increase in exogenous investment in the relevant sectors, such as in land transport for the investment in railway infrastructure, although the modelling cannot determine the transport-specific effects. For the waterways network only the additional investment was included, since it was not possible to determine which sector to allocate the energy reduction to. For these scenarios the environmental impact is not included in the summary results table. We therefore consider the likely environmental benefits of these measures along with the modelling results in the following sub-section.

Two of the green measures listed above, the Warm Front Programme and the Decent Homes Programme, both involved investment for the improvement of energy efficiency in buildings. They were therefore assessed using the methodology described in Section 3.3 for *investment in energy efficiency*. The UK is well-known for having an inefficient housing stock, suggesting that there could be low-cost investments with high energy savings. However, we have used the EU average ratio, to maintain consistency with other countries.

The ultra-low-carbon vehicles initiative was assessed in a similar way to the car scrappage schemes carried out in other Member States. The specific methodology is detailed in Section 3.3, under *car scrappage schemes*. Some of the figures used in the UK calculation were, however, different due to the slightly different nature of the scheme. While other car schemes included scrappage of an old car, the UK ultra-low-carbon vehicles initiative did not. For this reason, instead of comparing the average

CO_2 emissions of a new car with the average emissions of all cars on the road in Step 1 of the calculation, the average emissions of a new hybrid car (assumed to be 100gCO_2/km) were compared with the average emissions of all new cars. It was also assumed that only hybrid cars are bought under the scheme (as opposed to a mixture of hybrid and electric cars), since 99% of EV and PHEV cars bought in the UK are PHEVs[50].

Finally, Section 3.3 also describes the methodology used to assess the policy that aimed to further the development of offshore wind energy generation (*investment in renewables*).

Summary of results

The impact of the green recovery measures was found to be mildly positive for the UK economy. Together the measures represent 5.1% of the total stimulus package, which itself is only worth the equivalent of 1.5% of UK GDP; it is therefore not surprising that impacts are small. As shown in Table 3.17, GDP only increases by 0.07% compared to the baseline in 2009, and there is no lasting economic impact of the measures.

In the short term employment is boosted slightly by the additional jobs that the green measures create, plus the additional household spending that results from these jobs. We would expect most of the jobs to have been created or saved in the construction industry. None of the measures have a direct impact on employment.

Several of the measures specifically address energy efficiency and the reduction of GHG emissions (the efficiency in buildings measures, low-carbon vehicles subsidy and investment in renewables). The results therefore show a small initial reduction in both emissions and energy consumption.

Other environmental impacts

As previously mentioned, for some of the measures only the investment was used as an input to the model. The environmental benefits of these measures are therefore not reflected in the results shown in Table 3.17. This is the case for the investment in flood defences, the expansion of the railway network, and the improvement of the waterways infrastructure.

Included in the UK's stimulus package is £20m investment in flood defences for households. Investing in flood defences is an example of a measure that focuses on adaptation to climate change as opposed to mitigation. The benefits to coastal and riverbank households are both tangible (in terms of money saved) and intangible (reduced stress and anxiety). These benefits may not be realised until later in the forecast period.

The £300m investment in the railway network will increase its capacity by adding an additional 200 carriages. Much of this extra capacity will be concentrated in the Thames Valley, which is a busy commuter zone, since it provides fast rail and road links to London. However, the trains on these lines are notoriously crowded. By expanding the capacity of the rail network, it is possible that more commuters will be encouraged to take the train rather than drive. This has clear environmental benefits as vehicle emissions are reduced. However, this is only one factor in commuting choices so the benefits may in fact be a greater level of comfort to commuters. Either way, since the size of the investment is relatively small, it is unlikely that the environmental results shown in Table 3.17 would change a great deal, although perhaps a small fall

[50] See https://www.smmt.co.uk/shop/motor-industry-facts-2011-2/

in emissions and energy consumption would be seen from 2010 onwards, rather than no change.

The smallest of the green measures included in the UK stimulus plan addresses the energy efficiency of the waterways network by improving its infrastructure. This measure could help to reduce the total fuel used by the network. However, this reduction in fuel use will be very small, based on the £5m total investment. Using our assumed figure for the percentage reduction in fuel use for a €1m investment (from the *investment in energy efficiency* methodology in Section 3.3), we are able to say that this measure would lead to a 0.003% reduction in energy use. There could, however, be other environmental benefits through improved local conditions.

Table 3.17: Summary of Results, United Kingdom

SUMMARY OF RESULTS, UNITED KINGDOM

	2009	2010	2011	2012	2013	2020
GDP	0.07	0.04	-0.02	-0.01	-0.01	0.00
Employment	0.02	0.03	0.01	0.00	0.00	0.00
Household spending	0.05	0.02	-0.02	0.01	0.00	0.00
Investment	0.35	0.28	0.04	0.00	-0.01	0.01
Exports	0.01	0.01	0.00	0.00	0.00	0.00
Imports	0.04	0.04	0.03	0.03	0.02	0.01
Prices	-0.04	0.01	0.05	0.00	0.01	0.01
CO_2 emissions	-0.01	0.00	0.02	0.00	0.01	0.00
Energy consumption	-0.02	-0.01	0.01	0.00	0.01	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

Table 3.18: Overview by Assessment Criteria, United Kingdom

OVERVIEW BY ASSESSMENT CRITERIA, UNITED KINGDOM	
Assessment criteria	**Results**
Timeliness	This is dependent on the investment being made promptly. In our results it is assumed that payments are made in the specified years. The timeliness of the measures therefore appears to be good, since the highest impacts on GDP are seen in 2009. Although the economic impacts of the green measures are relatively small, it should be noted that they only account for around 5.1% of the total UK stimulus package.
Job creation impact	The impact on employment is small but still positive, with improvements in employment in 2009-11. The additional jobs created directly by the measures will be concentrated within a few industries, for example construction and engineering. None of the policies create jobs directly.
Targeting to vulnerable groups	Only one of the green recovery measures specifically targets vulnerable groups – the Decent Homes Programme. This aims to upgrade the energy efficiency of 16,000 social houses. However, the monetary size of this measure (£60m) is small compared to the size of the total stimulus package. Otherwise there may be some small benefits due to the increase in low-skilled jobs in construction caused by other measures.
Environmental impact	The short and long-term environmental impact of the green recovery measures is lower in percentage terms than the economic impacts. The results show that CO_2 and GHG emissions fall initially compared to the baseline by around 0.01-0.02%. There are no measures in the UK stimulus package that would be obviously harmful to the environment, except possibly the road expansion.
Fiscal deficits	The green measures are quite modest in nature (around 0.1% of GDP) so the impact on fiscal deficits is quite small. Although the fiscal deficit is made larger throughout the whole forecast period, this is unlikely to have any significant economic consequences. The subsequent austerity measures, aimed at eliminating the structural deficit by 2014/15, taken by the UK government are much larger in scale.
Productivity and innovation	The energy-efficiency measures will lead to small improvements in energy and carbon productivity in the short and long term. The support for ultra-low-carbon vehicles may provide support for innovation in the longer term.

Source(s): Cambridge Econometrics, E3ME.

Conclusions from the UK package

The UK stimulus package was found to be quite small in size and the green part of it was also small, although this is in part due to our exclusion of the car scrappage

scheme as a green measure. It is therefore not surprising that the economic impacts of the measures are also very small. Our results show that the measures contributed a temporary boost of less than 0.1% of GDP in 2009. Impacts on employment were even smaller.

Transition to a low-carbon and resource-efficient economy?

The focus of the measures was on renewables, transport and energy efficiency. However, the environmental impact of the measures on renewables was limited by the focus on offshore wind, which is currently a relatively expensive technology (although the hope is that the ROCs will help to boost long-term production). The green transport measures focused on rail, although the wider package included investment in roads.

The energy-efficiency programmes were relatively small in scale and are likely to have contributed only minor long-term energy savings. The UK was unusual in that it explicitly targeted vulnerable groups in these investments, but the effects were still small.

Other than energy consumption and emissions, the UK measures could have had some other small environmental impacts. There are also some policies where the impacts are not clear, including the large investment in additional rail capacity (on existing rather than new routes) and the possible harmful effects of the improvement to the A46 East Midlands road.

Feasibility for introduction in other countries

Some of the policies that were implemented were specific to conditions in the UK (notably the rail expansion and the flood defences) and the support for ROCs complements an existing UK policy. However, the underlying principles of the package are broadly consistent with many other European countries, although much smaller in relative size.

The key point that could be of interest to other countries is the targeting of the energy-efficiency measures towards social housing, benefiting low-income households who spend a larger share of income on energy. The UK also has more scope than most for improving energy efficiency in buildings due to its housing stock.

4 Assessment of Non-EU Countries' Green Recovery Plans

4.1 Introduction

In this chapter we provide an assessment of the measures that were undertaken in the four non-EU countries included in the analysis. This relates to Task 5 of the project.

Similarly to the previous chapter, a combined assessment approach is applied to each policy case to analyse the macroeconomic and environmental impacts of the identified green recovery measures. The results are presented in a similar manner against the same assessment criteria.

One important difference to note is that the modelling uses the E3MG model rather than E3ME. E3MG is global, rather than European, in coverage (although with less country detail within Europe) but is otherwise almost identical in structure. E3MG is described in more detail at www.e3mgmodel.com. South Korea is not explicitly defined in the model (it is grouped with other Asian countries) and so we use a more ad-hoc assessment approach.

As with the European countries, additional results on a policy-by-policy basis are presented in Appendix B.

4.2 Australia

Introduction

Two green measures were identified in Australia's recovery plans. They are generally quoted in Australian dollars and are converted to US dollars for our assessment.

Policies

The policies are as follows:

- 3.3bn AUD were devoted to The Energy Efficiency home package, with the majority of this going towards free ceilings insulation for 2.7m homes.
- 1.2bn AUD went towards 17 Australian Rail Transport Corporation (ARTC) projects. The projects focused specifically on; the interstate rail network, reducing transit times between major cities, reducing annual maintenance costs, improving ride quality and raising line capacity.

Assessment methodology

The energy-efficiency measures were modelled in the same way as those for the European countries, described in Section 3.3. As the IEA figures do not explicitly define Australia, we have used the USA as a proxy for determining units of energy reduction per millions of dollars invested.

For the investments in railways we have only included the economic impacts through a boost to investment. Other possible impacts are described below.

The findings in Section 4.1 suggest that both policies were implemented quickly and were in the majority of cases completed by the start of 2011. We have therefore split most of the investments evenly between 2010 and 2011 in the analysis, with one third of the rail investments running into 2012-13.

Summary of results

Table 4.1 shows a summary of the impacts of the measures. The two measures combined represent more than 10% of the total stimulus package in Australia and the results suggest an immediate small boost to GDP over 2010-11 in the range of 0.3%. Investment increases by 1% as a result of the measures. The change in GDP remains positive in 2012-13 as the final rail projects are completed and in the long run there is a small boost to GDP through the efficiency gains from energy savings.

The results also suggest a small temporary boost to employment. As with the European countries, the additional or saved jobs would have been in the construction and engineering sectors that delivered the investment projects.

Environmental impacts

Our results suggest a small but permanent reduction in energy consumption in the period up to 2020, due to the energy-efficiency measures. There is a corresponding reduction in CO_2 emissions.

There are also likely to be reasonably sized benefits from the expanded rail networks. The focus of the investment was on improving the travel time between major cities in Australia; as Australia has a relatively underdeveloped rail network this could offer an alternative to road and air travel for passengers and road haulage for freight. One government estimate[51] suggests that the investments will remove 1m trucks a year from the M5 motorway near Sydney.

A dedicated transport model could give an estimate of the impacts on transport and related emissions and in the next two years it should be possible to carry out an ex-post analysis of the investment.

[51] See http://www.financeminister.gov.au/archive/media/2010/mr_202010_joint.html

There are other possible minor impacts on the environment from the measures. The investments are quite material intensive and the new rail infrastructure will require land on which to operate. However, a large share of the track is likely to pass over land that is not currently used for other purposes.

Table 4.1: Summary of Results, Australia

SUMMARY OF RESULTS, AUSTRALIA						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.31	0.32	0.07	0.06	0.03	0.05
Employment	0.03	0.03	0.02	0.04	0.03	0.03
Household spending	0.02	0.05	0.07	0.10	0.11	0.09
Investment	1.06	1.06	0.14	0.06	-0.06	-0.01
Exports	0.00	0.00	0.00	0.00	0.00	0.01
Imports	0.14	0.16	0.07	0.07	0.06	0.03
Prices	-0.03	-0.06	-0.07	-0.06	-0.05	-0.07
CO_2 emissions	-0.06	-0.07	-0.10	-0.09	-0.09	-0.04
Energy consumption	-0.16	-0.16	-0.16	-0.15	-0.14	-0.07

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

Conclusions from the Australian package

Australia was partly insulated from the full effects of the global slowdown due to its natural resources and links to China and the Far East. It was therefore able to take a slightly longer-term view in its stimulus package. Nevertheless, the policies that we have assessed were announced and implemented quickly.

We have considered two policy packages, one of which focused on domestic energy efficiency and one on the expansion of the rail network. Both of these, but particularly the former, provided an immediate boost to investment and GDP. The energy-efficiency measures also provided a long-term boost to productivity.

The economic impacts of the expanded rail network are more difficult to judge because they require an estimate of passenger numbers and reductions from road and rail. However, we suggest that they could be of reasonable size, as there are significant reductions in journey times between major cities.

Transition to a low-carbon and resource-efficient economy?

Similar uncertainty exists over the environmental benefits of the measures, because these also depend on the uptake of new rail services by passengers and by freight. Again they could be reasonably sized if there is a substantial transfer from road (and air) to rail.

The energy-efficiency measures are likely to have permanently reduced energy demand by up to 0.1%. There were no other major environmental impacts.

Feasibility for introduction in other countries

The energy-efficiency measures that were carried out in Australia are similar in scope to those in European countries, although with a particular focus on solar energy to reflect the higher sunlight levels. The rail measures are fairly specific to Australia, reflecting the relatively undeveloped network that exists, and therefore the potential to shift traffic from road and air to rail.

Table 4.2: Overview by Assessment Criteria, Australia

OVERVIEW BY ASSESSMENT CRITERIA, AUSTRALIA

Assessment criteria	Results
Timeliness	Although the Australian package focused on investment schemes, which can take longer to implement, the indications are that they have progressed quite quickly and gave a boost to GDP in 2009-10. The majority of projects were completed in this period.
Job creation impact	The measures do not address job creation directly, but the affected sectors are the ones that were hit by the sharp reductions in investment spending in the recession (e.g. construction and engineering). The jobs that are created are temporary but could be replaced naturally as the economy recovers. The link in Footnote 51 provides some government estimates of jobs associated with the rail schemes, although it is not clear how they were derived.
Targeting to vulnerable groups	There is no evidence that the measures were targeted to vulnerable groups. Low-income households could benefit from the offer of free ceiling insulation, but are unlikely to benefit from subsidies for solar heating systems.
Environmental impact	There are clear benefits from the energy-efficiency measures that are permanent in nature. These are included in our results. It is much more difficult to judge the impact of the rail schemes as this depends on the resulting reductions in road and air travel. The scale of this is difficult for us to judge with the available tools and information but the effects are very likely to be positive in nature.
Fiscal deficits	The Australian green measures accounted for up to 2% of GDP, mostly spread over 2009-10. As Australia is in a relatively strong fiscal position this will have had no major impact.
Productivity and innovation	The additional transport infrastructure will boost productivity by reducing journey times between major cities, with some of the savings being quite substantial. The energy-efficiency measures will also lead to reductions in energy intensity. There are no direct effects on innovation.

Source(s): Cambridge Econometrics, E3MG.

4.3 China

Introduction

Four green measures were identified in China's national recovery plan. The measures cover a variety of areas identified in the EC's Non-Paper *Green Elements from Member States' Recovery Plans* (European Commission, 2009c), with a particular focus on transport and electricity infrastructure.

Policies

The green measures for China are:

- $182.4bn towards energy-efficiency improvements, mainly in rail networks and electricity grids.
- $400m towards a car scrappage scheme. This included a 5% reduction in sales tax on new cars with an engine size lower than 1.6 litres.
- $1.5bn towards a subsidy package in alternative energy cars. The rebates were set at between $450 and $900, with the government aiming to withdraw 2.9m inefficient cars by the end of the programme (May 2010).
- $30bn towards environmental improvements and cleaning up of and reduction of pollution.

Assessment methodology

All of the investments have been assessed in economic terms using E3MG. We have also added in a representation of the car scrappage scheme to the model, using the methodology described in Section 3.3, although some of the underlying assumptions may be less appropriate for China than for other countries (see below).

The environmental aspects of the other measures are subject to a wider range of uncertainty and are discussed separately below.

Summary of results

A summary of the results from the modelling is shown in Table 4.3. Given the speed of the initial response we have assumed that most of the spending is spread over 2009-10. The results therefore show that there was a large and immediate boost to GDP (around 4%) from the investment in rail and grid networks, which accounted for more than 80% of the total green measures. The measures add close to 10% on to total investment in China.

Our modelling results show almost zero impact on energy demand in the long run and a small reduction in emissions; however, given the scale of the investment and the rapid development in China's power sector, this should not be viewed as significant.

Investment in rail infrastructure

The largest single part of China's stimulus package is in rail infrastructure. For the other countries we have suggested that it is not possible to provide an estimate of the impacts of these investments because we do not know the displacement from other forms of transport. When considering investments in China, we must consider future displacement from other forms of transport in the context of rapid economic growth. This is an even more difficult assessment but the suggestion is that the rail services are likely to have a bigger impact (compared to a baseline) because it is easier to get new commuters to use rail than to persuade existing commuters to switch from other modes.

However, with the rapid accumulation of capital in China it is also necessary to consider how long it would have been before the services were built anyway. The conclusion is thus that the large-scale investment will have positive environmental benefits (at least in terms of energy consumption and emissions) but some of these positive effects would probably have been realised at a later stage without the stimulus.

Investment in electricity grids

The second biggest investment was in electricity grids. Again this is an investment that was likely to have happened at a later date anyway, but it is likely that the investment has led to a reduction in transmission losses (although very difficult to say how much). Like in European countries, some of the grid measures were aimed to aid the integration of renewable capacity so there is the possibility of a future increase in renewables.

Cleaning pollution

China is the only country to have allocated funds specifically for cleaning pollution, as part of a general measure to support environmental industry. This is the only measure that does not focus on energy or transport and is likely to have a broader impact on local environments. However, the scale of the funding is not large when spread across China's entire population so the impacts are likely to have been restricted to particular localities.

Car scrappage scheme

Our modelling results suggest that the car scrappage scheme had almost zero effect on fuel consumption and CO_2 emissions. This is because the short-term boost to economic activity and car manufacturing requires more energy than is saved by the vehicles.

This is a curious result that calls into question the realism of the assumptions used in the scenario. The Chinese subsidy is much smaller than the one used in the German scheme, meaning that a larger share of private money was used. Our assumption is that this would otherwise have been saved. In Europe in 2009-10 this may have been a reasonable assumption, but the Chinese economy did not stop growing. Our suggestion is therefore that the economic impacts are exaggerated, as many of the new vehicles would have been bought anyway, and some spending was displaced from other goods.

An alternative set of results, where only 50% of the spending is additional, is presented in Appendix B. These show that the increase in GDP from the car scrappage was more modest and there was a small short-term reduction in energy consumption.

Table 4.3: Summary of Results, China

SUMMARY OF RESULTS, CHINA

	2009	2010	2011	2012	2013	2020
GDP	4.20	3.58	0.45	0.12	-0.05	0.06
Employment	0.21	0.09	0.10	0.26	0.25	-0.02
Household spending	0.52	2.48	0.61	-0.17	-0.34	-0.06
Investment	9.47	6.89	0.65	0.58	0.45	0.33
Exports	0.03	0.03	0.03	0.07	0.07	0.06
Imports	0.15	0.32	0.17	0.16	0.29	0.12
Prices	0.79	-0.17	-0.63	-0.11	0.05	0.10
CO_2 emissions	1.29	0.90	-0.60	-1.60	-2.44	-0.41
Energy consumption	1.53	1.68	0.34	0.04	-0.06	0.03

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

Table 4.4: Overview by Assessment Criteria, China

OVERVIEW BY ASSESSMENT CRITERIA, CHINA	
Assessment criteria	**Results**
Timeliness	The political situation in China meant that the government was able to make a quick response to the crisis, with large amounts of investment front-loaded into 2009-10.
Job creation impact	None of the measures had direct job impacts, but this must be considered in the context of the role of the state in China. Our results suggest only small net changes in employment but this is in part because the state finds jobs for people. Hence the main impacts would be movements between sectors, especially into construction and engineering.
Targeting to vulnerable groups	There is no indication that the measures were targeted towards vulnerable groups. The largest measures, in rail and electricity infrastructure would have had no particular benefit to these groups.
Environmental impact	The environmental impact from the largest measures is unclear and must be considered in the context of China's rapid rates of growth. However, it seems likely that there will be environmental benefits in the short term at least. Our results suggest that the environmental effects of the car scrappage scheme will be limited at best, but the $30bn allocated to various environmental measures will have a small benefit.
Fiscal deficits	The stimulus package, and the green part of it, contributed a substantial share of GDP. However, China has both a high savings ratio and fast growth so there is no real impact.
Productivity and innovation	The measures to build new rail and electricity infrastructure should be viewed in the light of a rapid accumulation of capital in China. The measures will have boosted productivity but this would probably have happened in the near future anyway. In terms of innovation, the funds directed at alternative fuels for vehicles should support research in this area.

Source(s): Cambridge Econometrics, E3MG.

Conclusions from the Chinese package

The scale of the Chinese package, both in absolute terms and as a share of GDP, was large, and the green elements represented a significant share of it. The speed with which the Chinese authorities were able to act, even for investment projects, meant that the measures added around 4% to GDP over 2009-10. As a result of this and the rest of the stimulus package, Chinese growth rates were relatively unchanged over the period.

Our results suggest there would also have been a small boost to employment, but the nature of the labour markets in China meant that it is more likely there was a shift in jobs between sectors (into construction and engineering) rather than a large net change in total employment.

Transition to a low-carbon and resource-efficient economy?

By far the largest green element of the stimulus package was a boost to investment in rail and electricity infrastructure. This is unlikely to have been made purely for environmental reasons but our findings suggest there could have been quite large

short-term benefits. Chinese growth rates mean that these are unlikely to persist because at some point the projects would have been undertaken anyway.

The other measures (excluding the car scrappage scheme) would have had a small net benefit to the environment in various ways.

Feasibility for introduction in other countries

Although many of the European countries included large amounts of investment in their stimulus plans, the scale in China is very different. The success of the policies in China is to a certain extent reliant on the rapid current rates of development and the ability to implement projects quickly. Therefore they were likely to have been more effective as economic instruments in China than they would have been in Europe.

China was the only country that explicitly allocated funds for cleaning up pollution. While this may also be specific to China there could have been examples in Europe where such a policy could have been used to help economic output and local environments.

4.4 South Korea

Introduction

South Korea is included in the assessment because of the large share of green elements in its fiscal stimulus package (78.7%). In particular the 'Green New Deal Job Creation Plan' (referred to as Green New Deal below), which was announced in early 2009, focused on environmental investments. The subsequent five-year plan expanded on this.

It should be noted, however, that the 'greenness' of some of the policies was later questioned[52], particularly given the short-term impacts on CO_2 emissions.

Policies

The green elements of the South Korean stimulus package can be grouped into three categories:

- low-carbon power
- energy efficiency
- water and waste water

Assessment methodology

As South Korea is not explicitly defined in the E3MG model we do not apply a modelling approach in the assessment. Our approach is therefore more descriptive, for all of the policy types, drawing on the limited quantitative information that we have available.

Summary of results

All of the measures are investment-based, but the Korean government was fast to announce and implement them; it is therefore reasonable to assume that the positive economic effects from the Green New Deal were mostly seen in 2009-10. However, due to the open nature of the South Korean economy, it is likely that a fairly large share of the spending ended up on imported goods (e.g. machinery and other capital goods). It is unlikely that the boost to domestic production was more than the investment spending that was made (i.e. a multiplier of one).

Combining these assumptions, the estimate of the green measures on GDP in 2009-10 is in the region of 1%. This is not an insignificant amount.

Although the Green New Deal mentions employment in its full title, we have not found any information relating to employment explicitly. Therefore we can provide a rough estimate based on GDP growth; typically our model results show that the increase is half that of GDP, so a 0.5% increase is estimated. As with the other countries that have focused on investment measures, these jobs are likely to have been in traditionally male-dominated sectors such as construction and engineering.

Low-carbon power

According to the UN Millennium Development Goals Indicators[53], South Korea was the tenth largest emitter of CO_2, behind only Germany, the UK and Italy in Europe. It is similarly ahead of most European countries in terms of emissions per capita. According to the IEA, South Korea's primary energy consumption increased by five times between 1980 and 2005. Over the same period final consumption of electricity increased by ten times. Such growth rates suggest that new capacity would be additional, rather than replacing existing power plants.

A total of $15bn was allocated to low-carbon power in the Green New Deal. According to HSBC (2009) the funding was allocated to a combination of wind, solar and biodiesel. If we assume an even split and apply the average costs given in Section

[52] See e.g. http://www.guardian.co.uk/environment/2009/apr/21/south-korea-enviroment-carbon-emissions

[53] See http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=749&crid=

3.3, this suggests an increase in capacity of just over 5GW. This is between 5% and 10% of total electricity capacity in South Korea. Although power generation accounts for a relatively small share of emissions in South Korea, this could still lead to an emissions reduction of 1-2%.

Energy efficiency

In comparison, the energy-efficiency spending was much smaller in the Green New Deal, although much bigger in the Five-Year Plan. The funding was spread across measures for private and public buildings and transport. A rough estimate, based on the methodology outlined in Section 3.3 suggests that direct energy savings would have been up to 0.1% of final consumption.

Water and waste water

The final group of measures was fairly diverse in nature. There were benefits for rivers and forests and other measures to promote recycling. The measures included the construction of several dams which will also help to provide a guaranteed freshwater supply. This group of measures was not extended in the Five-Year Plan.

It should be noted that this group of measures (in particular constructing dams and concrete river embankments) may have had other harmful environmental impacts, in terms of large quantities of mineral-based materials used and land-use requirements. The GHG emissions from the production of concrete and from the construction sites should also be taken into account in the evaluation.

Conclusions from the South Korean package

South Korea's fiscal stimulus package was found to be the one with the highest proportion of green elements (HSBC, 2009). It is therefore included in this assessment as an example of how far the green measures can go, although it must be noted that the environmental nature of some of the measures has been questioned.

Our assessment was only able to look at the direct effects, but it suggests that the green measures did have a large and positive impact on GDP and employment in 2009-10. This came at a cost to central government, but relatively low debt levels meant that the stimulus could be funded fairly easily.

Transition to a low-carbon and resource-efficient economy?

The largest part of the package focused on renewables. Our findings suggest that this could reduce future CO_2 emissions by as much as 2% although it is noted that short-term increases are likely, and that this is from a base in which emissions are growing relatively quickly. The other measures had benefits in water management and resource efficiency although this must be balanced between (temporary) higher material demands, especially for concrete, and land-use requirements from the dams.

The Five-Year Plan, which is not included in our assessment, is likely to double the effects of the low-carbon investment, and could add a similar saving in emissions from new energy-efficiency measures.

Feasibility for introduction in other countries

The key reason for including an assessment of South Korea was to determine whether such a green stimulus package could be applied in European countries.

The answer to this is neither an unqualified yes nor a definite no. First, it should be noted that the package was entirely focused on investment and the economic benefits were only realised quickly because of the efficiency of the South Korean government.

Second, the demand for the investment must exist. South Korea was able to add renewables capacity partly because demand for electricity could be expected to expand in the future. Similarly the dams were constructed in places that were available and where it made sense to do so. It is noticeable that the smaller-scale energy-efficiency

projects, which made up a large part of many European packages, are not an important part of the Korean package.

However, given these conditions, there is no reason to suggest that South Korea benefited less than if the stimulus had been applied elsewhere. There is also likely to be a long-term benefit from reduced fossil fuel imports. The conclusion is therefore that the additional demand for environmental products can be made as long as there is an available supply to match.

Table 4.5: Overview by Assessment Criteria, South Korea

OVERVIEW BY ASSESSMENT CRITERIA, SOUTH KOREA

Assessment criteria	Results
Timeliness	Despite being highly focused on investment projects, a quick reaction by the South Korean government meant that the measures were carried out in a timely fashion, with boosts to the economy in 2009-10.
Job creation impact	The Green New Deal explicitly mentions job creation as one of its aims but we did not find specific measures. Nevertheless, a crude estimate suggests that the measures boosted employment by around 0.5% in 2009-10, mainly in the construction and engineering sectors.
Targeting to vulnerable groups	There were no references found to specific targeting. The only part of the package that may have benefited vulnerable groups is the energy-efficiency measures, which made up a small share of the total.
Environmental impact	The measures are likely to have led to a small reduction in South Korea's energy consumption and emissions (possibly up to 2%), although, as we found with in other countries, the short-term effects are likely to have been an increase in emissions due to the large construction projects. This must also be considered in the context of rapid growth. The third package led to increased water supplies and specified a range of different measures to protect natural resources, but would have had negative impacts on material consumption (especially concrete) and land use.
Fiscal deficits	The green elements of South Korea's package came to around 4% of GDP, so this question is highly relevant. However, South Korea has a relatively small national debt so would have been able to fund the measures fairly easily.
Productivity and innovation	The main boost to productivity is likely to have come at the macroeconomic level through reduced imports of fossil fuels (for power generation). The measures to boost energy efficiency may also have had a small impact but there are no other major factors. There are no direct effects on innovation.

Source(s): Cambridge Econometrics.

4.5 USA

Introduction

There are a large number of green elements within the recovery plans of the USA. These can be found within two policy initiatives: the Energy Improvement Extension Act (EIEA) of 2008, and the American Recovery and Reinvestment Act (ARRA) of 2009. To keep the task manageable we have grouped some similar policies together in the definitions used below and the modelling scenarios.

The overall size of the stimulus package was 7% of GDP of which 12% is estimated to have been green. However, although much of the spending did take place over 2009-10 (the US government's response was both quick and large), the implementation period is quite long with many of the measures lasting over several years.

Policies

The majority of policies that contained green elements are found within the EIEA, and are as follows:

- $758m towards a tax credit for plug-in electric vehicles. The minimum credit is $2,500 for a vehicle powered by a traction battery with capacity of at least 4 kilowatt hours. An additional credit of $417 is allowed for each additional kilowatt hour of traction battery capacity until the applicable credit cap is reached. The cap is $7,500 for lighter vehicles. However, for heavy vehicles with gross vehicle weight ratings (GVWRs) in excess of 10,000 pounds, the cap is $10,000-15,000 depending on the GVWR.
- $7.7bn towards extending the business energy tax credit for qualifying solar, fuel cell, micro-turbine, and geothermal energy equipment.
- $1.3bn towards credit (extended from 2008 up to 2016) for residential energy-saving expenditures, including solar and wind equipment.
- $827m towards building efficiency measures, involving a credit for installing energy-efficient insulation, windows, doors, roofs, and heating and cooling equipment.
- $891m towards the extension of a law to 2013 which allows deductions (instead of capitalisation) to the cost of qualified energy-saving improvements for commercial buildings.
- $600m towards a business and personal tax credit for alternative fuel vehicle refuelling property.
- $268m towards a contractor tax credit for building energy-efficient homes. The credit can also be claimed for substantially reconstructing and rehabilitating an existing home and making it more energy efficient.
- $322m towards a tax credit for manufacturing energy-efficient appliances, including dish-washers, washing machines and refrigerators. The credit ranged from $45-250 depending on the year, type of appliance and degree of efficiency.
- $10m towards a fringe benefit to bicycle commuters. Under this scheme, employers can give employees tax-free reimbursements of up to $20 per month to cover reasonable expenses to buy, improve, repair, or store bicycles regularly used for commuting to work.
- $48m towards extending the production tax credit for wind energy.

The ARRA contains the following green elements in its recovery plans:

- $198.2bn towards infrastructure and renewable energy projects, although at least some of the infrastructure spending should not be considered as green. This includes: a tax credit for renewable energy production ($13.1bn), investment in

new energy transmission networks and health information technology ($25.1bn), infrastructure spending ($120bn) and investments in energy infrastructure (in particular smart-grid technology, $40bn).
- $8.9bn on high-speed rail ($8bn) and various energy-efficiency measures. This figure only includes the money that has been spent so far; it is noted that there are remaining funds that may or may not be fully used, and potential strong co-financing impacts.
- $3.4bn towards CCS research and deployment from 2009-2012. This is also expected to raise $7bn in private capital.

Assessment methodology

Many of these measures go into a much higher level of detail than that offered by the modelling. For many of them the environmental effects are quite unclear, including investment in electricity grids; this is the largest contributing factor to the results for energy consumption and CO_2 emissions, so we have removed this from the table below (the model results otherwise show little long-term change). An assessment of the US measures could easily fill an entire report so in this section we focus on the most important measures. They are described below.

Summary of results

Table 4.6 summarises the effects of the spending. The results for energy consumption and emissions reductions have been excluded due to the large degree of uncertainty, particularly relating to electricity grids and transmission losses. It should also be noted that the economic impacts are questionable due to the definition of what counts as green (e.g. we have not included any of the $120bn of infrastructure spending) and the timing of the investment measures. The amount of leveraging achieved by some of the measures is also very unclear (we have not included any), but could have a strong impact on the economic results.

The figures in the table should be therefore only viewed as approximate, but they show a modest increase in GDP (and a smaller increase in jobs) over the recession period. This is led by investment spending, which was particularly hit during the crisis. Due to the structure of its economy, a relatively small share of the USA's stimulus package went abroad through imports although, because of its absolute size, this would still have boosted global activity slightly.

Renewables and electricity grids

The largest part of the stimulus package was used to promote the uptake of a range of renewables technologies and development of electricity grids. Although the US has a large potential for both solar and wind energy, development has been hampered by grid limitations, so these combined measures aimed to boost adoption. However, this must also be viewed in the context of continued support for conventional generation methods and a lack of carbon pricing.

Even so, the development of an advanced electricity grid provides the means for future integration of renewables, at both the micro and large-plant level. The same is true for the research into CCS technologies (3% of the green spending) which are unlikely to be available on a commercial scale until beyond 2020.

The benefits of smart grids are also more likely to be realised in the longer term, most likely beyond 2020. Again, the infrastructure provides the means to realise these benefits in the future. Spending on smart grids accounted for more than one third of the total green elements of the stimulus packages.

Energy-efficiency improvements

In the packages there are several measures that relate to energy efficiency, mainly in buildings, plus some smaller measures aimed at appliances. We assessed these using

the methodology outlined in Section 3.3 but the impacts are likely to be quite minor when compared to the effects of improvements to electricity grids.

High-speed rail

In the US, high-speed rail offers an alternative mainly to air and road passenger transport, as rail freight is already well developed. The impacts of high-speed rail therefore depend on rates of passenger take-up, plus the resolution of some issues in fitting high-speed passenger services alongside existing freight lines.

The main impacts are likely to be environmental (through avoided flights or car journeys) rather than economic, as air travel could remain the quicker means of travel. Chester and Horvath (2011) identified four critical factors in determining net benefits in California:

- type of train
- type of infrastructure
- electricity source
- occupancy rates

Each of these factors remains unclear.

Alternative fuels for vehicles

There are also several measures aimed at developing alternative fuel sources for vehicles (including electricity) and setting up the infrastructure to do this. Although numerous, the measures seem to be quite small in scale so the effects are more likely to be seen in the longer term. Nevertheless, it is recognised that this could be an important part of the package in the period after 2020.

Table 4.6: Summary of Economic Results, USA

SUMMARY OF ECONOMIC RESULTS, USA

	2009	2010	2011	2012	2013	2020
GDP	0.65	0.23	0.09	0.04	0.00	0.02
Employment	0.08	0.06	0.03	0.00	-0.03	0.01
Household spending	0.16	0.21	0.09	0.04	0.00	0.03
Investment	4.85	0.78	0.21	0.06	-0.04	-0.03
Exports	0.03	0.04	0.03	0.02	0.01	0.01
Imports	1.37	0.29	0.08	0.00	-0.02	0.00
Prices	-0.21	-0.08	0.05	0.10	0.08	-0.04

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

Table 4.7: Overview by Assessment Criteria, USA

OVERVIEW BY ASSESSMENT CRITERIA, USA

Assessment criteria	Results
Timeliness	The green measures are directed towards investment and in many cases focused on long-term impacts. There is evidence that many of them were delayed, which would have substantially reduced their timeliness and short-term benefits. It should be noted, however, that the announcement of the plans (green and non-green, plus quantitative easing) is likely to have had a positive effect on business and consumer confidence.
Job creation impact	It is difficult to judge the impact on job creation. Due to the timing the effects may not have been large but they could lead to future jobs. Additional jobs will be in the investment-based industries, but also in research positions.
Targeting to vulnerable groups	It is noted that the US had several measures that were targeted at vulnerable groups, particularly relating to the housing market. However, this was generally separated from the green measures above which were aimed more towards business groups.
Environmental impact	The focus of the green measures is almost entirely on energy and climate. The effects are undoubtedly positive in the long run but it is very difficult to quantify the effects, particularly in investment in electricity grids and high-speed rail infrastructure (which combined were more than 40% of the green elements).
Fiscal deficits	The US package was large in scale, but the green elements were relatively small, although still large in absolute terms. The current fiscal position in the US raises the question of whether all of the funds that have been allocated but not yet spent will eventually be used.
Productivity and innovation	The main boosts to productivity could come through the improvements in the electricity grids, particularly if smart technologies are integrated. This could result in electricity being produced with less fuel inputs, and potentially lower prices (the same applies for renewables once the initial construction costs are met). As described in the main text, we suggest that high-speed rail will have only limited productivity benefits. In terms of innovation several of the smaller elements of the package could have positive impacts, particularly relating to vehicles and alternative fuels.

Source(s): Cambridge Econometrics, E3MG.

Conclusions from the US package

The overall US stimulus package was large and was announced quickly in response to the crisis that was developing in 2008, although there is evidence that implementation has been slower. Green elements only make up a small (7%) part of the total package with the focus almost entirely on energy and climate change and promoting investment.

The green measures included in the US packages are varied and in many cases highly detailed and complex. This makes assessment difficult and in many cases the modelling results can be misleading, in economic impacts but especially in environmental effects. Our results should be viewed only as approximate but suggest that the measures added around 0.5% to GDP in 2009-10, depending on when the investments were made.

Transition to a low-carbon and resource-efficient economy?

More than one third of the total spending on green measures was used to fund developments in electricity grids, including integration of smart devices. The effects of this investment could be:

- immediate reductions in transmission losses
- establishment of infrastructure to connect future renewables (including micro-generation)
- long-term efficiency benefits from smart devices

Each of these is difficult to quantify but the effects will be beneficial overall, both in the short and long terms. Combined with the large-scale support for new renewables, mainly through tax credits, this has the potential to substantially increase the share of renewables in the US, as indeed happened in 2009.

The main negative environmental impact of this measure is the requirement for electric lines to cover long distances across the countryside.

The other environmental impacts are more likely to be long-term in nature, mainly through the development of new types of fuels for vehicles and establishing the infrastructure to make these technologies commercial. The impacts of high-speed rail are unclear.

Feasibility for introduction in other countries

The measures that were identified in the US could be applied in most other countries. The main constraint is likely to be the available natural resources (land, sun, wind and to a lesser extent geothermal) required for such a large-scale investment in renewables. However, the other elements, including electricity grids, energy efficiency and transport, could all be relevant to other countries.

5 Conclusions & Identification of Best Practice

5.1 Introduction

In the previous chapters we identified the policies and estimated impacts on a country-by-country basis. However, we found that there were many similarities in the policies implemented between countries, and the impacts often appeared to be similar. In this chapter we aim to consolidate these findings by providing summaries of the results for each of the main policy types, and for each of the impact types that was defined in the assessment criteria.

The following two sections provide these summary descriptions. We then draw some general conclusions from the full set of results. The final section aims to identify best practice and lessons that can be learned for future policy formation.

5.2 Summary of results by policy type

The most common types of policy that were identified are:

- investment in energy efficiency
- transport improvements (including vehicle scrappage schemes)
- investment in renewables
- R&D spending on eco-technologies

The previous European Commission non-paper (European Commission, 2009c) also identified water and waste management and fiscal instruments as common types. We have found less evidence of these in our review of EU countries, with the measures relating to water in Estonia and the tax changes in Germany being the main exceptions.

The four common types of policy are discussed in turn below.

Energy efficiency

The most common policy, which was a feature of almost all Member States' green recovery plans, was to initiate a programme of investment in energy efficiency. The main economic benefit of the schemes was the creation (or saving) of jobs in sectors such as construction or engineering that had been particularly affected by the recession due to their dependence on investment spending. However, there is also a longer-term environmental benefit from reducing energy requirements (in most cases heating costs) and resulting greenhouse gas emissions; this also has the economic benefit of increasing domestic efficiency and reducing imports of (and dependence on) fossil fuels. For example, in the Czech Republic the measures lead to a 0.3% reduction in emissions and a 0.05% increase in GDP in 2020.

There are some less positive aspects to these policies. Our results suggest that the energy savings are quite small, although these results are dependent on the assumption discussed below. The savings are also subject to rebound effects[54] and are likely to become smaller over time, even if we do not take into account the fact that some of the savings would have been made anyway. Our results also show that the short-term

[54] Rebound effects are when the initial gains are eroded due to energy effectively becoming cheaper, or increases in income leading to higher rates of energy consumption. Rebound effects can be large, Barker et al (2009) found that up to 50% of the original gains could be lost.

increases in energy demand from construction outweigh the environmental benefits in the years during implementation.

In most cases it would also be preferable and more economically efficient to let the market decide where it is best and cheapest to make the investment in energy efficiency. Finally, there could be a considerable time lag between policy announcement and implementation, although in most cases the investments appear to have been made quite quickly.

Our assessment

Our assessment of these measures suggests that the gains in energy efficiency are likely to be small but only due to the scale of the policies implemented. We use an average measure of reductions in energy consumption per unit of spending that is derived from the IEA's *World Energy Outlook* publication (IEA, 2010), taking an EU average and applying it to all countries[55]. This is clearly a key simplifying assumption as it effectively determines the energy savings; in the case of the Czech Republic our results differed substantially from those that were predicted in the original policy programme.

Aside from the likely possibility that the opportunities for savings will vary between countries, there are several ways in which the treatment could be questioned:

- The investment in WEO is the average from a large programme; smaller investments are likely to focus on the 'low-hanging fruit' or 'no regrets' options.
- Some of the investment would have happened anyway or at a later date.
- The government may not be directing investment efficiently.

The first of these factors suggests we may be understating impacts, while the other two suggest we may be overstating them. The conclusion is that we are never going to be 100% accurate, but that the figures we are using and the results they produce are broadly accurate.

Investment in the public sector

A reasonable share of the investment (35% of the total investment included in our analysis, with the largest part in Germany) was directed at the efficiency of buildings in the public sector. There are some advantages to this, for example the government is likely to have a better knowledge of public sector buildings and where energy savings could be made, and that plans could be implemented more quickly.

In the long run the whole economy could be expected to benefit from more efficient government, although in practice the impacts are very small.

Investment in dwellings

The largest share of the investment in energy efficiency was directed at residential property. Various studies have shown that households have failed to improve efficiency, for example due to a lack of knowledge or long-term perspective, and the policy aims to address these market failures. There is also an educational element to the scheme in that it could better inform residents about other possible savings.

Some of the schemes were in the form of partial grants or subsidies that encouraged higher levels of spending (although it was often not clear how much, so this is generally excluded from the assessment). However, although this could have had better economic benefits, it could also have excluded poorer households. Only the UK explicitly targeted a share of investment to vulnerable groups.

[55] Unfortunately this assumption makes it difficult for us to evaluate the effectiveness of spending as we are assuming that the spending is equally effective in all countries. A more detailed ex-post evaluation would require information regarding all the individual projects that were carried out.

Investment in industry

A much smaller share of the investment was directed towards industry. This could be due to a lack of knowledge about production processes, or suspicion that this would be subsidising investment that would have been made anyway (and hence boosting profits). However, it should be noted that there is a positive economic impact from improving industries' competitiveness in international markets.

Summary

In summary, investment in energy efficiency made up a large part of many Member States' green recovery packages and in most cases had a positive short-run economic benefit. However, the long-term gains in efficiency appear to be quite small in magnitude, although without details of the individual investments it is difficult to be absolutely certain of this result.

Transport

A fairly wide range of measures addressed issues relating to transport, although these were fairly diverse in nature. All of them include an element of investment, but the focus of the policies was quite different.

Vehicle scrappage schemes

The vehicle scrappage schemes were undoubtedly formed with short-term economic factors as a strong consideration. Some of the scrappage schemes had no recognisable environmental component and were therefore not included in the analysis.

In this respect the scrappage schemes can be considered a success. Their quick implementation provided an immediate boost to the motor vehicles sector that was severely hit by the recession, with knock-on effects to its suppliers. Our results show that this created or saved a substantial number of jobs. The leveraging effect of offering a partial reduction in vehicle prices stimulated additional spending (that we have assumed would otherwise have been saved) that had an impact beyond the direct spending from government.

The longer-term effects are less clear. Although many vehicle purchases were brought forward, meaning that future sales are lower, it is hoped that this will be in a period of recovery when gross sales are otherwise higher (although European capacity is still widely regarded as too high). More of an issue is the environmental benefits, which are likely to decrease over time as vehicle fleets would have been replaced anyway. In some cases (e.g. Germany) they may even become negative as future efficiency gains are not taken up as they would otherwise have been.

Our assessment draws on the results of a study that used a dedicated transport model (OECD, 2010). This study cannot make a comprehensive assessment of the economic impacts but does offer a much higher level of detail in the transport sector. Even so, the car scrappage schemes are a relatively new phenomenon and the effects are yet to be fully understood.

Our conclusion is therefore that these schemes were a very good way of stimulating short-term demand in a sector that suffered heavily in the recession. It was particularly effective in countries with a large domestic car industry, such as Slovakia. The effects are likely to decrease over time to become close to zero, say over a ten year period, as the vehicle fleets are replaced. However, it is still too early to give a full assessment of the long-term impacts.

Rail infrastructure

When considering rail infrastructure it is important to make the distinction between increases in existing capacity through additional rolling stock (UK) and investment in new services (France).

In both cases it is likely to be specific large engineering and construction firms that benefit from the additional investment, plus their suppliers. These benefits may not be

immediate though as the projects (particularly laying new track) can take time to implement.

The new rail coaches in the UK were allocated to specific services that were already over capacity. The effect has been to ease crowding on these trains. The possible environmental benefit of this is to shift commuting patterns from road to rail. It is too early yet to tell if this has actually happened but our view is that the effect is likely to be limited, particularly as much of the additional capacity is in and around London, where road-based options are limited. The main outcome is thus likely to be increased comfort for commuters, which is a benefit in itself but not an environmental one.

The same question applies to the construction of new or upgraded routes, which was part of a major investment in France. An ex-post assessment of whether the new infrastructure led to a significant shift from road to rail would be able to address this.

Investment in renewables

Another common policy that was announced in several countries was an increase in investment in renewables, including enhancements to electricity grids and meters. The details between countries often varied, both in terms of the types of renewables included (most often onshore wind and solar) and the scale involved (from micro to large installations). The UK provided funding for offshore wind in an attempt to stimulate development, but the immediate environmental effects of the investment are less due to the high unit costs of producing and installing offshore turbines.

The economic impact of the investment is a short-term boost to activity in the engineering and construction sectors. The extent of this is dependent on the share of renewables that is imported, although it should be noted that there could easily be delays in implementation, for example due to planning regulations or delivery time for wind turbines.

Our assessment of the environmental impacts of the renewables investment made use of the E3ME model and the submodel outlined in Barker et al (2007). The immediate impact is a reduction in fossil-fuel based generation as this is replaced with the generation from the renewable capacity. In the longer term these benefits could be eroded as other investment could be displaced and eventually the renewables will themselves need to be replaced. While there could also be economies of scale and learning-based effects that have additional benefits, they are unlikely to be significant given the scale of the investment seen here.

In summary the investment in renewable infrastructure is likely to have provided a short-term boost to organisations that install renewable capacity, plus the companies that build the equipment (although these may be in a different country). There should also be environmental and economic benefits from a reduction in fossil-fuel dependency. The long-term benefits are less clear but are likely to persist to some extent as long as the new capacity remains operational.

R&D spending in eco-innovation

Finally, several countries, but in particular Sweden, included programmes of R&D expenditure on eco-innovation. In the economic literature, R&D is commonly seen as a driver of long-term growth, but private spending on R&D was cut during the recession.

The spending on R&D may therefore have created or saved a small number of high-skilled technical jobs, although the short-term economic impacts are quite limited.

In the long term the benefits are dependent on whether the R&D leads to new products and product designs. In our assessment we have assumed that this would happen after

2020 and so it is excluded from our analysis, but it is important to note the possible outcomes as these could drive both future domestic growth and global development.

The conclusion is thus that the policy is one designed for possible long-term benefits. It is perhaps the one that is most focused on environmental outcomes and least focused on economic outcomes, at least in the recession period.

Summary of the policy types

Table 5.1 provides a summary of the main advantages and disadvantages of the most common policy types that are included in the assessment.

Table 5.1: Summary of Policy Types

Policy Type	Key Advantages	Key Disadvantages
Investment in energy efficiency	Short-term benefits to construction sector. Long-term increase in energy efficiency.	May not be implemented quickly. Energy savings could be small.
Vehicle scrappage schemes	Immediate boost to car industry and suppliers. Leveraging effect means efficient use of public money.	Probably few long-term benefits.
Investment in rail infrastructure	Benefits to large engineering and construction firms. Possible social and economic benefits from reduced journey times.	May not be implemented quickly. Negative environmental impacts on land use and materials. Impacts on energy use unclear.
Investment in renewables	Short-term boost to engineering firms (if domestically produced). Reduction in dependence on imported fossil fuels. Reduction in emissions.	Can be expensive, could displace private investment. Other possible negative environmental impacts.
R&D in new eco-technology	Could provide long-term economic and (global) environmental benefits.	Short-term benefits limited. No guaranteed success.

Source(s): Cambridge Econometrics.

5.3 Summary of results by impact area

In the country assessments we have used several criteria to determine the useful impact of the green elements of the stimulus packages. This section summarises those findings.

Timeliness

Our results have shown that in most cases the green measures were timely, with the positive effects seen during the recession periods. For some policies, such as changes in tax rates or the vehicle scrappage schemes, the effects were immediate, providing boosts to struggling industries. Many of the investment projects (e.g. rail infrastructure) took longer to implement and must be spread over several years; however, much of the evidence suggests that they were started quickly. This is

particularly the case where lots of small investments were made, rather than large infrastructure projects.

Job creation impact

None of the measures that we looked at had a direct impact on employment, for example subsidising employment in eco-industries. However, many of the policies were directed at sectors that are both labour intensive and were impacted severely by the crisis. These were mostly sectors dependent on investment demand, such as motor vehicles, construction and engineering. The policies therefore had a positive impact on net employment, although this was more likely to be in jobs saved rather than in jobs created.

The types of jobs that were saved are likely to have been a combination of basic and high-skilled jobs. Many of them would have been in traditionally male-dominated occupations.

Targeting to vulnerable groups

Perhaps surprisingly, few of the green recovery plans were targeted at vulnerable groups (the main example we found was the UK's Decent Homes Programme). This could be because the wider stimulus packages included more of a distributional element and in Europe the 'automatic stabilisers' in the form of social benefits tend to be quite strong.

It should also be noted that many of the policies, such as investment in transport infrastructure or R&D incentives, targeted businesses rather than households so this criterion was not relevant.

The main scope for policy targeted at vulnerable groups seems to be through the energy-efficient investment. If the correct conditions are set, or the investment is restricted to social housing (as was one of the UK's measures) then there could be a long-term benefit to low-income groups through lower future energy bills.

Environmental impact

One of the most notable aspects of the green recovery plans is that they almost exclusively focus on energy consumption and greenhouse gas emissions. As discussed in the previous section, our results tend to suggest that there are benefits in both of these areas, but that they may not be as large as initially was expected. This is due to:

- savings being smaller than suggested
- rebound effects
- energy use by the construction sector and its suppliers (e.g. cement, metals)

The first point is partly dependent on our assumption about the cost of energy savings based on the IEA report (see previous section). However, the other two points are often ignored in other (partial) assessments of individual policies.

It should also be noted that the impact on GHG emissions is also dependent on the fuel mix used for electricity generation in each country. Increased energy efficiency will lead to higher emission reductions if the marginal fuel used in power generation is coal.

Impacts on other resources

There are some exceptions to the focus on energy and emissions. In Estonia, a large share of the investment spending covered water resources, while China allocated funds for cleaning pollution. More generally, the other environmental impacts tend to stem from the indirect effects of the implemented policies. Possible positive benefits include reduced local air pollution, especially from reduced industrial or transport emissions.

On the other hand, infrastructure projects (and, in some cases, development of renewables) could use additional scarce land and many of the projects (e.g. infrastructure development, new cars, developing buildings) could be quite material intensive. As noted above this has knock-on effects for emissions, for example in production of cement and steel.

There are some projects, particularly relating to transport infrastructure, where it is not clear if the long-term environmental impact will be positive or negative, as this depends on a series of complex interactions (e.g. commuting patterns). This makes the overall environmental impact of the packages in some countries, such as France, quite difficult to determine.

Measures with possible negative impacts

Very few measures were found that are likely to be directly environmentally harmful. The main examples are road-building schemes in the UK and France. Although these may have short-term benefits from reduced pollution from congestion, the long-term outcomes are more likely to be an increased number of journeys.

The French investment in fossil-fuel plants is another example of a measure that is likely to have negative environmental consequences.

Fiscal deficits

Our review has covered a range of countries in very different fiscal positions, ranging from Germany and China (with large savings) to Portugal, which has subsequently requested and received European and IMF assistance with its debt. In each case the context of the stimulus packages, including the green elements, had to be considered in this light.

However, in almost all cases the green elements of the packages contributed only a very small amount to public debt levels, typically in the range 0.1-0.5% of GDP. In addition, some of this would have been made back through higher tax receipts, particularly resulting from the vehicle scrappage schemes. The conclusion is thus that any impact on fiscal deficits would have been small.

One additional point that is worth noting is that some European countries are dependent on fuel excise duties for a share of tax revenues. Any measure that aims to reduce long-run consumption will also therefore reduce revenues.

Boosting productivity

The results showed small gains in productivity due to reduced energy consumption coming from the measures that focused on energy efficiency (alternatively, a reduction in intensity). This boosted industrial competitiveness in cases where the measures were applied to companies (e.g. Slovakia), but much of the investment was in fact made in residential buildings and public offices.

Other measures, including car scrappage schemes and renewables investment, are unlikely to have had much impact on (energy) productivity. The investment in transport infrastructure may have led to some productivity improvements but this is difficult to assess without using specialist tools.

No other types of productivity were affected by the measures.

Policy synergies

The green elements of the recovery packages will have made some contribution towards meeting the EU's 2020 environmental targets. It should be noted, however, that the effects of the measures were much smaller than the effects of the recession itself.

Table 5.2 summarises the impacts of the recession and the measures on the EU's targets and objectives for 2020.

Table 5.2: Summary of Impacts in Relation to EU Targets

Target for 2020	Impact of Recession	Impact of Measures
To reduce GHG emissions by 20% compared to 1990 levels	Data for 2009 are not yet available, but a substantial reduction in emissions is likely to have taken place.	A small and permanent reduction in emissions.
To generate 20% of energy from renewable sources	Reductions in available credit and energy demand reduced investment in renewables.	A small increase in renewables investment using public money.
The objective of a 20% improvement in energy efficiency	Possibly a small positive impact as households and firms aim to cut costs.	A small and permanent improvement in efficiency, notably from buildings.

Source(s): Cambridge Econometrics, Ecorys.

As the implemented policies focus on energy efficiency and emissions, we do not see major synergies elsewhere.

5.4 General conclusions

Policy design

The countries that we assessed entered the recession in different fiscal positions and were impacted in different ways and by different amounts. The size of the implemented stimulus packages, and the share of green measures in these packages, also varied considerably between countries. However, there was a remarkable degree of consistency in the structure of the green measures that were announced (see Table 5.3).

This partly indicates the speed of policy response that was required. For example, the German car scrappage scheme proved to be successful and so was emulated in other countries, albeit slightly modified to suit local conditions. However, it also reflects the global nature of the recession, with a collapse in investment in all countries leading to major falls in output in the sectors dependent on investment demand. Thus it was more appropriate to translate policies across national boundaries.

Table 5.3: Summary of Measures

Country	Stimulus, share of GDP	Green share of stimulus	Green stimulus per capita	Main green policies
Belgium	0.5%	10%	€16	Investment in energy efficiency
Czech Republic	1.9%	33%	€86	Investment in energy efficiency
Estonia	6-10%	20% *	€185	Investment in water infrastructure Investment in energy efficiency Investment in renewables
France	1.3%	8-20% *	€55	Investment in transport infrastructure Car scrappage scheme Investment in electricity grid Investment in energy efficiency Investment in renewables
Germany	3.2%	13.3%	€129	Investment in energy efficiency Revision of motor vehicle tax Car scrappage scheme R&D in vehicles
Portugal			€29	Investment in renewables Investment in energy efficiency Car scrappage scheme
Slovakia	2.3%	6-12% *	€31	Investment in energy efficiency Car scrappage scheme
Sweden	2.9%	5%	€60	R&D in eco-technologies Investment in energy efficiency
UK	1.5%	5.1%	€24	Investment in renewables Investment in transport infrastructure Car scrappage scheme Investment in energy efficiency

Note(s): There are some variations due to definitions used and changes in exchange rates during the assessment period.

Economic impacts of the policies

For all the policies that stimulate investment, either through public spending or tax incentives, the economic results broadly show that GDP increases by slightly less than the amount that is put in, implying a domestic multiplier effect less than one. The reason for this is the relatively high import shares of the types of investment goods, and materials used to produce them, in European economies, including trade within the single market.

There was a lot of debate, particularly in the US, about possible multiplier effects from stimulus packages[56]. In a period of low demand and spare economic capacity, theory supports the possibility of multiplier effects above one. Our estimates of short-term national multiplier effects[57] across the countries range from around 0.5-0.6 in open economies, such as Belgium and Estonia, to 1.1 in Sweden, where many of the investment goods (e.g. cars and engineering equipment) are produced domestically. For most countries the multiplier is around 0.75 at the national level. This is low but, because of the high volume of trade between Member States, at the European level the values tend to be greater than one. The values of the multipliers tend to reflect national factors (e.g. sectoral composition, trade intensity) rather than the specific environmental policies.

The sectors that benefit tend to be similar across countries and policies, because (at least at the level of detail we have looked at) a lot of the investment benefits the same companies, principally those in construction, design and engineering, regardless of where in the economy the investment is made. This is consistent with the previous findings in Pollitt and Junankar (2009). However, it should be noted that the benefits are greater if the investment goods are produced domestically rather than imported. Our results suggest slightly higher domestic multiplier effects for spending on buildings (close to one) because the construction sector is wholly domestic, although the difference in multiplier values between policies is less than the difference between countries.

The vehicle scrappage schemes presented large additional economic benefits due to the induced increase in consumer spending that would otherwise have been saved. In terms of multiplier effects (GDP impact per unit of spending) they are therefore much higher, but this is dependent on the assumption that this money would not have been spent elsewhere anyway.

In the long term, there will be some benefits from reduced imports of fossil fuels and reduced exposure to volatile commodity prices. Our results suggest that these will be small, however, although this is also a contributing factor to the higher multipliers seen for these policies.

Environmental impacts of the policies

As discussed in Section 5.2, the green policies almost exclusively focused on energy consumption and greenhouse gas emissions. We suggest that this could be because:

- this has a higher prominence in the policy agenda
- EU countries have fixed targets/objectives that must be met through new policy
- policy in this area is better developed

As our results show, the impacts on energy demand and emissions are small (and certainly small compared to impacts from the recession), but will make a contribution to meeting the targets.

5.5 Identification of best practice

This leads to the question of identification of best practice and lessons to take forward either into future recession or in the fiscally restrained conditions that are likely to prevail in the medium term.

[56] See e.g. Krugman's article http://www.nytimes.com/2009/01/09/opinion/09krugman.html

[57] Car scrappage schemes have been excluded from these calculations as the multipliers are highly dependent on the assumptions about the leveraging effect of consumers spending additional money on cars from personal wealth.

It is important to note the dual economic and environmental objectives of the policies, but that some are more economy-focused, while some have larger environmental effects. It is also important to separate the short and long-term impacts. Figure 5.1 provides an interpretation of how the main policy types fit into these categories.

Some of the countries that we assessed included a combination of policies that addressed both short and long-term issues and included both strong economic and environmental components[58] (Germany is a good example). Other countries were able to tailor their measures to suit local conditions; for example Sweden required less short-term stimulus so was able to focus on longer-term issues. It is clear that this balance must be determined on a country-by-country basis.

Green measures in recession conditions

The main priority of the policies in the recession was to inject public money into the economy as quickly as possible. In this respect the changes to taxation and the car scrappage schemes had immediate effects. The investments took longer to make an impact but were in most cases implemented quickly (particularly when there were many small investments); from a short-run macroeconomic perspective it is less important where the investment is made, as long as the money is spent.

On the other hand, the investment represents a rare opportunity to provide environmental benefits while simultaneously helping the economy. Being able to direct the investment to cost-effective projects combines these benefits. However, policy makers must be informed about where the investments are made; maintaining a list of possible investments could be advantageous should the need ever arise in future.

One additional point to note is that the policies that combined public and private investment offered much better value for public money. The car scrappage schemes are notable examples, as they effectively converted money that would likely have been saved to current spending (countering the cyclical effect of the recession). Some of the investment schemes also included co-financing elements. The downside of this approach is that the measures may end up excluding the groups who need support the most, so it is necessary to strike a balance.

Green measures in times of austerity

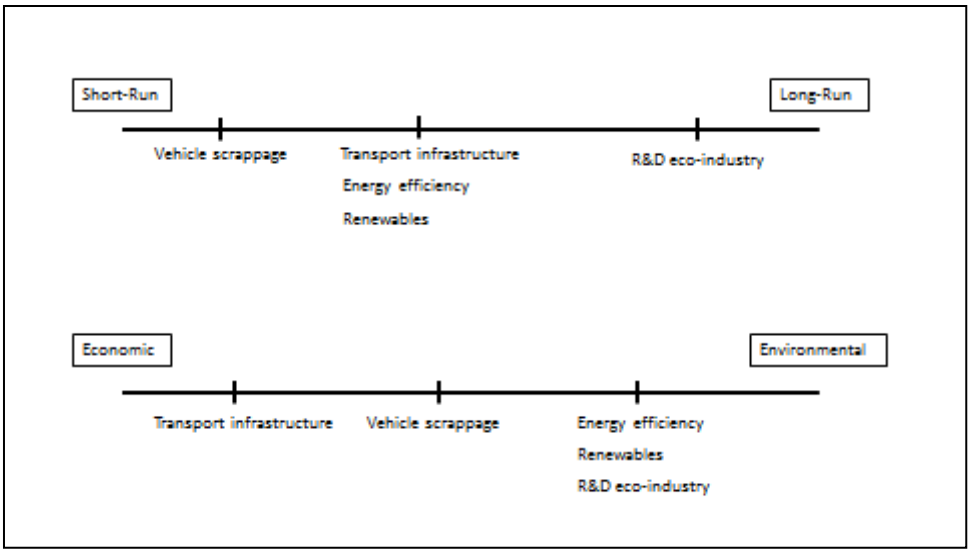
With much of Europe now engaged in deficit reduction measures, value for money is likely to remain a key factor in future policy making in the medium term, including green measures. On the other hand, it is clearly not desirable to continue vehicle scrappage schemes indefinitely.

The focus of energy and emissions policy could thus be expected to move more towards medium and long-term policies, including incentives for energy efficiency and renewables (see Figure 5.1). These could also be coupled with revenue-raising measures, such as higher energy or environmental taxes, reducing other taxes to compensate if necessary.

More generally our findings suggest that there is space for development in other environmental fields, such as water and material consumption or land use. A search for win-win policies could aid economic recovery (although the effects may be small) while at the same time providing environmental benefits.

[58] Although it is noted that all countries included other economic policies that we have not included in the assessment.

Figure 5.1: Summary Policy Characteristics



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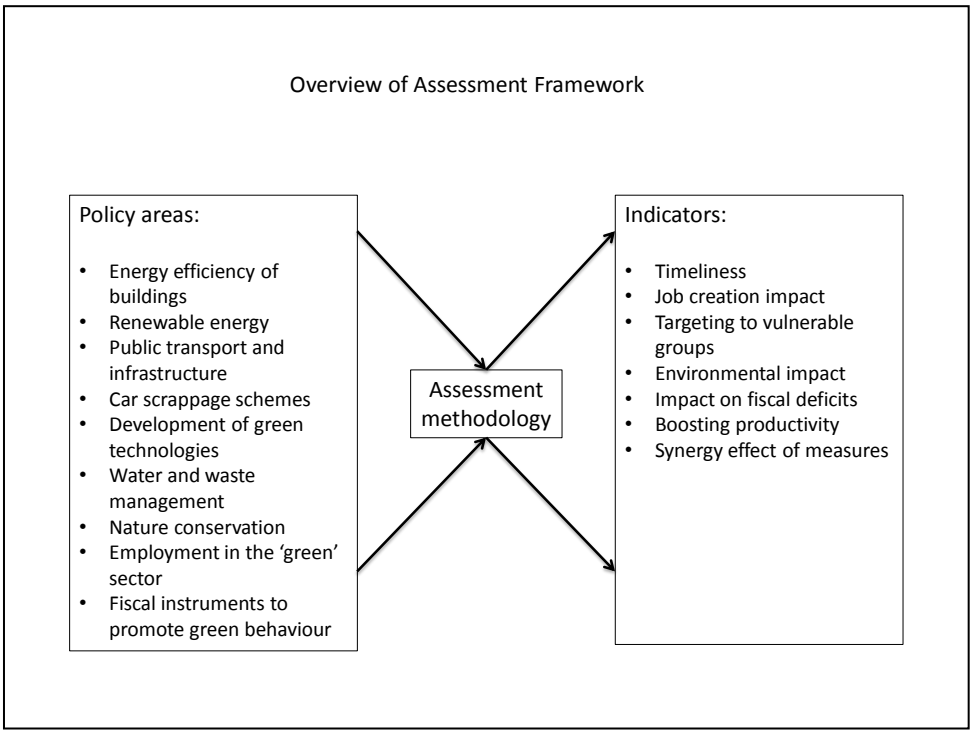
7 Appendix A: Framework for the Assessment

7.1 Overview

This Appendix presents the framework used to carry out the assessments described in Chapters 3 and 4. This constituted Task 3 of the project. More specific assessment techniques are described in Chapter 3.

As outlined in the project terms of reference, there are a range of economic and environmental indicators to consider when assessing the impacts of the implemented green recovery measures. The aim of Task 4 of the project is to link changes in these indicators to the implemented policies described in Chapter 2. Figure 7.1 gives a top-level overview of the process.

Figure 7.1: Overview of Assessment Framework



In this chapter we discuss the methodology that was used to determine the linkages. No single methodology could assess all these areas (either policies or indicators). The approach we therefore adopted was to apply a hierarchy of different techniques, depending on the coverage of the available data. The three approaches that we used were:

- a fully-specified modelling approach
- detailed quantitative methods
- qualitative assessment

These are described in turn below. Where possible we link the different approaches, for example using the outputs from the quantitative analysis as an input to the

modelling. All the approaches integrate economic and environmental assessment and the final output is a complete assessment that is as consistent as possible.

7.2 Modelling approach

The preferred means of assessment is to use a modelling approach where the data allow. The reasons for this are:

- the model structure accounts for secondary and indirect impacts
- a wide range of indicators is available from the model outputs
- the necessary data have already been collected
- the methodology and data been validated through previous application in European Commission and other projects

Overview of modelling approaches

Within the modelling approach there are many different methods that can be applied. Common approaches include Computable General Equilibrium (CGE) models, macroeconometric models, partial models and input-output modelling. Each of these is described below.

CGE models

Computable General Equilibrium (CGE) models draw heavily on neoclassical economic theory and provide a consistent long-run macroeconomic framework for economic analysis that may be extended into other areas. This approach integrates microeconomic mechanisms and institutional features with clear feedback mechanisms between equations and between sectors. All behavioural equations (demand and supply) are derived from microeconomic principles (for example utility-maximising individuals, profit-maximising enterprises). They assume that these principles hold.

Macroeconometric models

Econometric models are based on empirical relationships and are developed using large-scale (usually time-series) data sets. The parameters of the equations are estimated with formal econometric methods which are integrated into a framework based on the national accounts and also often extended into other areas. Depending on the econometric specification, econometric models are also suitable for short-term analysis. The main assumption is that the historical behavioural relationships remain valid in forward-looking projections.

Partial models

A partial[59], as opposed to general, model is one that focuses on a particular sector rather than a whole economy. This term derives from economic modelling; it could also be argued that even a fully-specified economic model (one that includes all the main components of demand) is also a partial model if it does not include an endogenous treatment of demographic or environmental inputs.

The main advantage of partial models is that they are able to make use of detailed, specialised data that are only available for a particular field. Common examples include the agricultural, energy and transport sectors.

The main disadvantage is that all external factors are treated as exogenous so the feedback is limited. For example, if new transport infrastructure is built, one of the outcomes could be an increase in average incomes and therefore transport demand; however, the partial model would not include the economic interactions so would miss this effect.

[59] These models are also described as 'partial equilibrium' or 'sectoral'; we have used the term partial as our examples include non-equilibrium models and so that there is not confusion with general models that have sectoral detail.

Input-output modelling

Input-output (IO) tables form the basis of most CGE and macroeconometric models that disaggregate the economy into sectors. However, they may be applied outside a formal modelling framework; although this means many of the feedback mechanisms in a full model are missing, it allows a much greater degree of flexibility. The simplest IO analysis is based on economic multipliers but recent developments have extended the approach to environmental and trade-based analysis.

E3ME

E3ME is a macroeconometric model which was used to carry out much of the analysis. It is described in more detail in Appendix C or at the model website www.e3me.com. The E3MG model is similar in design, but with global coverage.

7.3 Quantitative approach

Where it is not appropriate to apply a formal modelling technique we used a quantitative means of assessment if possible. This was the case where the level of detail required to properly assess a policy went beyond that which is available in the E3ME model (NACE 2-digit); see Box 4.1 for an overview of how data sets can be completed.

Box 4.1: Estimating Missing Data Points

The quantitative approach is reliant on data being available at quite a detailed level. However, it is often the case that the availability of data becomes more limited as the disaggregation of sectors becomes greater. It is therefore likely that data for NACE 3-digit and 4-digit sectors may be incomplete and, although (unlike modelling) quantitative assessment does not require data sets to be completely filled out, it may be necessary to fill out gaps prior to undertaking the analysis.

The following stages could be taken to fill missing data points at a NACE 4-digit level:

- Stage 1: use growth rates of variables from the E3ME database (which contains complete historical data at NACE 2-digit level for each Member State) and apply to the NACE 2-digit level data from Eurostat in order to expand and fill the missing gaps in the time period coverage.
- Stage 2: use the filled NACE 2-digit growth rates to fill missing gaps in the NACE 3-digit data.
- Stage 3: use the filled NACE 3-digit growth rates to fill missing gaps in the NACE 4-digit data.

Econometric analysis

Econometric analysis is one possible quantitative approach. Using historical data it is possible to estimate price elasticities[60] for each sector in Europe, and then combine these with anticipated cost increases/decreases to give an indication of the economic impacts.

It could also be likely that the time coverage of the data is limited. In this case the chosen econometric method would be a short time-series panel method which allows the pooling of data from different Member States to deal with the small sample size. A panel model increases the number of observations substantially compared with

[60] This is the response in demand to a change in price. It is unobservable so must be estimated using statistical techniques.

estimating separate time-series equations for each Member State. In contrast to a cross-sectional approach, it would allow us to use all the data within the specified time period.

Other quantitative approaches

However, quantitative assessment need not necessarily include econometric analysis. We see the general quantitative approach as a flexible combination of methodologies that make the best use of the available data at the most detailed level possible.

For example, a very simple type of quantitative analysis would involve making a chart of available data and highlighting the biggest changes; this can then be compared to the implemented policy (e.g. timing, region or affected sector) to give an indication of possible impacts.

7.4 Qualitative approach

Finally, where it is not possible to make a quantitative assessment we adopted an approach that was qualitative in nature. This was the case when considering:

- factors that are too detailed to be included in the data
- impacts that cannot be quantified
- cases where the necessary data are missing

We used an approach that broadly follows the EC's Impact Assessment Guidelines (European Commission, 2009a). The Impact Assessment Guidelines set out a three step process for carrying out impact analysis, the first two steps of which were used in the project for qualitative policy analysis. The first step is to identify the economic, social and environmental impacts of a policy, including the distributional impacts. Each of the likely impacts is then assessed qualitatively.

Using this assessment method, the following steps should be taken:

- Identify the areas in which the proposed policy is intended to produce benefits, as well as the areas where this may lead to direct costs or unintended negative impacts.
- Assign likelihoods (e.g. low, medium or high probability) that the impact will occur. This can be done by setting out assumptions about factors that may influence the probabilities that impacts occur, but which are outside the control of policy makers.
- Assess and estimate the magnitude of impacts on the basis of the two previous steps (e.g. from low likelihood/low magnitude to high likelihood/high magnitude)

When identifying impacts the following points should be considered:

- both short-term and long-term impacts should be considered
- impacts that cannot readily be expressed in quantitative or monetary terms are not overlooked
- different factors which influence impacts also interact with one another
- how the impacts of the policy may be affected by the implementation of other policies within the national recovery plans

7.5 The indicators

The project Terms of Reference provide a list of criteria with which the measures should be assessed (see Section 7.1 above). These are addressed in our assessment

framework following a similar hierarchy to that outlined above; the preferred (and in most cases anticipated) means of assessment are outlined in Table 7.1.

Table 7.1: Main Means of Assessment

MAIN MEANS OF ASSESSMENT		
Assessment Criteria	**Preferred means of assessment**	**Comments**
Timeliness	Model-based	The E3ME model produces results on an annual basis. If more detail is required it is provided on a qualitative basis, unless monthly or quarterly data are available.
Job creation impact	Model-based	Employment is an output from E3ME. The model produces impacts on a net basis, so also include effects of jobs that are lost (e.g. new jobs producing renewable power may replace jobs in conventional plant).
Targeting to vulnerable groups	Model-based, qualitative	The model results include a measure of income distribution. It is usually difficult to obtain data for other social effects so a qualitative approach is used.
Environmental impact	Model-based, quantitative, qualitative	E3ME produces outputs for air-borne emissions and material consumption. Where data are available we consider impacts on a quantitative basis, otherwise a qualitative approach is used.
Fiscal deficits	Model-based	This is one of the outputs from E3ME.
Boosting productivity	Model-based, quantitative	A combination of approaches is used for different types of productivity.
Synergies	Quantitative, qualitative	Analysis of policy synergies are largely separate from the other aspects of the assessment, but feed into the final recommendations based on the findings from Task 4.

8 Appendix B: Results by Policy

8.1 Introduction

This appendix provides a bit more detail by giving the results for each individual policy. The tables include the same outputs as those presented in Chapters 3 and 4.

In most cases the results shown are for 2009-13 but if there was a policy that was implemented in 2008 we show 2008-12. The final column provides an indication of any long-term costs or benefits and also allows an evaluation in terms of the targets that have been set under Europe 2020.

For some of the policies the impacts are too small to register at the second decimal place. They are included for completeness.

Sections 8.2 to 8.10 present results for the selected EU countries. The remaining sections show results for the non-EU countries that were included in the study.

8.2 Belgium

S4: Energy subsidy for households

This initiative aimed to improve residential energy efficiency by providing each household with a voucher worth €30 to spend on energy-saving measures such as insulation. This was the largest green measure included in Belgium's national recovery plan (€140m across 2009 and 2010).

In the years the investment takes place GDP is boosted, albeit by small amount. The environmental impact is lasting since energy consumption and CO_2 emissions are permanently reduced, although these changes are very small, reflecting the small scale of the overall scheme.

Table 8.1: Belgium: Energy Subsidy for Households, Summary of Results

BELGIUM: ENERGY SUBSIDY FOR HOUSEHOLDS, SUMMARY OF RESULTS

	2009	2010	2011	2012	2013	2020
GDP	0.02	0.01	-0.01	-0.01	-0.01	0.00
Employment	0.00	0.01	0.01	0.00	0.00	0.00
Household spending	0.00	-0.01	-0.02	-0.02	-0.01	0.00
Investment	0.09	0.10	0.01	0.00	0.00	0.01
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.03
CO_2 emissions	-0.01	-0.02	-0.03	-0.03	-0.03	-0.02
Energy consumption	-0.01	-0.03	-0.03	-0.03	-0.03	-0.03

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S38: Household green investments

As part of its stimulus package the Belgian government made €20m available across 2009 and 2010 to go towards interest payments for households who borrow to finance green investments. Since this measure was very small in value, the economic benefits are equally low and do not register at the second decimal place. The environmental benefits are expected to also be close to zero.

Table 8.2: Belgium: Household Green Investments, Summary of Results

BELGIUM: HOUSEHOLD GREEN INVESTMENTS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.00	0.00	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.3 Czech Republic

S7: Green investment scheme programme

The only green measure included in the Czech Republic's national recovery plan focuses on improving the energy efficiency of housing (as discussed in Section 2.2, no reference was found to other policies and the car scrappage scheme was not included). The programme provides subsidies to homeowners for improving the energy efficiency of heating, constructing new residential buildings with certain energy standards and investments in renewable energy sources. The programme operated between 2009 and 2010 and cost a total of €900m. In these years GDP is increased moderately, with a small longer-term impact as a result of greater efficiency.

The environmental benefits are, however, realised more in the long term although there are some rebound effects by 2020. Increases in energy consumption and emissions in 2009 are caused by the effects of higher economic activity outweighing any improvements in energy efficiency.

Table 8.3: Czech Republic: Green Investment Scheme, Summary of Results

CZECH REPUBLIC: GREEN INVESTMENT SCHEME PROGRAMME, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.36	0.35	-0.01	0.02	0.01	0.05
Employment	0.05	0.11	0.10	0.06	0.04	0.05
Household spending	0.03	0.09	0.05	0.06	0.05	0.14
Investment	1.54	1.51	-0.01	-0.01	-0.02	-0.02
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.17	0.20	0.03	0.01	0.01	0.02
Prices	-0.01	0.00	0.03	-0.01	-0.03	-0.15
CO_2 emissions	0.03	-0.05	-0.21	-0.29	-0.28	-0.27
Energy consumption	0.12	-0.10	-0.37	-0.47	-0.40	-0.31

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.4 Estonia

S8: Energy efficiency in housing

Between 2009 and 2010, the Estonian government invested a total of €51m in energy efficiency in the residential sector. The results for this policy are presented in Table 8.4. The measures added 0.7% to investment in these years and GDP is boosted by up to 0.2%. There is also a small long-term gain from a reduction in the volume of gas imports.

The effect on energy consumption is a reduction of 0.14%, coming from a reduction in the demand for household heating fuels. We have assumed that this primarily leads to a reduction in gas consumption, so the fall in CO_2 emissions is comparatively smaller.

Table 8.4: Estonia: Energy Efficiency in Housing, Summary of Results

ESTONIA: ENERGY EFFICIENCY IN HOUSING, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.17	0.16	-0.01	-0.01	0.01	0.04
Employment	0.03	0.03	0.01	0.01	0.00	-0.01
Household spending	0.01	0.01	0.00	0.01	0.01	0.02
Investment	0.70	0.72	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.07	0.08	0.02	0.02	0.00	-0.04
Prices	-0.02	-0.03	-0.01	-0.03	-0.02	-0.05
CO_2 emissions	0.00	-0.02	-0.04	-0.05	-0.05	-0.02
Energy consumption	-0.01	-0.10	-0.15	-0.15	-0.15	-0.14

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S23: Improvements in waterways infrastructure

This measure provided €153m of funding (split equally between 2008 and 2009, although it is possible in reality the funding came later) to improve water infrastructure and the management of waste water. This is the largest green measure included in Estonia's stimulus package and the results suggest a large immediate 1.5% increase in investment and a modest boost to GDP of around one third of 1%. The modelling results are presented in Table 8.5.

The effects of the additional investment are fairly temporary although there are some lagged effects in the longer term. The main environmental impacts would have been specific to Estonia, in the form of better water treatment, accelerating an ongoing programme of investment. Increased activity rates are likely to result in slightly higher rates of energy consumption and CO_2 emissions.

Table 8.5: Estonia: Improvements in Waterways, Summary of Results

ESTONIA: IMPROVEMENTS IN WATERWAYS INFRASTRUCTURE, SUMMARY OF RESULTS						
	2008	**2009**	**2010**	**2011**	**2012**	**2020**
GDP	0.33	0.34	-0.05	-0.02	0.01	0.04
Employment	0.06	0.10	0.03	0.02	0.00	0.00
Household spending	0.03	0.02	0.00	0.01	0.00	0.00
Investment	1.50	2.10	0.00	-0.03	-0.03	-0.02
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.27	0.42	0.06	0.02	-0.02	-0.06
Prices	-0.08	-0.04	0.02	0.02	0.03	0.01
CO_2 emissions	0.11	0.12	0.08	0.06	0.06	0.12
Energy consumption	0.09	0.15	0.07	0.02	0.01	0.03

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S35: Green investment schemes

The sale of Estonia's unused emission permits led to revenues being reinvested in environmentally friendly projects designed to reduce CO_2 and greenhouse gas emissions. Between 2008 and 2009 €23m was invested in wind energy projects, €21m in public buses and further investment in improving the energy efficiency of selected public buildings. This was an increase in investment of 0.5% in 2008-09.

The results of the modelling assessment of this policy are shown in Table 8.6. Modest increases in GDP in the range of 0.1% are seen in 2008 and 2009 with a small change in the long term due to slightly reduced energy imports. The reduction in energy consumption (after 2008-10 when higher activity boosts consumption) is quite small, reflecting the scale of the scheme.

Table 8.6: Estonia: Green Investment Schemes, Summary of Results

ESTONIA: GREEN INVESTMENT SCHEMES, SUMMARY OF RESULTS						
	2008	**2009**	**2010**	**2011**	**2012**	**2020**
GDP	0.09	0.09	-0.01	-0.01	-0.01	0.00
Employment	0.02	0.03	0.01	0.00	0.00	0.00
Household spending	0.01	0.01	0.00	0.00	0.00	0.00
Investment	0.43	0.61	0.00	-0.01	-0.01	-0.01
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.08	0.13	0.02	0.01	0.01	-0.01
Prices	-0.02	-0.01	0.01	0.01	0.01	0.00
CO_2 emissions	0.03	0.02	-0.01	-0.07	-0.10	-0.05
Energy consumption	0.02	0.04	0.03	-0.03	-0.03	-0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.5 France

S27: Investment in solar energy

This measure provides €300m of investment in solar energy, split equally between 2009 and 2010. Small improvements in GDP compared to the baseline are seen in the years in which the investment takes place. There is almost no difference to the baseline regarding energy consumption and GHG emissions.

Table 8.7: France: Investment in Solar Energy, Summary of Results

FRANCE: INVESTMENT IN SOLAR ENERGY, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.01	0.01	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.03	0.03	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.00	0.00	0.00	0.00
Prices	0.00	-0.01	-0.01	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S6: Energy efficiency in public buildings

This measure increased energy efficiency in public buildings. The investment totalled €400m over 2009 and 2010, or a 0.04% annual increase. The modelling results show that an increase in GDP is only seen in the years of the investment and it is very small. There is a small reduction in emissions.

Table 8.8: France: Energy Efficiency in Public Buildings, Summary of Results

FRANCE: ENERGY EFFICIENCY IN PUBLIC BUILDINGS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.01	0.01	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.04	0.04	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.00	0.00	0.00	0.00
Prices	0.00	-0.01	-0.01	0.00	0.00	0.00
CO_2 emissions	-0.01	-0.02	0.00	0.00	0.00	0.00
Energy consumption	-0.01	-0.02	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S22: Investment in railway infrastructure

The government investment in improving rail infrastructure is the largest of the green measures in France, totalling €1.3bn. It therefore has the largest impact on GDP out of all the green measures assessed. Positive economic outcomes are seen in the years in which the investment takes place, after which the results show there is almost no change from the baseline. This reflects the fact that we have not included any efficiency gains from a more efficient rail transport network; a dedicated transport model may be able to provide an estimate of this.

There are small changes in energy consumption and emissions in this scenario, in line with increases in economic activity. Again, the improved infrastructure could have an impact (possibly positive or negative) but this has not been included in the modelling.

Table 8.9: France: Transport and Railway Infrastructure, Summary of Results

FRANCE: INVESTMENT IN RAILWAY INFRASTRUCTURE, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.02	0.03	0.00	0.00	-0.01	0.01
Employment	0.01	0.01	0.00	0.00	-0.01	0.01
Household spending	0.00	0.01	0.00	0.00	-0.01	0.01
Investment	0.14	0.13	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.01
Imports	0.05	0.05	0.00	0.00	0.00	0.00
Prices	-0.01	-0.02	-0.02	0.00	0.01	-0.01
CO_2 emissions	0.01	0.01	0.00	0.00	0.00	0.00
Energy consumption	0.01	0.01	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S31: Car scrappage scheme

The car scrappage scheme in France provided consumers with a subsidy of €1,000 for the scrappage of a car at least ten years old, and the purchase of a new car with emissions lower than 160gCO_2/km. The scheme was in operation between 2009 and 2010 and a total number of subsidies worth €500m were paid out to consumers (according to initial plans, although later reports suggested a much larger amount had been). The modelling results show that the economic impact of the scheme was positive in 2009 and 2010, led by a relatively large increase in household spending. Energy consumption and GHG emissions increase in the long term as the vehicle fleet would have been updated anyway. There is a small long-term increase in GDP along with CO_2 emissions and energy use.

Table 8.10: France: Car Scrappage Scheme, Summary of Results

FRANCE: CAR SCRAPPAGE SCHEME, SUMMARY OF RESULTS

	2009	2010	2011	2012	2013	2020
GDP	0.44	0.44	0.02	-0.03	-0.04	0.10
Employment	0.13	0.15	0.00	-0.05	-0.08	0.08
Household spending	1.19	1.10	0.04	-0.01	-0.06	0.11
Investment	-0.02	-0.02	-0.03	-0.05	-0.03	0.05
Exports	0.01	0.01	0.01	0.02	0.01	0.08
Imports	0.90	0.76	-0.01	0.02	0.01	-0.01
Prices	-0.12	-0.25	-0.18	-0.06	0.04	-0.04
CO_2 emissions	0.18	0.05	-0.08	0.01	0.03	0.05
Energy consumption	0.34	0.26	-0.03	-0.01	-0.02	0.04

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S20: Investment in electricity grids

This investment in the electric grid infrastructure in France aimed to improve the quality and security of electricity distribution and regional electricity grids. A total of €600m was invested between 2009 and 2010. The results in Table 8.11 show that the economic impact of this measure is quite small with almost no change to GDP compared to the baseline.

We have not included any environmental impacts in the modelling because it is not clear that there would be any direct impacts from the investment. However, by creating the possibility for better integration of renewables or smart devices in the future, the new infrastructure could be important when considering future policy in this area.

Table 8.11: France: Investment in Electricity Grids, Summary of Results

FRANCE: INVESTMENT IN ELECTRICITY GRIDS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.01	0.01	0.00	0.00	0.00	0.00
Employment	0.00	0.01	0.00	0.00	0.00	0.00
Household spending	0.00	0.01	0.00	0.00	0.00	0.00
Investment	0.06	0.06	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.02	0.02	0.01	0.00	0.00	0.00
Prices	0.00	-0.01	-0.01	0.00	0.01	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S31b: Investment in transport R&D

This measure involved €450m support for the car industry through low-carbon R&D funding and other measures. The results in Table 8.12 show that there were small increases in GDP during the years which investment took place. Otherwise, both economic and environmental variables have a negligible difference from the baseline across both the short and long terms.

Table 8.12 France, Investment in Transport R&D, Summary of Results

FRANCE: INVESTMENT IN TRANSPORT R&D, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.01	0.01	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.01	0.00	0.00	0.00	0.00
Investment	0.05	0.04	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.00	0.00	0.00	0.00
Prices	0.00	-0.01	-0.01	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.6 Germany

S5: Energy efficiency in public buildings

This measure provided €3.3bn of funding to improve the energy efficiency of school and university buildings in 2009 and 2010 and was the largest green measure included in Germany's stimulus package. The boost to investment was around 0.3%.

The results show that there are small, beneficial impacts on GDP in the short term, and persistent, long-term reductions in energy consumption and CO_2 emissions. The fall in CO_2 is comparatively smaller because the measures are assumed to reduce consumption of natural gas.

Table 8.13: Germany: Energy Efficiency in Public Buildings, Summary of Results

GERMANY: ENERGY EFFICIENCY IN PUBLIC BUILDINGS, SUMMARY OF RESULTS

	2009	2010	2011	2012	2013	2020
GDP	0.07	0.07	0.00	0.00	0.00	0.00
Employment	0.05	0.04	-0.01	0.00	0.00	0.00
Household spending	0.00	0.01	0.00	0.00	0.00	-0.01
Investment	0.32	0.34	0.03	0.01	0.01	0.00
Exports	0.01	0.01	0.00	0.00	0.00	0.00
Imports	0.04	0.06	0.02	0.01	0.01	-0.01
Prices	-0.01	0.01	0.02	0.02	0.02	0.02
CO_2 emissions	-0.06	-0.13	-0.12	-0.11	-0.10	-0.09
Energy consumption	-0.10	-0.20	-0.21	-0.19	-0.18	-0.15

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S18: Support for clean car technologies

As part of the stimulus package, the German government provided €500m of support (split equally between 2009 and 2010) for the development of hybrid and other clean car technologies. This measure is quite small in comparison to the other green measures; therefore its economic impact is small, with a 0.05% increase in investment.

The environmental impacts are rather unclear as the spending has been used to fund longer-term technological developments. We have not included any impacts in the modelling but it is possible that a more developed hybrid vehicle could boost efficiency gains by 2020. However, assuming technological progress, we would expect to see this measure contributing environmental benefits in the period after 2020.

Table 8.14: Germany: Support for Clean Car Technologies, Summary of Results

GERMANY: SUPPORT FOR CLEAN CAR TECHNOLOGIES, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.01	0.01	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.05	0.05	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.00	0.00	0.00	0.00
Prices	0.00	-0.01	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S30: Car scrappage scheme

The car scrappage scheme in Germany was originally expected to cost around €5bn. However, 682,961 applications were received during 2009, meaning the scheme would only have cost the government €1.7bn (based on the bonus of €2,500 per car). The results show that the scheme provides a short immediate boost to the economy and a more modest but more persistent increase in employment over the short-to-medium term.

The benefits to energy consumption and CO_2 emissions are likely to be short lived (compared to baseline) as vehicles would have been replaced anyway. By 2020 we would not expect to see any net difference.

Table 8.15: Germany: Car Scrappage Scheme, Summary of Results

GERMANY: CAR SCRAPPAGE SCHEME, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.53	-0.04	-0.02	0.01	0.00	-0.01
Employment	0.07	0.02	0.02	0.02	0.01	0.00
Household spending	1.04	0.01	0.01	0.01	0.00	-0.01
Investment	0.23	0.01	0.03	0.04	0.00	0.00
Exports	0.12	0.00	-0.02	0.00	-0.01	-0.01
Imports	0.41	0.11	0.05	0.01	0.00	0.00
Prices	-0.07	0.04	0.01	0.03	0.03	0.04
CO_2 emissions	0.00	-0.01	-0.02	-0.02	-0.01	0.00
Energy consumption	0.00	-0.01	-0.02	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S37: Revision of motor vehicle tax

The revision of the motor vehicle tax between 2008 and 2011 to include CO_2 emissions of passenger cars in the taxable base is expected to cost the German government €1.8bn in lost tax revenues over this period. On the other hand, households with cars on average observe an increase in disposable income and therefore can increase their spending. The results accordingly show a small increase in household spending. GDP is similarly boosted.

The environmental impacts are not shown in the modelling results as they are difficult to estimate with the tools we have available. There are likely to be competing factors with the incentive to use smaller and more efficient vehicles but also an increase in the total number of vehicles owned. We therefore see this as more of an economic policy with an environmental component rather than vice versa. However, it should also be noted that its introduction at the same time as the vehicle scrappage scheme may favour the benefits as the combined policies promote replacing older and inefficient vehicles with new and more efficient ones.

Table 8.16: Germany: Revision of Motor Vehicle Tax, Summary of Results

GERMANY: REVISION OF MOTOR VEHICLE TAX, SUMMARY OF RESULTS						
	2008	**2009**	**2010**	**2011**	**2012**	**2020**
GDP	0.00	0.01	0.01	0.01	0.01	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.01	0.01	0.02	0.01	0.00
Investment	0.00	0.00	0.00	0.01	0.01	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.01	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.7 Portugal

S28: Investment in solar and wind energy

This green measure involved providing private sector firms with a tax rebate when installing solar panels or micro-generating wind turbines. The measure was worth a total of €145m between 2009 and 2010, which is between 0.1% and 0.2% of baseline investment. The results in Table 8.17 show that the measure gave a small temporary boost to GDP, employment and household spending in the short term.

Increased activity also led to a small increase in energy consumption, although the larger share of electricity coming from renewable sources meant that there was a (small) fall in CO_2 emissions compared to the baseline.

Table 8.17: Portugal: Investment in Solar and Wind Energy, Summary of Results

PORTUGAL: INVESTMENT IN SOLAR AND WIND ENERGY, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.02	0.02	0.00	0.00	0.00	0.00
Employment	0.01	0.01	0.00	0.00	0.00	0.00
Household spending	0.01	0.01	-0.01	0.00	0.00	0.00
Investment	0.16	0.16	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.05	0.06	0.00	-0.01	-0.01	0.00
Prices	0.00	0.01	0.00	0.00	0.00	0.00
CO_2 emissions	0.01	0.00	-0.02	-0.02	-0.02	-0.02
Energy consumption	0.01	0.01	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S9: Energy efficiency in private buildings (households & small businesses)

The energy-efficiency measures for buildings in Portugal covered both private homes and buildings owned by small businesses. A total of €100m was spent on improving efficiency between 2009 and 2010, adding roughly 0.1% to investment.

As the results in Table 8.18 show, even in 2009-10 the economic and environmental impacts of this were very small. Our estimates suggest that the energy savings were up to 0.06% of final demand.

Table 8.18: Portugal: Energy Efficiency in Private Buildings, Summary of Results

PORTUGAL: ENERGY EFFICIENCY IN PRIVATE BUILDINGS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.02	0.03	0.00	0.00	0.00	0.00
Employment	0.02	0.02	-0.01	0.00	0.00	0.00
Household spending	0.01	0.02	-0.01	-0.01	-0.01	0.00
Investment	0.08	0.10	0.01	0.00	-0.01	-0.01
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.02	0.00	-0.01	-0.01	-0.01
Prices	-0.01	0.01	0.00	0.00	0.00	0.00
CO_2 emissions	-0.03	-0.06	-0.08	-0.08	-0.08	-0.06
Energy consumption	-0.01	-0.04	-0.06	-0.06	-0.05	-0.05

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S10: Investment in smart energy meters

The smallest of the green measures included in Portugal's stimulus package is the investment in smart energy meters for households, to promote energy-efficient behaviour. This measure totalled €15m between 2009 and 2010; if a smart meter costs €250 to buy and install (a rough estimate) this would pay for 60,000 new meters.

As yet there is no consensus about reductions in energy consumption from the installation of smart meters so we have not tried to model this. The impact is likely to depend on complementary policy, including education and information campaigns.

However, the effects are not likely to be big. If the scheme provides smart meters for 1.5% of households and each one reduces consumption by 5% that would lead to a reduction in electricity consumption of around 800 tonnes of oil equivalent, which is in the region of 0.005% of final energy demand in Portugal.

Table 8.19: Portugal: Investment in Smart Energy Meters, Summary of Results

PORTUGAL: INVESTMENT IN SMART ENERGY METERS, SUMMARY OF RESULTS

	2009	2010	2011	2012	2013	2020
GDP	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.01	0.02	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
Energy consumption	0.00	0.00	-0.01	-0.01	-0.01	-0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S32: Car scrappage scheme

The car scrappage scheme in Portugal offered a subsidy of €1,250 for the scrappage of a car older than eight years or €1,500 for a car older than ten years, when purchasing a new car with average emissions of less than 140gCO_2/km. The scheme was in operation in 2009 and provided €45m worth of bonuses. The results in Table 8.20 show that the scheme had a positive impact on the economy in the short term.

In 2009, the increase in energy consumption and CO_2 emissions caused by the rise in economic activity outweighed any direct reduction from more fuel-efficient cars on the road. However, in the longer term the scheme does achieve a reduction in both energy consumption and emissions, even once the direct effects from an improvement to the vehicle fleet become small.

Table 8.20: Portugal: Car Scrappage Scheme, Summary of Results

PORTUGAL: CAR SCRAPPAGE SCHEME, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.18	0.04	-0.02	0.00	-0.01	0.01
Employment	0.03	0.01	-0.01	-0.01	-0.02	0.00
Household spending	0.64	0.01	-0.03	-0.03	-0.02	0.00
Investment	0.05	0.03	-0.05	-0.06	-0.09	-0.04
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.46	-0.06	-0.03	-0.06	-0.06	-0.04
Prices	-0.06	-0.01	0.00	0.00	-0.01	-0.01
CO_2 emissions	0.05	-0.01	-0.03	-0.03	-0.04	-0.01
Energy consumption	0.06	-0.01	-0.03	-0.04	-0.04	-0.03

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.8 Slovakia

S1: Energy efficiency in public buildings

This measure increased energy efficiency in public buildings in specific regions of Slovakia. Investment was spread across 2009-11 as follows: €0.5m in 2009, €0.7m in 2010 and €8.8m in 2011. The total value of the measure was therefore only €10m, meaning it had little individual economic or environmental impact, as Table 8.21 shows.

Table 8.21: Slovakia: Energy Efficiency in Public Buildings, Summary of Results

SLOVAKIA: ENERGY EFFICIENCY IN PUBLIC BUILDINGS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.00	0.03	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.00	0.01	0.14	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.01	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	-0.01	-0.02	-0.02	-0.03
Energy consumption	0.00	0.00	-0.01	-0.01	-0.01	-0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S33: Increase in SLOVSEFF II fund

The SLOVSEFF II measure was established to support industrial energy-efficiency projects, renewable energy projects and energy-efficiency projects in the residential sector in 2010. This was the largest green measure included in the Slovakian stimulus package (€105m, although our interpretation is €93.5m was used). In 2010 the economic impact of the measure is positive, although this does not last once the investment comes to an end. However, the environmental benefits of the improvements in energy efficiency can be seen in the long term.

Table 8.22: Slovakia: Increase in SLOVSEFF II Fund, Summary of Results

SLOVAKIA: INCREASE IN SLOVSEFF II FUND, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.15	-0.01	-0.01	-0.01	-0.01
Employment	0.00	0.03	-0.01	0.01	0.01	0.01
Household spending	0.00	0.01	0.00	0.01	0.01	0.03
Investment	0.00	0.74	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.05	0.02	0.02	0.02	0.03
Prices	0.00	-0.01	-0.03	-0.03	-0.04	-0.11
CO_2 emissions	0.00	-0.01	-0.05	-0.05	-0.05	-0.05
Energy consumption	0.00	-0.02	-0.07	-0.07	-0.07	-0.06

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S25: Development of biomass & solar for households

This measure aimed to increase the installation and use of renewables (particularly biomass and solar) in households. The investment was spread out over three years as follows: €0.5m in 2009, €1.85m in 2010 and €5.65m in 2011. Since the measure is the smallest in value among all the green policies in the Slovakian stimulus package, it is not unexpected to see the almost negligible results shown in Table 8.23.

Table 8.23: Slovakia: Biomass & Solar for Households, Summary of Results

SLOVAKIA: DEVELOPMENT OF BIOMASS & SOLAR FOR HOUSEHOLDS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.00	0.01	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.00	0.01	0.04	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S34: Car scrappage scheme

The car scrappage scheme in Slovakia was carried out between 2009 and 2010, and totalled €55.3m in value. The bonus was set at a maximum of €2,000 for scrappage of a car of ten years or older. The value of the new car being purchased was set at a maximum of €25,000 meaning more small cars were bought rather than larger, less fuel-efficient cars.

Table 8.24 shows that increased economic activity due to increased household spending means that initially the scheme positively affects emissions and energy consumption, where increases in economic activity outweigh the benefits of more fuel-efficient cars being adopted. The impact on energy consumption becomes negative from 2011-13 as a result of the scheme, although the effects decrease over time as the vehicle fleet is updated.

Table 8.24: Slovakia: Car Scrappage Scheme

SLOVAKIA: CAR SCRAPPAGE SCHEME						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.52	0.31	-0.03	-0.01	0.01	0.00
Employment	0.20	0.08	0.02	0.00	-0.01	0.00
Household spending	1.14	0.78	0.01	0.02	0.02	0.01
Investment	0.00	0.00	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.19	0.16	0.04	0.02	0.01	0.01
Prices	-0.44	-0.26	0.02	0.01	-0.02	0.02
CO_2 emissions	0.05	0.01	0.01	0.00	-0.01	0.01
Energy consumption	0.08	0.03	-0.03	-0.02	-0.01	0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.9 Sweden

S13: Funds for biofuels development

This green fund in the Swedish stimulus package supported projects developing second generation biofuels. The investment was spread over three years as follows: 145m SEK in 2009, 380m SEK in 2010 and 350m SEK in 2011. In the short to medium term the economic impacts of the measure are positive but modest in nature (see Table 8.25).

We have not assumed any environmental impacts, as seems unlikely that second generation biofuels would come to market by 2020. However, if the research yields positive outcomes there could be an important contribution to emission reductions in the long term.

Table 8.25: Sweden: Funds for Biofuels Development, Summary of Results

SWEDEN: FUNDS FOR BIOFUELS DEVELOPMENT, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.01	0.01	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.02	0.06	0.06	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.01	0.01	0.00	0.00	0.00
Prices	0.00	0.00	-0.01	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S14: Green vehicle technologies

As part of the stimulus package the Swedish government established a venture capital company to support green technology projects in the motor vehicles sector. 3bn SEK of support was made available over the period 2008-13 (we have assumed this is split equally across the six years). The measure is much larger than any of the other measures included in the Swedish package and therefore has a greater impact on GDP in the years the investment takes place.

Similarly to the case for biofuels above, the environmental impacts of this measure are not reflected in the modelling as many of the outputs are likely to come to market after 2020. However, the measure could result in both long-term reductions in energy consumption by vehicles and also support the presence of Swedish suppliers.

Table 8.26: Sweden: Green Vehicle Technologies, Summary of Results

SWEDEN: GREEN VEHICLE TECHNOLOGIES, SUMMARY OF RESULTS						
	2008	**2009**	**2010**	**2011**	**2012**	**2020**
GDP	0.01	0.01	0.02	0.01	0.01	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.01	0.01	0.00
Investment	0.07	0.07	0.08	0.08	0.08	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.02	0.01	0.02	0.00
Prices	0.00	0.00	0.00	-0.01	-0.01	0.01
CO_2 emissions	0.00	0.00	0.00	0.01	0.01	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.01	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S15: Vehicle batteries

The Swedish stimulus package also includes a separate fund to specifically support the development of batteries for electric vehicles. The fund is worth 85m SEK, and is assumed to be split equally across the years in which it is operational (2008-13). This is the smallest green measure in Sweden in monetary terms; hence the near-zero economic impacts (see Table 8.27).

Again, the environmental impacts are not considered in the modelling but the possible long-term benefits to energy efficiency and Swedish industry are noted.

Table 8.27: Sweden: Vehicle Batteries, Summary of Results

SWEDEN: VEHICLE BATTERIES, SUMMARY OF RESULTS

	2008	2009	2010	2011	2012	2020
GDP	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.00	0.00	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S16: Energy efficiency in various sectors

The 1.75bn SEK energy-efficiency package in the Swedish recovery plan is focused on local and regional voluntary energy-efficiency agreements, improvements in procurement, information and counselling and the reinforcement of governmental work to improve energy efficiency. Since we are not aware of which sectors the measure covers, efficiency is assumed to improve in industry, transport, households and commerce. The investment is spread across five years as follows: 300m SEK each year between 2010 and 2014, with an extra 255m SEK in 2012. The economic impacts from 2010 onwards are small but positive, although temporary.

Energy consumption falls by around 0.04% from 2012 across the whole Swedish economy. As some of the industrial sectors use coal, there is also quite a large fall in emissions; in the baseline the sectors involved account for a growing share of total Swedish emissions, so the percentage reduction for the whole economy increases over time amounting to 0.11% by 2020.

Table 8.28: Sweden: Energy Efficiency in Various Sectors, Summary of Results

SWEDEN: ENERGY EFFICIENCY IN VARIOUS SECTORS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.01	0.01	0.02	0.01	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.01	0.00	0.00
Investment	0.00	0.05	0.05	0.08	0.05	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.01	0.01	0.00
Prices	0.00	0.00	-0.01	-0.01	-0.01	0.00
CO_2 emissions	0.00	-0.01	-0.02	-0.05	-0.06	-0.11
Energy consumption	0.00	-0.01	-0.02	-0.03	-0.04	-0.05

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S17: Commercialisation of green technologies

The final measure included in Sweden's recovery plan is another fund focused on green technologies, although this time it is the deployment rather than the development. It aims to encourage the commercialisation of green technologies such as biogas and solar-cells. The investment takes place over three years (100m SEK in 2009, 122m SEK in 2010 and 117m SEK in 2011).

The total value is small compared to some of the other green measures and to the total stimulus package, so the economic impacts of these measures on their own are therefore close to zero. However, when combined with other measures to develop the technologies the impacts could be much greater. An assessment of this would by nature be quite speculative as we would be trying to second guess future technologies and their rate of uptake. It would be interesting to reassess this in five years' time.

Table 8.29: Sweden: Green Technologies, Summary of Results

SWEDEN: COMMERCIALISATION OF GREEN TECHNOLOGIES, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.01	0.02	0.02	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

8.10 United Kingdom

S2: Warm Front programme

The Warm Front Programme aimed to improve energy efficiency in households through subsidising insulation and heating improvements. The programme was worth £150m in total (less than 0.1% of baseline investment), and was operational in 2009.

The results in Table 8.30 show a very small and temporary economic benefit and a long-term reduction in energy consumption and CO_2 emissions.

Table 8.30: UK: Warm Front Programme, Summary of Results

UNITED KINGDOM: WARM FRONT PROGRAMME, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.01	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.08	0.00	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Energy consumption	-0.02	-0.01	-0.01	-0.01	-0.01	-0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S3: Decent Homes Programme

The Decent Homes Programme plans to upgrade the energy efficiency of approximately 16,000 social houses in 2011. £60m has been set aside to carry out these improvements. Since the value of the measure is small, we would not expect to see a large increase in either economic activity or gains in energy efficiency (see Table 8.31).

Table 8.31: UK: Decent Homes Programme, Summary of Results

UNITED KINGDOM: DECENT HOMES PROGRAMME, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.00	0.01	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.00	0.00	0.03	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	-0.01	-0.01	-0.01	-0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S11: Flood defences

This measure constituted £20m brought forward to 2009 from a later date to establish flood defences for 27,000 homes. This scheme is too small to register at macro level and Table 8.32 shows that the economic impacts of the measure are close to zero.

Investing in flood defences is an example of a measure that focuses on adaptation to climate change as opposed to mitigation. The possible future benefits to coastal and riverbank households are both tangible (in terms of money saved) and intangible (reduced stress and anxiety). These benefits may not be realised until later in the forecast period and are not included in the modelling results.

Table 8.32: UK: Flood Defences, Summary of Results

UNITED KINGDOM: FLOOD DEFENCES, SUMMARY OF RESULTS

	2009	2010	2011	2012	2013	2020
GDP	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.01	0.00	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S12: Increasing railway capacity

The capacity of the railway network was increased by adding an additional 200 carriages, costing £300m between 2009 and 2010. This leads to small increases in GDP in those years compared to the baseline.

As described in the main text, the environmental costs and benefits are not completely clear but our suggestion is that they are probably quite small if they do not change commuting patterns. The benefits to existing commuters could be considered more social in nature in terms of increased comfort.

Table 8.33: UK: Increasing Railway Capacity, Summary of Results

UNITED KINGDOM: INCREASING RAILWAY CAPACITY, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.01	0.01	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.08	0.08	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.00	0.00	0.00	0.00
Prices	0.00	0.01	0.01	0.00	0.01	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S29: Low-carbon vehicles premium

The UK government launched a scheme that reimbursed consumers £4,500 for every purchase of an ultra-low carbon vehicle, i.e. a hybrid or electric vehicle. The scheme was operational in 2009 and 2010 and cost £250m in total. The results show a small positive increase in GDP in 2009 and 2010, after which the results are almost identical to the baseline. Energy consumption and GHG emissions barely change compared to the baseline.

Table 8.34: UK: Low-Carbon Vehicles Premium, Summary of Results

UNITED KINGDOM: LOW-CARBON VEHICLES PREMIUM, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.03	0.01	-0.01	0.00	0.00	0.00
Employment	0.01	0.02	0.01	0.00	0.00	0.00
Household spending	0.04	0.01	-0.01	0.00	0.00	0.00
Investment	0.03	0.05	0.01	0.00	-0.01	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.02	0.02	0.02	0.02	0.02	0.01
Prices	-0.02	0.03	0.03	0.00	0.01	-0.01
CO_2 emissions	-0.01	0.00	0.01	0.01	0.01	0.01
Energy consumption	-0.01	0.00	0.01	0.01	0.01	0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S24: Energy efficiency of waterways

This measure provided £5m of funding (split equally between 2009 and 2010) to improve the energy efficiency of the waterways network in the UK. Given the small value of the measure, it has zero economic impact.

The environmental impact is not assessed using the model, but the main impact could be an improvement to the appearance of the UK's waterways as gains in energy efficiency would have been small when judged at the macro level.

Table 8.35: UK: Energy Efficiency of Waterways, Summary of Results

UNITED KINGDOM: ENERGY EFFICIENCY OF WATERWAYS, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.00	0.00	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.00	0.00	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.00	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

S26: Support for offshore wind

Through the Renewables Obligation Certificates, the UK government allocated £525m worth of support for the development of offshore wind between 2009 and 2010. This is the largest green measure included in the UK's stimulus package, and therefore sees the largest positive economic impacts in the years the investment takes place (we have assumed the stimulus is up front even though the turbines could take longer to build and install).

The environmental effects from this are small in scale. This is perhaps surprising but reflects the fact that the amount of capacity that is displaced is very small (around 350MW out of 90GW). The impact on emissions (not shown in the table) depends on the type of generation that is being replaced but it is not likely to be more than 0.1-0.2% reduction.

Table 8.36: UK: Support for Offshore Wind, Summary of Results

UNITED KINGDOM: SUPPORT FOR OFFSHORE WIND, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.02	0.02	0.00	0.00	0.00	0.00
Employment	0.00	0.01	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.14	0.14	0.01	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.01	0.01	0.01	0.01	0.00	0.00
Prices	0.00	0.00	0.01	0.00	0.00	0.00
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3ME.

The rest of this appendix presents results for the non-EU countries that were assessed in the study.

8.11 Australia

S50: Energy efficiency

Table 8.37 shows that the stimulus package towards energy efficiency in housing had a positive effect during the years of investment that persisted into the long term, though at a lower level. Environmental benefits were also observed immediately as houses adopted more efficient measures, with the reductions in CO_2 emissions and energy consumption persisting in the long term.

Table 8.37: Australia: Energy Efficiency, Summary of Results

AUSTRALIA: ENERGY EFFICIENCY, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.26	0.27	0.04	0.03	0.03	0.04
Employment	0.03	0.02	0.02	0.04	0.02	0.03
Household spending	0.02	0.05	0.06	0.08	0.09	0.08
Investment	0.88	0.88	0.05	-0.02	-0.05	-0.01
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.11	0.13	0.05	0.05	0.05	0.03
Prices	-0.02	-0.05	-0.05	-0.04	-0.04	-0.07
CO_2 emissions	-0.06	-0.07	-0.10	-0.10	-0.09	-0.08
Energy consumption	-0.16	-0.16	-0.16	-0.15	-0.15	-0.11

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

S51: Investment in rail infrastructure

The investments in Australian rail networks had a small but positive effect on GDP in the near term, which disappears by 2020. In the long term CO_2 emissions and energy consumption increase slightly, driven by the small but persistent increase in household spending resulting in greater usage of the rail network in Australia. However, we have not assumed any emission reductions from switching from road to rail; this could easily offset the increase.

Table 8.38: Australia: Investment in Rail Infrastructure, Summary of Results

AUSTRALIA: INVESTMENT IN RAIL INFRASTRUCTURE, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.05	0.05	0.03	0.03	0.00	0.00
Employment	0.01	0.01	0.01	0.01	0.00	0.00
Household spending	0.00	0.01	0.01	0.02	0.02	0.01
Investment	0.18	0.18	0.09	0.08	-0.01	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.03	0.03	0.02	0.02	0.01	0.00
Prices	-0.01	-0.02	-0.01	-0.01	-0.01	-0.01
CO_2 emissions	0.00	0.00	0.00	0.00	0.00	0.03
Energy consumption	0.00	0.00	0.00	0.00	0.00	0.04

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

8.12 China

S52: Investment in rail and electricity grids

The investment was on a completely different scale to the other policies that have been assessed in this report. Our results suggest they added 2.5-3% on to GDP in 2009-10 with some additional lagged effects (the emissions profile in the modelling results is affected by an immediate requirement for more energy but is largely unaffected in the long term).

Both types of investment are likely to have environmental benefits in the long run but these are difficult to quantify. This is partly because we do not know the uptake of new rail services and the reduction in transmission losses, but also because it is difficult to establish a baseline, i.e. when the investment would have been made anyway. However, in both cases we suggest that the effects should be a reduction in energy consumption and emissions.

Table 8.39: China: Investment in Rail and Electricity Grids, Summary of Results

CHINA: INVESTMENT IN RAIL AND ELECTRICITY GRIDS, SUMMARY OF RESULTS

	2009	2010	2011	2012	2013	2020
GDP	2.83	2.76	0.38	0.13	-0.02	0.05
Employment	0.14	0.11	0.09	0.20	0.19	-0.03
Household spending	-0.27	0.54	0.59	-0.08	-0.22	-0.03
Investment	6.99	6.61	0.45	0.44	0.31	0.24
Exports	0.02	0.02	0.01	0.04	0.05	0.04
Imports	0.13	0.23	0.08	0.06	0.18	0.08
Prices	0.60	0.09	-0.49	-0.10	0.01	0.07
CO_2 emissions	0.73	0.66	-0.15	-0.74	-1.30	-0.29
Energy consumption	0.79	1.02	0.30	0.04	-0.03	0.02

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

S53: Vehicle scrappage scheme

The vehicle scrappage scheme in China was also large, but smaller than the investment above in terms of direct government input. Our modelling results suggest that it had an immediate economic impact, adding around 0.5% on to GDP in 2009 and in 2010 (see Table 8.40).

However, it had almost no impact on energy demand because the effects of an increase in economic activity outweighed the effects of more efficient cars (the short-term changes in emissions are again due to developments in the power sector and do not persist).

This calls into question the assumptions that were made about the scheme. In most European cases, it was reasonable to assume that the spending made by households came from savings and did not displace other spending. IHS Global Insight (2010) drew similar conclusions. In China the situation was different, however, as the economy was not in recession and incomes were growing. Therefore the modelling result that a modest government incentive led to a large number of additional cars being bought with additional money being put into the economy should be questioned.

We therefore ran an alternative scenario, in which only half the money used to buy cars came from savings, with the rest being taken from reductions in other spending. The results are shown in Table 8.41 and are roughly half in magnitude in all outcomes. This highlights a key sensitivity in the results.

Table 8.40: China: Car Scrappage Scheme, Summary of Results

CHINA: CAR SCRAPPAGE SCHEME, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.41	0.69	0.02	0.00	-0.03	0.00
Employment	0.01	0.00	0.00	0.03	0.02	-0.01
Household spending	0.95	1.67	0.04	-0.03	-0.05	-0.02
Investment	0.08	0.15	0.08	0.09	0.06	0.04
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	-0.01	0.02	0.07	0.06	0.08	0.03
Prices	-0.03	-0.12	-0.09	0.01	0.01	0.02
CO_2 emissions	0.16	0.20	-0.31	-0.52	-0.66	-0.09
Energy consumption	0.31	0.54	0.03	0.00	-0.01	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

Table 8.41: China: Car Scrappage Scheme with Reduced Additional Spending

CHINA: CAR SCRAPPAGE SCHEME WITH REDUCED ADDITIONAL SPENDING, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.20	0.35	0.01	0.00	-0.01	0.00
Employment	0.00	0.00	0.00	0.01	0.01	0.00
Household spending	0.47	0.84	0.02	-0.01	-0.02	-0.01
Investment	0.04	0.07	0.04	0.04	0.03	0.02
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	-0.01	0.01	0.04	0.03	0.04	0.02
Prices	-0.02	-0.06	-0.05	0.00	0.00	0.01
CO_2 emissions	0.08	0.09	-0.15	-0.26	-0.33	-0.04
Energy consumption	0.15	0.27	0.01	0.00	-0.01	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

S54: Investment in alternative fuel vehicles

The R&D that was made in alternative fuels for vehicles was much more modest in scale, although still large in absolute value compared to the measures adopted in Europe. We have assumed that the direct investment takes place in 2009-10, but the results show it has only a very small impact on GDP.

As is the case with many of the Swedish measures, we have treated this as a long-term investment, with no further economic or environmental impacts until after 2020 when products may become commercial. There is clearly a lot of uncertainty around what the effects might eventually be, but there could be benefits for Chinese industry and the global environment.

Table 8.42: China: Investment in Alternative Fuel Vehicles, Summary of Results

CHINA: INVESTMENT IN ALTERNATIVE FUEL VEHICLES, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.02	0.02	0.00	0.00	0.00	0.00
Employment	0.00	0.00	0.00	0.00	0.00	0.00
Household spending	0.00	0.00	0.00	0.00	0.00	0.00
Investment	0.06	0.05	0.00	0.00	0.00	0.00
Exports	0.00	0.00	0.00	0.00	0.00	0.00
Imports	0.00	0.00	0.00	0.00	0.00	0.00
Prices	0.01	0.00	0.00	0.00	0.00	0.00
CO_2 emissions	0.00	0.00	0.00	0.00	-0.01	0.00
Energy consumption	0.01	0.01	0.00	0.00	0.00	0.00

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

S55: Cleaning pollution and nature protection

A total of $30bn was allocated to a wide range of environmental measures. The economic effects are quite large because it was assumed that all the investment took place in 2009.

It is difficult to make much of an assessment without further details but, given the scale, it is reasonable to suggest that the effects would be localised.

Table 8.43: China: Cleaning Pollution and Nature Protection, Summary of Results

CHINA: CLEANING POLLUTION AND NATURE PROTECTION, SUMMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.95	0.12	0.06	0.02	0.01	0.01
Employment	0.06	-0.02	0.03	0.03	0.03	0.01
Household spending	-0.15	0.29	0.00	-0.01	-0.05	-0.01
Investment	2.35	0.08	0.14	0.08	0.08	0.06
Exports	0.01	0.00	0.01	0.02	0.02	0.01
Imports	0.01	0.06	0.01	0.04	0.03	0.01
Prices	0.24	-0.16	-0.06	0.00	0.01	0.01
CO_2 emissions	0.40	0.05	-0.14	-0.31	-0.46	-0.02
Energy consumption	0.95	0.12	0.06	0.02	0.01	0.01

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

8.13 South Korea

No modelling was carried out for South Korea, as it is not defined as a region in the E3MG model (it is grouped with other Asian countries). The individual policies are therefore described in the main text in Section 4.4.

8.14 USA

There was a wide range of policies in the US, many of which could only be assessed approximately. In the tables below we have therefore separated them into the largest investment scenario and the other smaller measures combined.

S67: Investment in energy infrastructure

The largest investment part of the green measures came from the ARRA 2009 package. It included tax credits for renewables ($13.1bn), investment in new energy transmission networks and health information technology ($25.1bn), and investments in energy-infrastructure, including smart-grid technology ($40bn). The other large general investment in 'infrastructure' has not been counted as a green measure.

The results are shown in Table 8.44, although the impacts on energy consumption are not included because they are not possible to measure (at least without a detailed energy network model of the US). The timing of the impacts is also dependent on when the funding was spent which is not always clear; our assumption is that it was all made in 2009.

The result is an additional 0.7% of GDP spread over 2009-10, caused by the large increase in investment. The resulting increase in imports is smaller.

Table 8.44: USA: Investment in Energy Infrastructure, Summary of Results

USA: INVESTMENT IN ENERGY INFRASTRUCTURE, SUMMARY OF RESULTS

	2009	2010	2011	2012	2013	2020
GDP	0.52	0.18	0.05	0.02	-0.01	0.01
Employment	0.07	0.05	0.02	0.00	-0.02	0.01
Household spending	0.13	0.17	0.06	0.02	-0.01	0.02
Investment	3.95	0.56	0.09	0.00	-0.07	-0.02
Exports	0.02	0.03	0.02	0.01	0.00	0.01
Imports	1.22	0.21	0.05	-0.01	-0.02	0.01
Prices	-0.18	-0.06	0.05	0.09	0.07	-0.03
CO_2 emissions	0.01	0.03	0.01	0.00	-0.01	0.01
Energy consumption	-0.02	0.05	0.01	-0.01	-0.01	0.02

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

Other measures in the US

The other measures combined have a smaller effect on GDP as the investment effect is smaller. Small reductions in energy demand as a result of the energy-efficiency measures are evident, although the possible impacts of high-speed rail are not included in these figures.

Table 8.45: USA: Other Measures in the USA, Sumary of Results

USA: OTHER MEASURES IN THE USA, SUMARY OF RESULTS						
	2009	**2010**	**2011**	**2012**	**2013**	**2020**
GDP	0.13	0.05	0.04	0.02	0.01	0.01
Employment	0.01	0.01	0.01	0.00	-0.01	0.00
Household spending	0.03	0.04	0.03	0.02	0.01	0.01
Investment	0.90	0.22	0.12	0.06	0.03	-0.01
Exports	0.01	0.01	0.01	0.01	0.01	0.00
Imports	0.15	0.08	0.03	0.01	0.00	-0.01
Prices	-0.03	-0.02	0.00	0.01	0.01	-0.01
CO_2 emissions	-0.01	-0.01	-0.02	-0.02	-0.02	-0.01
Energy consumption	-0.02	-0.01	-0.03	-0.03	-0.04	-0.02

Note(s): Figures shown are % difference from baseline.
Source(s): Cambridge Econometrics, E3MG.

9 Appendix C: Description of E3ME

This appendix provides a short non-technical description of the Energy-Environment-Economy Model for Europe (E3ME), developed by Cambridge Econometrics (CE).

For further details, including the full technical manual, the reader is referred to the E3ME website: http://www.e3me.com. E3ME is also described in the IA Tools model inventory.

For a list of acknowledgements see the preface of the model manual.

Introduction to E3ME

E3ME is a computer-based model of Europe's economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe for policy assessment, for forecasting and for research purposes.

E3ME's structure

The structure of E3ME is based on the system of national accounts, as defined by ESA95 (European Commission, 1996), with further linkages to energy demand and environmental emissions. The labour market is also covered in detail, with estimated sets of equations for labour demand, supply, wages and working hours. In total there are 33 sets of econometrically estimated equations, also including the components of GDP (consumption, investment, international trade), prices, energy demand and materials demand. Each equation set is disaggregated by country and by sector.

E3ME's historical database covers the period 1970-2008 and the model projects forward annually to 2050[61]. The main data sources are Eurostat, DG Ecfin's AMECO database and the IEA, supplemented by the OECD's STAN database and other sources where appropriate. Gaps in the data are estimated using customised software algorithms.

The main dimensions of the model

The other main dimensions of the model are:

- 29 countries (the EU27 member states plus Norway and Switzerland)
- 42 economic sectors, including disaggregation of the energy sectors and 16 service sectors
- 43 categories of household expenditure
- 19 different users of 12 different fuel types
- 14 types of air-borne emission (where data are available) including the six greenhouse gases monitored under the Kyoto protocol.
- 13 types of household, including income quintiles and socio-economic groups such as the unemployed, inactive and retired, plus an urban/rural split

Typical outputs from the model include GDP and sectoral output, household expenditure, investment, international trade, inflation, employment and unemployment, energy demand and CO_2 emissions. Each of these is available at national and EU level, and most are also defined by economic sector.

The econometric specification of E3ME gives the model a strong empirical grounding and means it is not reliant on the assumptions common to Computable General

[61] See Chewpreecha and Pollitt (2009).

Equilibrium (CGE) models, such as perfect competition or rational expectations. E3ME uses a system of error correction, allowing short-term dynamic (or transition) outcomes, moving towards a long-term trend. The dynamic specification is important when considering short and medium-term analysis (e.g. up to 2020) and rebound effects[62], which are included as standard in the model's results.

E3ME's key strengths

In summary the key strengths of E3ME lie in three different areas:

- the close integration of the economy, energy systems and the environment, with two-way linkages between each component
- the detailed sectoral disaggregation in the model's classifications, allowing for the analysis of similarly detailed scenarios
- the econometric specification of the model, making it suitable for short and medium-term assessment, as well as longer-term trends

A brief history of E3ME

Quantifying the short and long-term effects of E3 policies

E3ME was originally intended to meet an expressed need of researchers and policy makers for a framework for analysing the long-term implications of Energy-Environment-Economy (E3) policies, especially those concerning R&D and environmental taxation and regulation. The model is also capable of addressing the short-term and medium-term economic effects as well as, more broadly, the long-term effects of such policies, such as those from the supply side of the labour market.

The European contribution

The first version of the E3ME model was built by an international European team under a succession of contracts in the JOULE/THERMIE and EC research programmes. The projects 'Completion and Extension of E3ME'[63] and 'Applications of E3ME'[64], were completed in 1999. The 2001 contract, 'Sectoral Economic Analysis and Forecasts'[65] generated an update of the E3ME industry output, product and investment classifications to bring the model into compliance with the European System of Accounts, ESA 95. This led to a significant disaggregation of the service sector. The 2003 contract, Tipmac[66], led to a full development of the E3ME transport module to include detailed country models for several modes of passenger and freight transport and Seamate (2003/2004)[67] resulted in the improvement of the E3ME technology indices. The COMETR[68] (2005-07), Matisse[69] (2005-08) and CEDEFOP[70] (2007-2010) projects allowed the expansion of E3ME to cover 29 European countries, including the twelve accession countries. More recently the model has been used to contribute to European Impact Assessments, including reviews of the EU ETS, Energy Taxation Directive and TEN-E infrastructure policy. E3ME is now applied at the national, as well as European, level.

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[62] Where an initial increase in efficiency reduces demand, but this is negated in the long run as greater efficiency lowers the relative cost and increases consumption. See Barker et al (2009).

[63] European Commission contract no. JOS3-CT95-0011

[64] European Commission contract no. JOS3-CT97-0019

[65] European Commission contract no. B2000/A7050/001

[66] European Commission contract no. GRD1/2000/25347-SI2.316061

[67] European Commission contract no. IST-2000-31104

[68] European Commission contract no. 501993 (SCS8)

[69] European Commission contract no. 004059 (GOCE)

[70] European Commission project no. 2007-0089/AO/AZU/Skillsnet-Supply/010/07 and European Commission project no. 2006/S 125-132790

A full list of recent projects involving E3ME, and references from related publications, is available from the model website.

E3ME is the latest in a succession of models developed for energy-economy and, later, E3 (energy-environment-economy) interactions in Europe, starting with EXPLOR, built in the 1970s, then HERMES in the 1980s. Each model has required substantial resources from international teams and has learned from earlier problems and developed new techniques. E3ME is now firmly established as a tool for policy analysis in Europe. The current version is closely linked to the global E3MG[71] model, which is similar in structure and dimensions.

The theoretical background to E3ME

Economic activity undertaken by persons, households, firms and other groups in society has effects on other groups after a time lag, and the effects persist into future generations, although many of the effects soon become so small as to be negligible. But there are many actors, and the effects, both beneficial and damaging, accumulate in economic and physical stocks. The effects are transmitted through the environment (with externalities such as greenhouse gas emissions contributing to global warming), through the economy and the price and money system (via the markets for labour and commodities), and through the global transport and information networks. The markets transmit effects in three main ways: through the level of activity creating demand for inputs of materials, fuels and labour; through wages and prices affecting incomes; and through incomes leading in turn to further demands for goods and services. These interdependencies suggest that an E3 model should be comprehensive, and include many linkages between different parts of the economic and energy systems.

These economic and energy systems have the following characteristics: economies and diseconomies of scale in both production and consumption; markets with different degrees of competition; the prevalence of institutional behaviour whose aim may be maximisation, but may also be the satisfaction of more restricted objectives; and rapid and uneven changes in technology and consumer preferences, certainly within the time scale of greenhouse gas mitigation policy. Labour markets in particular may be characterised by long-term unemployment. An E3 model capable of representing these features must therefore be flexible, capable of embodying a variety of behaviours and of simulating a dynamic system. This approach can be contrasted with that adopted by general equilibrium models: they typically assume constant returns to scale; perfect competition in all markets; maximisation of social welfare measured by total discounted private consumption; no involuntary unemployment; and exogenous technical progress following a constant time trend (see Barker, 1998, for a more detailed discussion).

E3ME as an E3 model

The E3ME model comprises:

- the accounting balances for commodities from input-output tables, for energy carriers from energy balances and for institutional incomes and expenditures from the national accounts

[71] See www.e3mgmodel.com

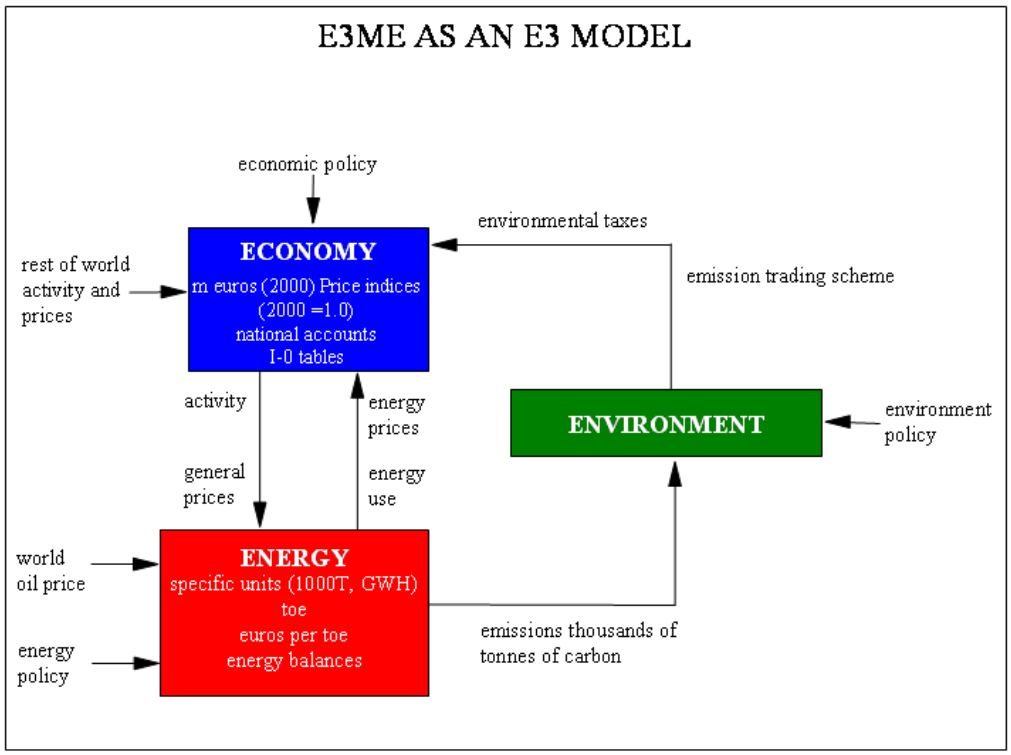
- environmental emission flows
- 33 sets of time-series econometric equations (aggregate energy demands, fuel substitution equations for coal, heavy oil, gas and electricity; intra-EU and extra-EU commodity exports and imports; total consumers' expenditure; disaggregated consumers' expenditure; industrial fixed investment; industrial employment; industrial hours worked; labour participation; industrial prices; export and import prices; industrial wage rates; residual incomes; investment in dwellings; normal output equations and physical demand for seven types of materials)

Energy supplies and population stocks and flows are treated as exogenous.

The E3 interactions

Figure C.1 shows how the three components (modules) of the model - energy, environment and economy - fit together. Each component is shown in its own box with its own units of account and sources of data. Each data set has been constructed by statistical offices to conform to accounting conventions. Exogenous factors coming from outside the modelling framework are shown on the outside edge of the chart as inputs into each component. For the EU economy, these factors are economic activity and prices in non-EU world areas and economic policy (including tax rates, growth in government expenditures, interest rates and exchange rates). For the energy system, the outside factors are the world oil prices and energy policy (including regulation of energy industries). For the environment component, exogenous factors include policies such as reduction in SO2 emissions by means of end-of-pipe filters from large combustion plants. The linkages between the components of the model are shown explicitly by the arrows that indicate which values are transmitted between components.

Figure C.1



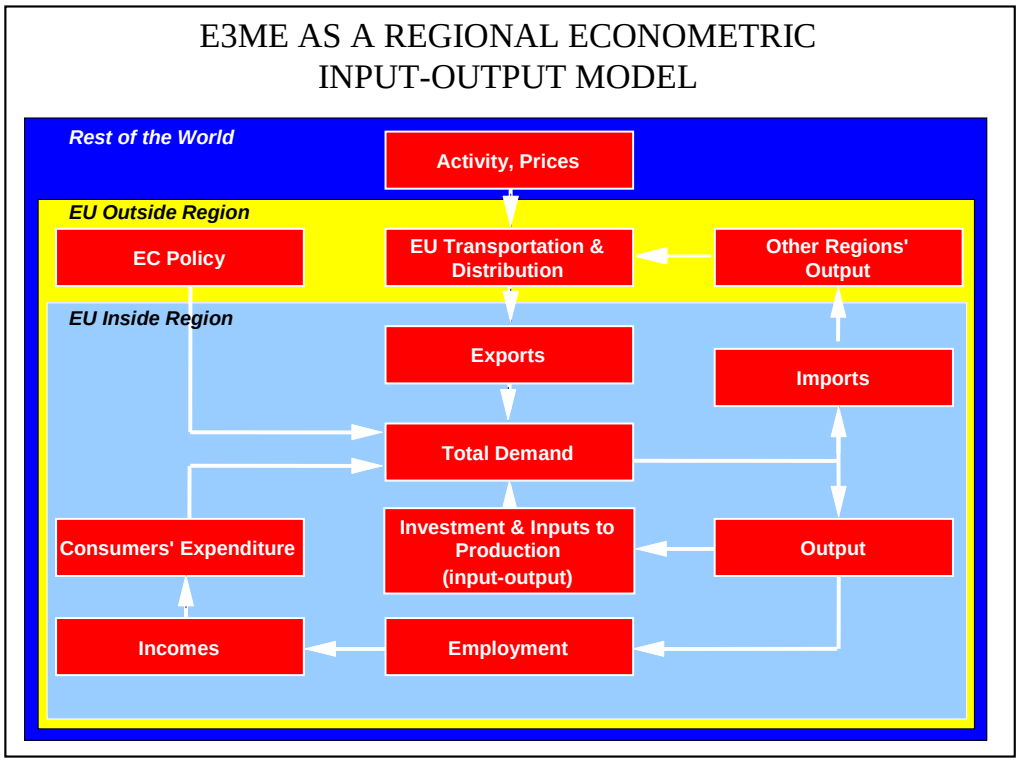
The economy module provides measures of economic activity and general price levels to the energy module; the energy module provides measures of emissions of the main

air pollutants to the environment module, which in turn gives measures of damage to health and buildings (estimated using the most recent ExternE[72] coefficients). The energy module provides detailed price levels for energy carriers distinguished in the economy module and the overall price of energy as well as energy use in the economy.

The E3ME regional econometric input-output model

Figure C.2 shows how the economic module is solved as an integrated EU regional model. Most of the economic variables shown in the chart are at a 42-industry level. The whole system is solved simultaneously for all industries and all 29 countries, although single-country solutions are also possible. The chart shows interactions at three spatial levels: the outermost area is the rest of the world; the next level is the European Union outside the country in question; and finally, the inside level contains the relationships within the country.

Figure C.2



The chart shows three loops or circuits of economic interdependence, which are described in some detail below. These are the export loop, the output-investment loop and the income loop.

The export loop

The export loop runs from the EU transport and distribution network to the region's exports, then to total demand. The region's imports feed into other EU regions' exports and output and finally to these other regions' demand from the EU pool and back to the exports of the region in question.

Treatment of international trade

An important part of the modelling concerns international trade. The basic assumption is that, for most commodities, there is a European 'pool' into which each region supplies part of its production and from which each region satisfies part of its demand.

[72] http://www.externe.info/tools.html

This might be compared to national electricity supplies and demands: each power plant supplies to the national grid and each user draws power from the grid and it is not possible or necessary to link a particular supply to a particular demand.

The demand for a region's exports of a commodity is related to three factors:

- domestic demand for the commodity in all the other EU regions, weighted by their economic distance from the region in question
- activity in the main external EU export markets, as measured by GDP or industrial production
- relative prices, including the effects of exchange rate changes

Economic distance

Economic distance is measured by a special distance variable. For a given region, this variable is normalised to be 1 for the home region and values less than one for external regions. The economic distance to other regions is inversely proportional to trade between the regions. In E3ME regional imports are determined for the demand and relative prices by commodity and region. In addition, measures of innovation (including spending on R&D) have been introduced into the trade equations to pick up an important long-term dynamic effect on economic development.

The output-investment loop

The output-investment loop includes industrial demand for goods and services and runs from total demand to output and then to investment and back to total demand. For each region, total demand for the gross output of goods and services is formed from industrial demand, consumers' expenditure, government consumption, investment (fixed domestic capital formation and stockbuilding) and exports. These totals are divided between imports and output depending on relative prices, levels of activity and utilisation of capacity. Industrial demand represents the inputs of goods and services from other industries required for current production, and is calculated using input-output coefficients. The coefficients are calculated as inputs of commodities from whatever source, including imports, per unit of gross industrial output.

Determination of investment demand

Forecast changes in output are important determinants of investment in the model. Investment in new equipment and new buildings is one of the ways in which companies adjust to the new challenges introduced by energy and environmental policies. Consequently, the quality of the data and the way data are modelled are of great importance to the performance of the whole model. Regional investment by the investing industry is determined in the model as intertemporal choices depending on capacity output and investment prices. When investment by user industry is determined, it is converted, using coefficients derived from input-output tables, into demands on the industries producing the investment goods and services, mainly engineering and construction. These demands then constitute one of the components of total demand.

Accumulation of knowledge and technology

Gross fixed investment, enhanced by R&D expenditure in constant prices, is accumulated to provide a measure of the technological capital stock. This avoids problems with the usual definition of the capital stock and lack of data on economic scrapping. The accumulation measure is designed to get round the worst of these problems. Investment is central to the determination of long-term growth and the model embodies endogenous technical change and a theory of endogenous growth which underlies the long-term behaviour of the trade and employment equations.

The income loop

In the income loop, industrial output generates employment and incomes, which leads to further consumers' expenditure, adding to total demand. Changes in output are used

to determine changes in employment, along with changes in real wage costs, interest rates and energy costs. With wage rates explained by price levels and conditions in the labour market, the wage and salary payments by industry can be calculated from the industrial employment levels. These are some of the largest payments to the personal sector, but not the only ones. There are also payments of interest and dividends, transfers from government in the form of state pensions, unemployment benefits and other social security benefits. Payments made by the personal sector include mortgage interest payments and personal income taxes. Personal disposable income is calculated from these accounts, and deflated by the consumer price index to give real personal disposable income.

Determination of consumers' demand

Totals of consumer spending by region are derived from consumption functions estimated from time-series data (this is a similar treatment to that adopted in the HERMES model). These equations relate consumption to regional personal disposable income, a measure of wealth for the personal sector, inflation and interest rates. Sets of equations have been estimated from time-series data for each of the 43 consumption categories reported by Eurostat in each country.

Energy-Environment links

Top-down and bottom-up methodologies

E3ME is intended to be an integrated top-down, bottom-up model of E3 interaction. In particular, the model includes a detailed engineering-based treatment of the electricity supply industry (ESI). Demand for energy by the other fuel-user groups is top-down, but it is important to be aware of the comparative strengths and weaknesses of the two approaches. Top-down economic analyses and bottom-up engineering analyses of changes in the pattern of energy consumption possess distinct intellectual origins and distinct strengths and weaknesses (see Barker, Ekins and Johnstone, 1995).

A top-down submodel of energy use

The energy submodel in E3ME is constructed, estimated and solved for 19 fuel users, 12 energy carriers (termed fuels for convenience below) and 29 countries. Figure C.3 shows the inputs from the economy and the environment into the components of the submodel and Figure C.4 shows the feedback from the submodel to the rest of the economy.

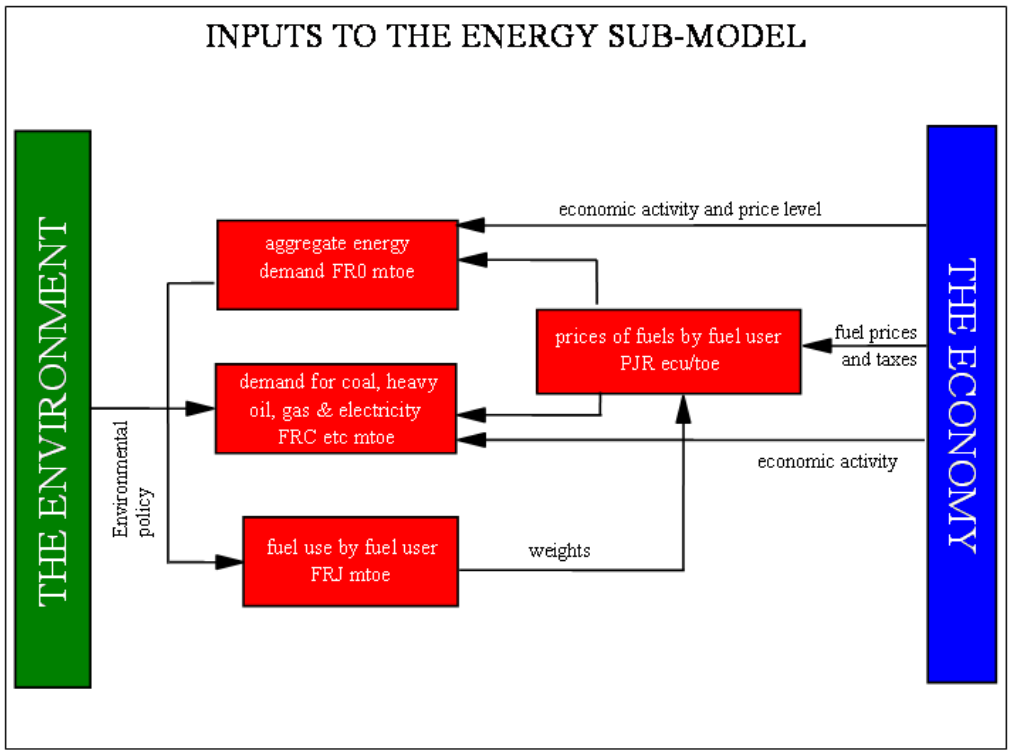
Determination of fuel demand

Aggregate energy demand, shown at the top of Figure C.3, is determined by a set of co-integrating equations[73], whose the main explanatory variables are:

- economic activity in each of the 19 fuel users
- average energy prices by the fuel users relative to the overall price levels
- technological variables, represented by investment and R&D expenditure, and spillovers in key industries producing energy-using equipment and vehicles

[73] Cointegration is an econometric technique that defines a long-run relationship between two variables resulting in a form of 'equilibrium'. For instance, if income and consumption are cointegrated, then any temporary shock (expected or unexpected) affecting these two variables is gradually absorbed since in the long run they return to their 'equilibrium' levels. Note that a cointegration relationship is much stronger relationship than a simple correlation: two variables can show similar patterns simply because they are driven by some common factors but without necessarily being involved in a long-run relationship.

Figure C.3



Fuel substitution

Fuel use equations are estimated for four fuels - coal, heavy oils, gas and electricity – and the four sets of equations are estimated for the fuel users in each region. These equations are intended to allow substitution between these energy carriers by users on the basis of relative prices, although overall fuel use and the technological variables are allowed to affect the choice. Since the substitution equations cover only four of the twelve fuels, the remaining fuels are determined as fixed ratios to similar fuels or to aggregate energy use. The final set of fuels used must then be scaled to ensure that it adds up to the aggregate energy demand (for each fuel user and each region).

Emissions submodel

The emissions submodel calculates air pollution generated from end-use of different fuels and from primary use of fuels in the energy industries themselves, particularly electricity generation. Provision is made for emissions to the atmosphere of carbon dioxide (CO_2), sulphur dioxide (SO2), nitrogen oxides (NOx), carbon monoxide (CO), methane (CH4), black smoke (PM10), volatile organic compounds (VOC), nuclear emissions to air, lead emissions to air, chlorofluorocarbons (CFCs) and the other four greenhouse gases: nitrous oxide (N2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF6). These four gases together with CO2 and CH4 constitute the six greenhouse gases (GHGs) monitored under the Kyoto protocol. Using estimated (ExternE) damage coefficients, E3ME may also estimate ancillary benefits relating to reduction in associated emissions e.g. PM10, SO2, NOx.

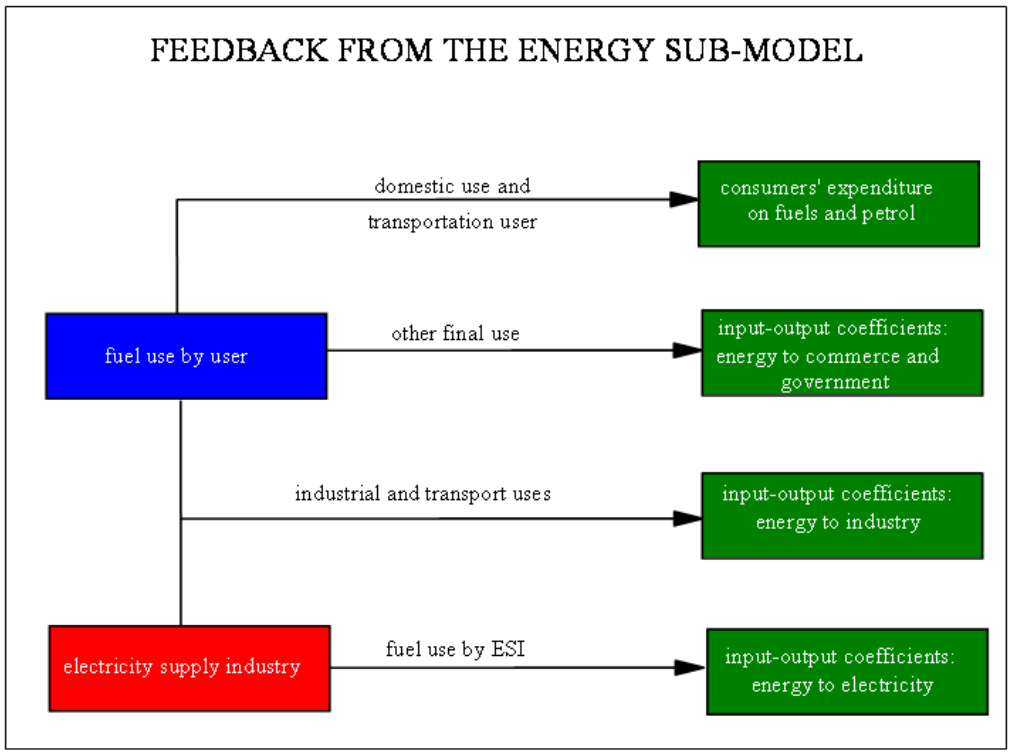
CO_2 emissions

Emissions data for CO_2 are available for fuel users of solid fuels, oil products and gas separately. The energy submodel estimates of fuel by fuel user are aggregated into these groups (solid, oil and gas) and emission coefficients (tonnes of carbon in CO_2 emitted per toe) are calculated and stored. The coefficients are calculated for each year when data are available, then used at their last historical values to project future emissions. Other emissions data are available at various levels of disaggregation from a number of sources and have been constructed carefully to ensure consistency.

Feedback to the rest of the economy

Figure C.4 shows the main feedbacks from the energy submodel to the rest of the economy. Changes in consumers' expenditures on fuels and petrol are formed from changes in fuel use estimated in the energy submodel, although the levels are calibrated on historical time-series data. The model software provides an option for choosing either the consumers' expenditure equation solution, or the energy equation solution. Whichever option is chosen, total consumer demand in constant values matches the results of the aggregate consumption function, with any residual held in the unallocated category of consumers' expenditure. The other feedbacks all affect industrial, including electricity, demand via changes in the input-output coefficients.

Figure C.4



Parameter estimation

The econometric model has a complete specification of the long-term solution in the form of an estimated equation that has long-term restrictions imposed on its parameters. Economic theory, for example the recent theories of endogenous growth, informs the specification of the long-term equations and hence properties of the model; dynamic equations that embody these long-term properties are estimated by econometric methods to allow the model to provide forecasts. The method utilises developments in time-series econometrics, in which dynamic relationships are specified in terms of error correction models (ECM) that allow dynamic convergence to a long-term outcome. The specific functional form of the equations is based on the econometric techniques of cointegration and error-correction, particularly as promoted by Engle and Granger (1987) and Hendry et al (1984).

Application of E3ME

Scenario-based analysis

Although E3ME can be used for forecasting, the model is more commonly used for evaluating the impacts of an input shock through a scenario-based analysis. The shock may be either a change in policy, a change in economic assumptions or another change to a model variable. The analysis can be either forward looking (ex-ante) or evaluating previous developments in an ex-post manner. Scenarios can be used either to assess policy, or to assess sensitivities to key inputs (e.g. international energy prices).

For ex-ante analysis a baseline forecast up to 2050 is required; E3ME is usually calibrated to match a set of projections that are published by the European Commission. The scenarios represent alternative versions of the future based on a different set of inputs. By comparing the outcomes to the baseline (usually in percentage terms), the effects of the change in inputs can be determined.

Typical scenarios

It is important to design scenarios carefully so that they do not present a biased set of outcomes, for example in a scenario where public spending increases there should be a similar increase in tax receipts (ensuring 'revenue neutrality', so that the scenario represents a shift in resources rather than an increase or decrease).

It is possible to set up a scenario in which any of the model's inputs or variables are changed. In the case of exogenous inputs, such as population or energy prices, this is straight forward. However, it is also possible to add shocks to other model variables. For example, investment is endogenously determined by E3ME, but additional exogenous investment (e.g. through an increase in public investment expenditure) can also be modelled as part of a scenario input.

Price or tax scenarios

Model-based scenario analyses often focus on changes in price because this is easy to quantify and represent in the model structure. Examples include:

- changes in tax rates
- changes in international energy prices
- emission trading schemes

Regulatory impacts

All of these can be represented in E3ME's framework reasonably well, given the level of disaggregation available. However, it is also possible to assess the effects of regulation, albeit with an assumption about effectiveness and cost. For example, an increase in vehicle fuel-efficiency standards could be assessed in the model with an assumption about how efficient vehicles become, and the cost of these measures. This would be entered into the model as a higher price for cars and a reduction in fuel consumption (all other things being equal). E3ME could then be used to determine:

- secondary effects, for example on fuel suppliers
- rebound effects[74]

[74] In the example, the higher fuel efficiency effectively reduces the cost of motoring. In the long-run this is likely to lead to an increase in demand, meaning some of the initial savings are lost. Barker et al (2009) demonstrate that this can be as high as 50% of the original reduction.

Standard outputs from the model

As a general model of the economy, based on the full structure of the national accounts, E3ME is capable of producing a broad range of economic indicators. In addition there is range of energy and environment indicators. The following list provides a summary of the most common outputs:

- GDP and the aggregate components of GDP (household expenditure, investment, government expenditure and international trade)
- sectoral output and GVA, prices, trade and competitiveness effects
- consumer prices and expenditures, and implied household distributional effects
- sectoral employment, unemployment, sectoral wage rates and labour supply
- energy demand, by sector and by fuel, energy prices
- CO_2 emissions by sector and by fuel
- other air-borne emissions
- material demands

This list is by no means exhaustive and the delivered outputs often depend on the requirements of the specific project. In addition to the sectoral dimension mentioned in the list, all indicators are produced at the member state level and annually over the period up to 2050.

Limitations to the analysis

The main limitation of E3ME is the sectoral disaggregation of its sectors. The industry classification is relatively detailed, covering 42 sectors at the NACE 2-digit level. However, due to the availability of the data, it is not possible to go into more detail, for example to the firm-based level, or to very detailed product groups. For this type of analysis our recommendation is that the model (which provides an indication of indirect effects) is used in conjunction with a more detailed bottom-up or econometric analysis (which can capture detailed industry-specific effects).

The other main limitations to the model relate to its dimensions and boundaries. Broadly speaking E3ME covers the economy, energy and material demands and atmospheric emissions. While it is possible to provide an assessment of other policy areas, it is necessary to make assumptions about how this is translated into model inputs. Other limitations, such as the geographical scope (Europe) and time horizon (2050) are more obvious, although it should be noted that the global E3MG model can be used to address the first of these issues.