Green the Union : an investment strategy towards a sustainable European Union

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GREEN THE UNION: AN INVESTMENT STRATEGY TOWARDS A SUSTAINABLE EUROPEAN UNION

Restoring economic growth in Europe using only monetary policy, even of the unconventional variety, appears more and more insufficient and in desperate need of a second or third leg. In a much debated speech at Jackson's Hole this summer, Mario Draghi recalled this difficult context in the fight against the risk of stagnation.

Structural reforms are often presented as a suitable complementary policy tool. However, aside from the vagueness of their content, they could prove recessionary, deflationary, and costly in the short term, procuring benefits in terms of potential growth in the long or medium term only. Even though some structural reforms may have positive impacts on activity or prices in the short term, recent experiences, conducted in periods of large negative output gaps, tend to confirm the general intuition that positive impacts may be long to manifest (see Chapter 1).

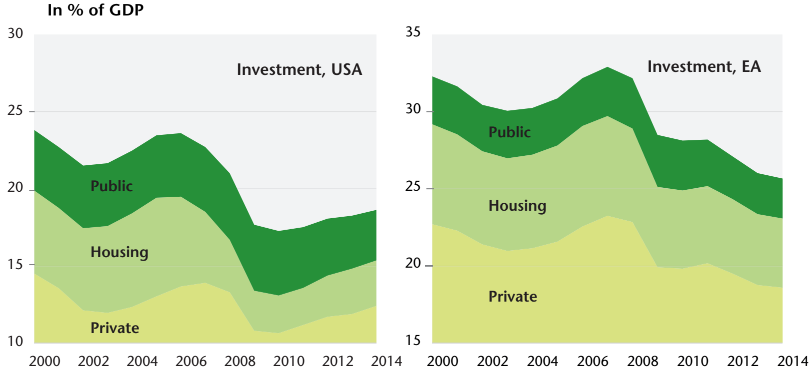
Fiscal policy could also be used as a complement. However, the governance of the euro area, notably the reinforced framework of the growth and stability pact (TSCG, 6-pack and 2-pack), combined with the continued weakness of Euro area economies burdened by high cyclical deficits, have maintained restrictive fiscal policies across the Euro area. The euro area as a whole has now suffered from a cumulated fiscal impulse of more than *negative* 5 GDP points since 2010, explaining in part the double dip recession of the euro area starting in 2011. It remains important to salvage the heritage from the painful process of fiscal governance building in Europe, even if the current governance presents many flaws. In particular, when faced with a need for investment known to have a high social return because of climate change, the Euro area's fiscal governance still calls for consolidation despite enjoying very low sovereign rates.

Characteristically, one of the key aspects of the European economic malaise is the dramatic drop in physical investment since the onset of the crisis. Unlike other countries such as the US, investments in the euro area have not yet begun to recover (see Figure 1).

This situation is both a reflection of the current European macroeconomic context, and a cause for the continued sluggishness of economic activity in the Euro area. Worse, low investment threatens the long-term ability of the European economy to develop and service individual and social needs.

In reaction to this deadlock, dissenting voices are now defending that the European Union needs an immediate yet sustained boost in investment, to avoid deflation in the short-term, and to prepare for the future and improve its sustainability in the long term. This is the proclaimed goal of the "€300 billion investment plan" recently announced by the European Commission's newly elected president, Jean-Claude Juncker. The current proposal does not go nearly far enough though—the expected multiplier of 15:1 between private and public investments underlines the utter lack of fresh public funding committed to the plan. The ability of the new European Fund for Strategic Investments to mobilise hundreds of

Figure 1. Investment in the USA and the Eurozone



Source: OECD, *EO96*, December 2014.

billions of private money over three years with €21 billion of (mostly recycled) EU public money can be questioned. Worse still, the Juncker plan has not clearly determined its target sectors and the projects it could potentially fund. It has not identified either the channels through which the projected increase in investments will be financed, or the ways in which it could be sustained in the medium to long term (see Chapter 1).

A European investment plan should strive to maximize both its short-term impact on activity and its long-term effects on the sustainability of future European growth—particularly regarding official EU policy goals such as the 20-20-20 objective.[1] This entails that investment in business-as-usual, unsustainable "brown" infrastructure should be avoided, as it maintains the European economy on a development pathway that grows harder to reverse the later the transition towards sustainability begins. This irreversibility of infrastructure investment makes energy a high priority sector.

This paper identifies three sectors that fulfil the double criteria of short-term boost to growth and long-term sustainability: energy production and distribution, energy retrofit in the building sector, and sustainable mobility. For each of them, we will discuss the macroeconomic interest of investing in their transformation, as well as the capacity of the EU to stimulate and maintain an increase in investments: does the EU has the financial institutions and instruments to stimulate tens or even hundreds of billions of investments in these sectors in the short term, for example in the coming three years, and at the same time how could the EU ensure the stimulus in investments will continue over decades?

It is worth noting here that, when studying the financial capacity of the EU to increase investments, the public-private debate pops up: how much of the investments should be public, how much should be private, what is the leverage effect

1. European 2020 Climate and Energy Package, setting a target of a 20% reduction in EU greenhouse gas emissions from 1990 levels, an increase in the share of EU energy consumption from renewable sources to 20% and a 20% improvement in energy efficiency.

expected? We consider this discussion important, but think it is more relevant to base the analysis on sector specific studies and determine—from the ground up—what needs to be public money and what can be private money. More generally, we think that analysing the sectorial needs for investment is a better starting point to design an investment strategy than the source of financing or the relevant institutions and instruments to be used by the plan.

Beyond sector-specific analysis, it should be noted that in order to stimulate investments in the short and in the long run, it is not enough to inject public money and attempt to achieve the strongest leverage possible on private investments. In addition to the push strategy (introducing fresh money into an adapted financial pipeline), any European investment strategy should adopt a complementary pull strategy (attracting financing out of the pipeline).

By modifying the relative prices of different sources of energy, putting in place a carbon price can spur an increase in investment through the depreciation of existing energy- and carbon-intensive capital and an improvement in the profitability of, and therefore the demand for, the projects analysed in Section 1. This paper supports the idea of a “Carbon fiscal shock”, whereby this effect on investment would be maximised by setting the carbon price at a relatively high level instantly, instead of following a more traditional progressive increase over time.

Section 2 presents this proposal, which could secure increased investments in the long run and strongly reduce the current European output gap. It discusses the conditions under which such a scheme could be implemented in Europe, notably in terms of compensation and border tax adjustments. The macroeconomic impacts of an EU-wide “Carbon fiscal shock” are then analysed through the results of simulation exercises using the ThreeME and E3ME models.

1. Where to invest and how to invest?

Given the double criteria of a short-term boost to economic activity and a long-term improvement of the sustainability of European economic growth, an EU investment strategy should:

— Put energy supply and energy efficiency in buildings and transport at its core, as these sectors are key for a sustainable economy and tend to have strong macroeconomic benefits (growth, jobs, trade and economic resilience);

— Build on the existing EU financial institutions and instruments to effectively deliver a short term boost in investment, and progressively adapt them to ensure this boost is sustained in the longer term.

This section investigates three sectors: energy supply, energy efficient buildings and energy efficient mobility. For each of them we identify the current investment gap and then discuss the short and long-term macroeconomic benefits of closing this gap for the European economy, distinguishing between:

— The growth impact
— The employment impact
— The trade impact
— The resilience impact.

Then we present the financial institutions and instruments the EU has at its disposal to boost investment in these sectors. We also discuss whether there is a need for complementary instruments for the EU to effectively support higher investments in the short and in the long term.

From a general perspective, investing in mobility, housing and energy sectors is key to build an Energy Union that is much less dependent on costly energy imports, more resilient to energy price shocks and at the forefront of the fight against climate change on the road to the Paris Climate Summit in December 2015. Moreover, these sectors are labour-intensive and support the activity mostly in the construction sector—building construction and civil engineering—where the output gap remains wide: the activity in 2013 was still below the 1996 level.[2] With a longer term perspective, it turns that the energy and climate transition entails costs that are outweighed by savings: according to the European Commission Energy Roadmap 2050, the additional capital cost of a decarbonisation pathway for the EU energy system is below €260 billion annually, whereas savings are above €310 billion.

Energy production and distribution

Why investing?

Investment gap. Improving European energy security, particularly in the face of heightened tensions with Russia, and fulfilling the EU energy and climate objectives for 2020 and beyond require large scale investments in the European energy production and distribution infrastructure.

Concerning the energy grid, the European Commission has been identifying since 2006 a number of Projects of Common Interests grouped under the TEN-E (Trans-European Networks – Energy) umbrella. These projects entail[3] extending the European gas pipeline network—notably the strengthening of reverse flow natural gas transmission capacities, thereby improving Eastern Europe's resilience; interconnecting Member States' electric grids, which will improve the effectiveness of the internal energy market and allow long-distance transportation of electricity, in particular when produced from renewable energy sources; developing "smart grids", to facilitate the integration of renewable electricity supply and improve load balancing. The European Commission has estimated that until over the decade leading to 2020, €70 billion will be needed for gas pipelines, storage, LNG and reverse flow infrastructure, and €140 billion for high-voltage electricity transmission systems.[4] Compared with the investments delivered during the past decade, the current decade needs a rise of investments by respectively 30% and 100% for gas and electricity networks.

In addition, more than €120 billion have to be invested in additional renewable energy supply capacity[5] if Europe is to achieve its 2020 target. After weathering the beginning of the economic crisis fairly well, investments in new renewable energy production capacity have declined for the second year in a

2. Source: Eurostat.

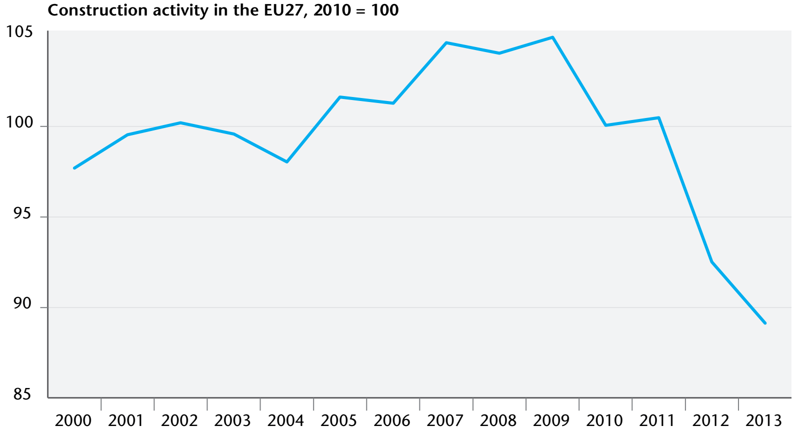
3. Decision No 1364/2006/EC on Trans-European energy networks, http://europa.eu/legislation_summaries/energy/internal_energy_market/l27066_en.htm

4. MEMO/11/710, http://europa.eu/rapid/press-release_MEMO-11-710_en.pdf

row in 2013, suffering a precipitous drop of 41%.[6] This leaves ample room for a quick rebound in the deployment of new renewable energy production capacity in Europe.

Growth impact. Fulfilling the TEN-E and renewable agenda entails the completion of large scale infrastructure projects that would provide a Keynesian boost to the European economy in the short-term. Indeed, such investments would trigger activity in the civil engineering sector, a sector that has experienced a steep decline since 2008 and has not recovered yet (Figure 2).

Figure 2. Civil engineering activity in the EU27



Source: Eurostat.

In the longer term, the new gas and electricity infrastructure will improve the effectiveness of the European energy markets, with a beneficial effect on the level and stability of energy prices. If investments in renewable energy sources reduce the European energy trade deficit and protect the European economy from energy crisis (see below), their impact on long term growth remains uncertain however as it crucially depends on future fossil fuel prices.

Employment impact. The construction of new energy networks, whether it be pipelines or high-voltage power lines, would be accomplished by the civil engineering sector, with a relatively high average European labour intensity of 7.7 jobs

5. Estimation made using the Green-X model, developed by the Energy Economics Group (EEG) at the Vienna University of Technology under the EU research project "Green-X–Deriving optimal promotion strategies for increasing the share of RES-E in a dynamic European electricity market". Initially focused on the electricity sector, this modelling tool, and its database on renewable energy (RES) potentials and costs, has been extended to incorporate renewable energy technologies within all energy sectors.

6. This evolution needs to be nuanced by the falling cost of solar components: worldwide, 26% more solar capacity was installed in 2013 than in 2012 for an investment cost 20% lower. However, this can only account for part of the steep European decline in renewables investment: from 2011 to 2013, total investment fell from €92 billion to €38 billion.

per million euro of activity (vs 4 for the manufacturing sector).[7] Further, these infrastructure jobs would be purely European, and could not be off-shored. While some of the equipment used in the production of renewable energy is manufactured outside the EU, Table 1 shows that most renewable energy sources present a relatively high labour intensity.

Table 1. Direct and indirect jobs supported in the EU in 2012 per million euro of turnover, by energy source

Full time equivalents, FTEs

Wind power	8.9	**Heat pumps**	11.1
Solar power	8.2	**Biogas**	12.1
Solar thermal	11.5	**Biofuels**	7.9
Small hydropower	8.1	**Geothermal**	9.2

Source: The State of Renewable Energies in Europe, Eurobserv'er (2013), iAGS calculations.

Trade impact. Most of the infrastructure planned in the TEN-E projects, such as pipelines and high-voltage power lines can be produced within the EU. This is not the case, however, for all renewable energy supply equipment. Whereas the EU-27 has a considerable trade deficit with the rest of the world in solar components (European Commission, 2014),[8] the situation is reversed for the other main renewable energy source offering a large investment potential, wind power: in 2012, the EU had a trade surplus of more than €2.45 billion with the rest of the world.[9]

The risk for an increase in the trade deficit on solar components is dwarfed by the potential improvement that renewable energy sources promise to bring to the energy trade deficit. In 2012, EU trade deficit in energy products with the rest of the world reached €421 billion, or 3.3% of EU GDP[10]—almost three times as high as in 2004. The European Commission estimated that in 2010, renewables had already allowed to avoid €10.2 billion in imported fuel costs for electricity generation, €12.2 billion for heating and €7.6 billion for transport (Eurobserv'er, 2013).

Resilience impact. The proposed improvements to the European energy grid, along with the increased deployment of renewable energy sources, would help insulate the EU from future energy price or supply shocks. Investing in these projects would help avoid a repeat of the January 2009 gas crisis, when from 6 to 20 January, the 28.6% of European natural gas consumption that transit through Ukraine were cut off (European Commission, 2009).

Besides, the expansion of renewable energy generation in Europe is central to the achievement of Europe's objectives of greenhouse gas emissions reduction. Reaching a milestone of 20% renewable energy supply by 2020 is, along with a

7. Source: Eurostat.
8. As noted by the European Commission in a recent report, "the EU-27 has a considerable trade deficit with the rest of the world in solar components and equipment", which amounts to €9 billion in 2012—mostly with China. While still very large, this deficit has been halved since 2010, when it stood at €21 billion.
9. Source: Eurostat.
10. Source: Eurostat.

20% improvement in energy efficiency, the pillar that will allow Europe to succeed in reducing its greenhouse gas emissions by 20% in 2020 from its 1990 level.

How to boost the investment?

State of the art

In order to finance the upgrade of projects targeted by the Transport European Networks in Energy, Transport, and Communications, the European Commission has set up the Connecting Europe Facility (CEF) in 2013 by a new European Regulation.[11]

In the energy sector, the CEF aims at closing the estimated investment gap of €60 to €70 billion (European Commission, 2011) in the development of European energy infrastructure. By providing technical assistance, coordination among member states and co-financing from 10% to a maximum of 50% of a project's total costs, the CEF intends to unlock investments that could not have been made in its absence. In particular, it targets an increase in private funding by bringing in new classes of investors such as pension and insurance funds through new innovative instruments such as project bonds initiative. Importantly, it will also provide grants to enable the funding of projects which, while providing very strong positive externalities, are not commercially viable in the current economic environment.

The Connecting Europe Facility complements the existing funding from the EIB, along with other existing European programs which also participate in cross-border energy infrastructure, most notably the Cohesion and the Structural Funds. More generally the CEF seeks to avoid duplicating existing European instruments, and to integrate and coordinate with existing programs, such as the Common Strategic Framework or the Partnership Contracts.

On the renewables front, while the bulk of investments are largely carried out by private banks, public finance institutions are essential in catalysing renewable energy investments. These institutions mostly offer loans on favourable terms, guarantees, but also provide equity or grants (Eurobserv'er, 2013). After a decrease from 2011 to 2012, the EIB stepped up its support for renewables in Europe to €6.4 billion in 2013, a doubling from the year before. It represents a major actor in this space, providing a channel through which future renewables investments can be disbursed.

Issues for today and for the future

To increase investments in energy grid, the EU already has at its disposal the newly established CEF. This Facility however is under-funded. Indeed, €5.85 billion have been made available for energy infrastructure over the period 2014-2020 whereas, during its design phase in 2011, the European Commission estimated that "nothing less than €9.1 billion will suffice to make sure that the infrastructure Europe needs is built in time".

Similarly, provided that the EIB financial support is stepped up, existing financial instruments appear adequate to bring European investments in renewables

11. Regulation of the EP and of the Council of 11 December 2013 establishing the Connecting Europe Facility. Official Journal of the European Union.

back to their 2010-2011 levels. But the cost of financing renewable energy projects remains an ongoing concern: perceived risks on the evolution of support policies, volatility on the energy markets, difficulties in obtaining licenses and other administrative roadblocks all contribute to increase the cost of financing. This increased financing cost can have a large impact on the ultimate cost of the electricity delivered by the renewable energy installation over its lifecycle, impacting its profitability and competitiveness negatively.[12] There clearly is a need to enhance the link between local projects (generally financed by retail banks) and the financial market. This intermediation could be facilitated in several ways, through concessional loans,[13] securitization vehicles to improve the refinancing options for retail banks and potentially guarantee funds to reduce the cost of capital and facilitate the implication of institutional investors through harmonized and large-scale products (Ecofys, 2011).

Energy efficient buildings

Why investing?

Investment gap. Capturing the full potential of energy efficiency in European buildings requires financing a large-scale deep renovation of the existing building stock. Indeed, with a construction rate of around 1% per annum[14] and a demolition rate an order of magnitude lower (Thomsen & Flier, 2009), renewing the building stock with new, energy efficient constructions cannot be enough.

The European Commission (2012) estimated that €60 billion would be needed annually from 2012 to 2020 to conduct a moderately ambitious energy renovation of the European building stock. Copenhagen Economics (2012) estimated that conducting a deep retrofit of the whole existing stock would require €78 billion per annum over the same period. It should be noted that only a deep renovation can capture the full energy efficiency potential without risking "freezing" part of the savings in place through a partial retrofit[15] (IEA, 2013c).

Growth impact. The buildings construction sector accounted for 5.4% of EU's GDP in 2013 (compared with 6.4% in 2008), and has been one of the hardest hit since the beginning of the economic crisis. European construction output in 2013 was more than 22% below its level of 2007 and had been falling for 6 years straight. The construction sector is thus primed for a rapid rebound given an increase in energy renovation investments. Moreover, it is largely composed of SMEs, with 61% of output produced by companies of 50 employees

12. According to the IEA, reducing the discount factor (including cost of capital and risk premium) from 10% to 5% can reduce the levelized cost of electricity generation from highly capital-intensive assets (such as wind and solar power) by up to 30% over the entire lifetime. Projected costs of generating electricity, International Energy Agency (2010). See also: Towards triple-A policies, RE-Shaping project, Ecofys *et al.* (2011).

13. The German KfW's concessional loans for renewable projects (with interest rates starting at 1% for up to 20 years) are generally considered a good example. The preferential interest rate is achieved through the provision of low-cost finance through international markets and limited public support to further reduce interest rates.

14. Source: Eurostat.

15. A partial renovation can lead to a suboptimal situation where a full renovation is no longer possible, thereby locking some of the potential energy savings away.

or less,[16] which make up one of the main focal point of many European financial support programs.

On a longer-term perspective, the impact of energy renovation on growth appears to be very dependent on future fossil fuel prices and on the modalities of the energy renovation policies implemented. For example, a policy that promotes deep and "one-shot" energy renovation of buildings at the same time they have to undergo other renovation operations will be more likely to have a strong beneficial impact.

Employment impact. The high labour intensity of energy renovation, estimated as high as 17 full-time equivalents per million euros invested (IDDRI, 2012), is expected to support a large number of jobs creation.[17] Besides, with 12 million less employed in the construction of buildings in 2012 than in 2008, there is a large pool of unemployed qualified professionals in the sector.

However, in a longer term, there is a need for some capacity development in the construction industry to master the necessary skills and techniques—which requires complementary policies to support the investment effort. Indeed, deeper renovations require more skilled crews, with deep energy renovations requiring an estimated 30% professionals among crews, compared with 5% in a base renovation (Herrero *et al.*, 2011). This increases the level of qualification of the jobs created.

Trade impact. The European construction sector is almost entirely domestic. The impact of investments in energy renovation would thus directly benefit the domestic economy. The situation is comparable regarding construction materials: with a surplus of €9 billion in 2013, the EU is a net exporter of non-metallic minerals. Moreover, buildings account for 38% of the total EU natural gas consumption (IEA, 2013a): energy savings in this sector would thus help reduce the €72 billion natural gas imports bill.

Resilience impact. The buildings sector accounts for close to 40% of final energy consumption in Europe (IEA, 2013d) and has long been identified as the sector offering the largest energy savings potential. Fraunhofer (2009) estimates the full energy savings potential at 165 Mtoe when cumulated until 2030. Further, buildings account for 38% of the total EU gas consumption (IEA, 2013a). In particular, this proportion reaches close to 50% in most Eastern Member States, such as Poland, the Slovak Republic or the Czech Republic, which import more than 90% of their natural gas from Russia (IEA, 2013b). Energy savings in this sector can therefore play a central role in the reduction of Europe's gas dependency, particularly towards Russian gas.

How to boost the investment?

State of the art

The buildings sector is highly fragmented: it comprises a large variety of building types, which serve very different residential and non-residential needs,

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16. Source: Eurostat.

17. The reduction of employment in the energy sector following the decrease in energy consumption is expected to be small compared with the number of jobs creation in the buildings sector, due to the very low labour intensity of the energy sector—see in particular (Quirion, 2010).

and its ownership structure is varied and scattered.[18] As such, improving the energy efficiency of the buildings sector combines most of the main barriers traditionally identified when analysing the lack of investment in energy efficiency (IEA, 2007): the relatively low level of energy expenses in the buildings sector hampers the effectiveness of price signals, access to capital for energy renovation remains difficult, the incentives of owners and occupants can prove divergent (principal-agent problem), and finally, a general lack of awareness on energy efficiency potential benefits and best practices prevents households and commercial buildings owners alike to take action.

These roadblocks pose specific challenges to investment in energy renovation, and require innovative financing arrangements. The European Union has put in place a range of programs in the field of energy efficiency, particularly buildings energy retrofit.

- **Joint European Support for Sustainable Investment in City Areas (JESSICA)**. This program makes use of the Structural Funds to develop financial engineering instruments aimed at "strengthening the urban dimension in cohesion policy through repayable assistance". JESSICA operates through a series of specific funds (872 in 2013) that can offer revolving equity,[19] loans and loan guarantees to local authorities across the EU, in order to support sustainable urban development—including energy retrofits. These funds can be supervised by a holding fund handled by a financial institution, such as the EIB, or directly by a national, regional or local managing authority. As of December 2013, JESSICA had committed €591 million for energy efficiency, mostly in the buildings sector, an increase of 31% over 2012. However, with only 4% of the total €14.3 billion committed in 2013, energy efficiency investments made through JESSICA can still grow significantly.
- **European Energy Efficiency Fund (EEEF)**. The EEEF has been put in place in July 2011 to provide loans, loan guarantees and equity through PPPs with European municipalities, local and regional authorities, or "private authorities acting on their behalf", such as utilities, public transportation providers, social housing associations, ESCOs. Set up with an initial endowment of €265 million, the EEEF had committed €146 million across 7 projects by the end of 2013, spanning energy efficiency, renewable energy and clean urban transport. The fund targets projects in the €5 to 50 million range, suitable for the energy retrofit of large buildings or entire districts.[20] This fund could be used as a channel for further financing of medium—to large-scale energy retrofit projects.
- **European Local ENergy Assistance (ELENA)**. This joint EIB-European Commission initiative assists local and regional authorities in preparing

18. More than 70% of the EU population owning its dwelling, 18.5% renting at a market price, and 11% in social housing.

19. It should be noted that even in the case of equity investments, this program does not offer grants—the equity provided through JESSICA is repayable over time so as to be reinvested in the future.

20. Examples include the energy retrofit of the Jewish Museum Berlin Foundation, with €1.7 million invested out of a €3.1 million total, or of the University Hospital S. Orsola Malpighi, with €31.8 million out of a €41 million total.

energy efficiency or renewable projects. It is not a financial support program for investment *sensu stricto*, since it provides grants covering up to 90% of the preparation costs of an energy efficiency project.[21] The role of ELENA is crucial: given the complexity of existing European financing mechanisms, assistance is often needed for local authorities to design eligible project proposals. Indeed, with only €49 million disbursed in technical assistance, ELENA has enabled more than €1.6 billion of investments, an "assistance leverage" of more than 32.[22] Expanding this type of program is key to overcome the apparent lack *of fundable p*rojects often underlined by financial institutions such as the EIB (Kollatz, 2014).

Financing issues for today and for the future

If one remains far from the level of investment needed to conduct a deep retrofit of the entire European building stock, the EU appears to be well positioned to boost investments in public buildings and/or large scale commercial buildings through its existing institutions and instruments. Indeed, boosting investment requires ensuring:

— First, financial support for energy renovation is tied to the performance level of the renovation. Otherwise, there exists a risk of funding partial and ineffective retrofits that do not capture the full energy savings potential.

— Second, financial support must be accompanied by supporting policies to build capacity in the buildings sector to deliver deep energy retrofits. This entails training programs, information campaigns and technical assistance.

The EU already is well positioned to help on all these fronts. It can enforce that its financial arms active in energy renovation, such as the EIB and programs like JESSICA only provide loans to renovation projects that promise a certain level of energy savings—similar to what the KfW Energy Efficient Renovation program offers in Germany. It can greatly expand its technical assistance program, such as ELENA, and extend their mandate to also cover capacity building beyond the sole local authorities, and across the buildings industry stakeholders. This two action points would enhance the sustainability of a short-term boost to energy renovation investment. To enhance it even further, the EU should develop third party financing building on its experiments with this type of innovative schemes through the forfeiting loans offered by EEEF to municipalities (Box 1).

However, while existing EU instruments are well adapted to support energy renovation in public buildings and/or large scale commercial buildings, they fail to fully support residential renovation. Investments in the latter can be unlocked through third party financing: the EU can help develop these practices for the residential sector by supporting national or local energy efficiency institutions in the Member States, which have the capacity to design and manage energy renovation projects in lieu of the homeowners (see box below).

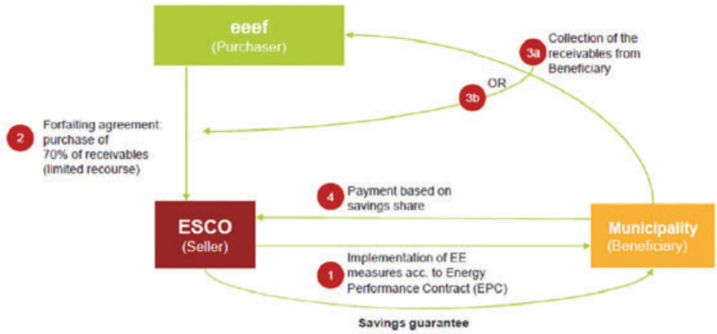
21. Including program structuring, business plans, energy audits, or tendering procedures and contracts preparation. It can also fund project implementation units.
22. ELENA – European Local ENergy Assistance, EIB (2013).

Box 1. Third-party financing

Third-party financing, where the loan financing an energy retrofit is neither carried by the occupant nor the owner of the retrofitted building, relieves the beneficiary from all liquidity constraints. Further, by having companies conducting the renovation carry part of the financing loan to be repaid through future energy savings, this kind of scheme ensures that renovation companies' incentives are well aligned with the ultimate performance of the energy retrofit.

The EEEF is already experimenting with this type of financing in the field with their forfeiting loans, used for the €1.1 million energy renovation of the University of Applied Sciences in Munich.

Figure 3. Example of third-party financing used by EEEF



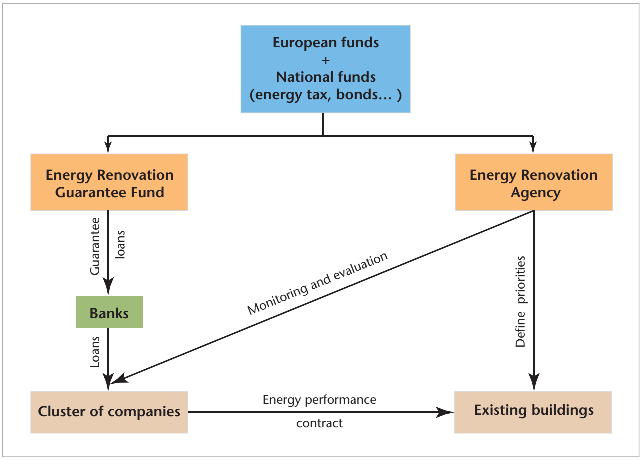
Source: EEEF (European Energy Efficiency Fund).

In this arrangement, the Energy Service COmpany (ESCO) commits to achieve energy savings for the municipality through an Energy Performance Contract (EPC) (step 1). This EPC serves as collateral to the loan financing the renovation. The loan is to be repaid using part of the energy savings. The EEEF then purchases part (in this example 70%) of the net present value of future municipality payments (step 2), thereby taking on most of the risk on the actual delivery of the promised energy efficiency improvement. The municipality then pays back part of its energy savings to both EEEF and the ESCO (steps 3 and 4), in proportions depending on the split made at step 2 between the two institutions. In such a scheme, the beneficiary does not have to invest capital, carry a loan, or master the required know-how to supervise an energy renovation. Everything is handled by third parties, under the supervision of EEEF.

A similar, broader financing model is being developed at the European Joint Research Centre (JRC, 2014). It aims at being applicable at a much larger scale, to enable deep energy retrofit for residential housing.

In this model, an Energy Renovation Agency reporting to the government will be needed to supervise the entire energy renovation process. When a dwelling is to be renovated, the Agency sets up a tendering process to be answered by a cluster of companies that combines all the expertise necessary to successfully carry out the energy renovation. To finance the renovation, the cluster of companies takes out a long-term loan that will be reimbursed using future energy savings. These savings are guaranteed by an energy performance contracting between the cluster of companies and the dwelling—that is, companies are responsible for the successful reduction in the energy consumption of the renovated dwelling. It is important to note that just as in the PACE program, the energy performance contract is tied to the dwelling itself, and is to be transferred in case of a change in ownership. Finally, to facilitate the involvement of commercial banks, loans granted to finance energy retrofits would be guaranteed by an Energy Renovation Guarantee Fund, thereby mitigating uncertainties on the actual magnitude of future energy savings.

Figure 4. Third-party financing scheme proposal (JRC, 2014)



Source: JRC (2014).

European funds would be essential in setting up the Guarantee Fund, and possibly in helping funding or developing the Renovation Agency where needed. Setting up this type of financing scheme today would establish sustainable channels through which future European financial support can be deployed.

Energy efficient mobility

Why investing?

Investment gap. According to the European Commission (2011), the need for investment in transport infrastructure development in EU Member States for the period 2010-2030 has been estimated at over 1.5€ trillion. By 2020, the need for investment projects of trans-European interest (the Trans-European Network Transport projects) is about 500€ billion, half of which for what is now called the "core network" of the EU transport system. The Commission defines the core network as those projects "that carry the main concentration of trans-national traffic •ows for both freight and passengers. It will ensure the effective connectivity of the Eastern and Western parts of the Union and of its peripheral regions to the central ones". Most projects that constitute the core network are rail and port infrastructures,[23] hence contribute to a more sustainable mobility system.

However, while the need for investment is high, EC's forecasts point the risk of a serious financing gap if no vigorous action is taken for attracting investment. For example, as regards the projects of trans-European interest, forecasts for the 2014-2020 period indicate an investment of 48€ billion per year, 21% lower than what has been realised for the period 2007-2013. Similar "financing gap" concerns exist for urban mobility projects as the share of the European population living in cities—around 70 currently – is still growing and should reach 80% by 2035 according to the United Nations. Funding needs for operational and capital expenditure may double by 2040 (Booz & Company, 2012) whereas local budget are under tight constraints.

Growth impact. Transport infrastructure investments trigger economic activity in the civil engineering sectors where the output gap is wide (see above). This makes such investments particularly relevant to create a short term stimulus effect on the economy. To guarantee their longer-term macroeconomic benefits, infrastructures have to be proved to be evaluated through appropriate market studies, to demonstrate their socio-economic beneficits.

Employment impact. Investment in transport infrastructure triggers activity mainly in the civil engineering sector, where employment is low currently and where labour intensity is relatively high (see above). Beyond the construction phase and in a longer-term perspective, it is worth noting that the construction of trains or tramways is relatively labour intensive when compared with the manufacturing sector or, more specifically with the automobile industry (4.7 vs 2.7 jobs per million euros).[24]

Trade impact. In the short term, infrastructure development benefit to the EU domestic economy notably through the construction sector. Beyond the construction phase, rail infrastructures support mostly the EU economy: as pointed by the Commission in its White Paper on Transport in 2011, many European companies are world leaders in infrastructure, logistics, traffic management systems and manufacturing of transport equipment, although this position has still to be maintained. Moreover, the oil imports savings—that will arise if investments focus on resource efficient infrastructures in rail and water—are important and contribute massively to the trade balance.

Resilience impact. Investments in transport infrastructures—once again if focused on most sustainable transport modes—may increase drastically the energy security of the EU, as the current mobility relies at 96% on oil and as transport represents around 60% of the European oil consumption. From the climate perspective, it appears that a quarter of EU greenhouse gases emissions are generated by the transport sector and that it should cut them by 60% by 2050. Moreover, the total external cost of transport in urban areas (congestion, air quality, accidents, noise and CO2) is estimated to be about €230 billion annually (European Commission, 2013).

23. Regulation of the EP and of the Council of 11 December 2013 establishing the Connecting Europe Facility. Official Journal of the European Union.
24. Source: Eurostat.

How to boost the investment?

State of the art.

Although the needs for investment are important, the transport sector risks a financing gap be it for urban or trans-European projects. The main issue here is that the bulk of investment in transport infrastructures has been and is provided by the public sector, a public sector under tight fiscal constraints in the aftermath of the financial crisis. What are the tools the EU has at its disposal in order to increase investment in transport infrastructures? Both for trans-European projects and for more local ones, it has a set of institutions and instruments already in place.

In order to speed up investments in the "core" transport network of the EU, the already mentioned Connecting Europe Facility has been created in 2013 by a new European regulation.[25] Although dedicated also to digital and energy networks, the bulk of its financial support goes to transport projects: 26€ billion for the 2014-2020 period, with a strong emphasis on rail. Coupled with potential EIB loan, the support from the CEF will take mainly the form of grants, as otherwise this type of projects of European value added would not be implemented. Grants may amount from 20 to 50% of the project cost, and up to 85% for specific projects in Member States eligible for Cohesion fund. European Commission expectations are to trigger around 120€ billion of investments in transport infrastructures (European Commission, 2011),[26] mostly from the public sector.

Within a context of tight budgetary constraints, the CEF is also expected to act as a catalyst to attract funding from the private sector. That is why it will build on the new financial instruments put in place in cooperation with the EIB, such as the Loan Guarantee Instrument for trans-European transport network projects (LGTT) or the Project Bond Initiative.[27] For transport infrastructure, a market uptake of 2€ billion is expected by the European Commission (2011) from these innovative instruments, with an expected multiplier effect of 1:15 to 1:20. The use of such instruments is supposed to be progressive: it is notably capped to 10% of the CEF funds until 2015, and this cap may be raised to 20% at a later stage.[28]

Beyond the trans-European projects considered by the CEF, there are important investment needs in infrastructure for urban mobility. The existing EU instruments to support these projects are:[29]

— The Structural Funds and the Cohesion Fund. They are the major financial instruments in place to support investment in mobility infrastructures. Over

25. Regulation of the EP and of the Council of 11 December 2013 establishing the Connecting Europe Facility. Official Journal of the European Union.

26. The 32 billion expected for the transport infrastructure sector where supposed to leverage 140 to 150 billion.

27. "The Europe 2020 Project Bond Initiative, for which the pilot phase has been launched in 2012, is envisaged to become the main EU instrument to help the promoters of individual infrastructure projects attract private sector investors, in particular insurance companies and pension funds. This initiative will enable the issuance by project companies of long-term well-rated bonds instead of relying only on bank lending. The participation of the European Commission and the EIB will mitigate some of the risk associated with a project bond issued to finance a specific project. Member States, infrastructure managers or companies will therefore be able to access a competitive source of finance and consequently improve the cost of financing such projects." CEF Brochure.

28. Communication of the Commission, 7 Jan 2014, on the building of the core transport network.

a fifth of regional funding is allocated to transport. In addition to the grants provided by these funds, resources are also available from the EIB and the European Bank for Reconstruction and Development (Booz & Company, 2012). Between 2007 and 2013 however, only 9% of all credits allocated by the Structural Funds to transport (€82 billion) were dedicated to urban transport.[30]

— The JESSICA programme (see above in the building section). It enables cities to access private finance for urban regeneration projects, but is limited to projects that can generate a sufficient commercial return.
— The JASPERS programme that assists cities in managing delivery of already funded urban mobility projects.

Financing issues for today and for the future

Be it through the CEF, the EIB or the Cohesion and Structural Funds, the European Union seems to have the necessary institutions and instruments to increase investment in transport infrastructures within coming years. The CEF for example could get more credits: the European Commission had asked for 6 billion more for transport in its first proposal European Commission (2011). For more local transport projects, the EIB and the Structural and Cohesion Funds could increase their investment contributions.

However, the rise in investment will hardly sustain if the investment capacity of the public sector is not increased. Indeed, if the overall EU financial contribution could leverage many other investments, these investments are traditionally mostly being made by the public sector, be it at the national or at a more local level. It is worth noting that there are new innovative financial instruments trying to attract private investors, and that there is probably again much room for them to develop. But talking about transport infrastructures, it is likely that most investments will have to be made by public investors, and that they will have much trouble making it as long as these investments are counted as debt.

Beyond the issue of access to funding, the long term improvement of urban mobility requires a focus of improving the capacity of cities to use funding effectively, plan and implement projects. This could be reinforced through JASPERS for example that provides technical assistance. Booz & Company (2012) suggests moreover that there may be a need for « the creation of a new financial instrument to better address the capabilities, capacities and innovation requirements of local agencies to deliver significant gains in urban mobility outcomes".

Cross-sectorial conclusions

The sector analysis above has shown that closing the investment gap in energy supply, energy efficient buildings and transports may have a number of macroeconomic benefits, both in the short and in the long term. In particular,

29. We do not mention here the CIVITAS program that "provides funding and technical support for demonstration, evaluation and implementation of innovative technology led projects, but is focused on promoting innovation rather than addressing specific needs across Europe".

30. Resolution du parlement européen sur un plan d'action sur la mobilité urbaine, 2009. http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A6-2009-0199+0+DOC+XML+V0//FR#title1

these sectors prove to be relatively labour-intensive and to support activity in building construction and civil engineering where the output gap is wide.

Maybe more original is the fact that the EU appears to have a set of financial institutions and instruments already in place, and sometimes recently established, to effectively boost investment in these sectors. In other words, provided additional public money is made available, the EU has the ability to trigger a short term rise in investments in energy supply, buildings and mobility without having to design and implement new financial tools. For the increase to be sustained, the EU should ascribe some of this additional funding to its most innovative tools, and develop new ones such as third financing for building renovation and—most importantly for transport infrastructures—address the fiscal constraints on public actors.

2. A "Carbon price shock" to boost investment

Delivering the investments needed for building an Energy Union is not only about injecting some public money from the EU and MS and try as much as possible to have a strong leverage effect on private investments. As shown by previous sector-specific analysis, there is a need for policies and measures to support investments in the short and in the long run: adapted feed-in tariff for early renewables, technical and financial assistance for housing renovation, norms to guide and anchor expectations, appropriate road taxation to increase modal shift to rail and waterways and so on.

More generally, in addition to the push strategy (put fresh money into an adapted financial pipeline, target money to selected sectors which are believed to be of strategic importance), a sound plan should adopt a complementary pull strategy (attract financing out of the pipeline) through appropriate tax systems, laws and norms, technical assistance. This section argues that a "Carbon fiscal shock"—accompanied by appropriate compensation schemes—may not only attract financing for low carbon investments, but also strongly boost both public and private investments. By over compensation for a limited period of time (e.g. 5 years), implementation of carbon price (with a tax, an Emission trading scheme (ETS) or crediting instruments) would be facilitated and over compensation would provide a short term boost to the European economy, helping to fight against the risk of deflation.

The point of this scheme is to combine the necessity to get out of the crisis, i.e. increase activity in order to reduce unemployment swiftly, and to put the EU economy on the track of a real carbon emissions reduction. A high enough carbon price (see Box 2) is one of the tools to make carbon emission reduction happens.

Recent experience has shown that carbon taxes, or carbon prices as in ETS, may encounter serious opposition. High costs on certain individuals, lock-in in investments and technologies that imply high cost when switching to low carbon solutions, direct impact on competitiveness when carbon price is high in one country but low or inexistent for competitors, a loss of competitiveness which can also result in carbon leakage and compromise the efficiency of the carbon price. High level of taxes and degraded balance sheets are in today's EU another obstacle to accepting a carbon price, not to say a high one. Positive experience of carbon price implementation are often obtained through a full policy package helping the transition, including decreases in taxes (see World Bank 2014 – State and trends in carbon pricing).

Full carbon recycling and overcompensation would thus be constituent of the full policy package making the pricing of carbon more desirable. It is usually considered that a ramp approach to carbon pricing is more optimal. Slow adaptation is indeed needed due to investment irreversibility and a (slowly) growing price of carbon help to form sound expectations. The proposal made here takes the other side of bets by calling for a rapid increase in the carbon price and then a stabilisation at a rather high level (a stepwise increase in carbon price). What is lost in time to adapt is gained in credibility and trust in the recycling of carbon revenue. Nevertheless, because of an operating EU ETS, carbon price increase can be slower for large firms than for households or scattered CO_2 emissions by office buildings. Over compensation is thus a way to offset the stepwise increase in carbon. As it can be directed on specific individuals or maybe sectors, it allows addressing different speed of carbon pricing for different economic agents.

Thus, over compensation is not only justified because it has a positive impact in the short term on the economy. Over compensation, by making carbon pricing acceptable and less costly to economic agents, is an investment for the transition. It is not the type of investment which one spontaneously think of when referring to an investment plan like the Juncker Plan, but, as it is increasing the success and the ambition of engaging the economy on a path of lower carbon emission, it can have more social return than any kind of investment. By making private or public physical investment in low carbon equipment or infrastructure more profitable, it provides the shock on the rate of return of capital we are desperately seeking. Moreover, investing in the possibility of the low carbon economy is a public investment by nature, i.e. the kind of investment private sector is not going to finance and for which public debt is justified. We present a financing scheme for the over compensation, where public debt is a mutualized debt to participating countries and can be used as a monitoring method for a cooperative carbon pricing.

This section presents the proposal of a "Carbon fiscal shock" and proposes to address its negative effects through two measures: a Compensation scheme and a Carbon tax on imports. A transition fund would allow for carrying public debt generated in the transition period, debt repaid back on a longer term (e.g. 20 years), back loading the initial stimulus and accompanying policies. A simulation of such an EU wide Carbon fiscal shock is then presented and discussed.

Paris Climate Summit at the end of the year 2015 could be a decisive moment to launch such an initiative and credibly engage in climate change mitigation and stagnation threats response.

Proposals

Proposal 1: A stepwise CO2 price increase to boost investment

The core of the proposal is a steady increase in the social price of carbon for the EU simultaneously, from a low 5 to 10€ presently to a higher 50 to 150€ per ton of CO_2. Instead of a slow ramping in the price of carbon, the price of carbon would be high initially and would not increase in the future. Later on, it could even diminish, reflecting then the marginal cost of abatement of CO_2.

A high initial price would aim at a higher rate of depreciation of capital, a higher marginal productivity of capital, inducing a loss in capital (whereas smoothed by some compensation packages) but a boost in private investment. A social price of carbon would have a similar impact on public investment, and given that some flexibility is granted to Member States on the calculus of public deficit, public investment would be a strong driver of the investment boost.

The social price of carbon can be affected through a minimum price of carbon on ETS and a tax for non ETS economic units. Public subsidies to green investment, lowering the cost of capital can be a second option, which may seem more acceptable, but this option implies rising taxes in order to finance subsidies. It raises the problem of monitoring and certifying the emission reduction content of investment. As a (large, depending on sectors) part of emission reduction is achieved by change in behaviour, investing in the right technology does not necessarily deliver emission reductions. For that reason, letting the price of carbon flow from the easily accountable sources (fossil fuels, concrete, fertilizers consumption) to the final prices is appealing.

Addressing negative effects

A high carbon price would have negative effects that have to be considered, mainly through 3 channels: 1. loss of consumption by high carbon emitters among households. High carbon emitters may be poor households with low possibility of substitution because energy is a primary good and because choices made by households forbid rapid adaptation to a large shift in relative prices. 2. The same effect arises for producers who cannot shift rapidly (or without depreciating a large quantity of capital) on their production function when facing a change in relative prices. The high carbon price would have a strong negative impact on their balance sheet or on their ability to operate their business. The irreversibility of investment (as in the case of households) is the cause of the loss occurred. 3. A general loss of competitiveness generated by a higher cost of energy in the EU compared to the cost of energy in other parts of the world where such a carbon price wouldn't be implemented. That effect could be even stronger if energy efficiency is improved in Europe and global energy demand is reduced as a result. Carbon leakage, through the localisation of carbon emitting industrial processes where they are less priced or taxed could result in an overall increase of global carbon emissions and jobs destruction in "virtuous" countries.

Those 3 channels could be mitigated by a compensation scheme for households, a reconversion and compensation fund for firms and a carbon tax on Euro area (or EU) imports.

Box 2. How to estimate a monetary price for carbon?

The concept of a carbon tax is coming from the theoretical concept proposed by the economist Pigou to address market failures and consists in levying a tax on the goods that impose spill over costs on society which are not supported by the externality's source. Then adding a tax allows through private markets reflecting the social cost in a cost-effective way. Climate change has been identified as a bad externality to the society by shaping the world in a less welcoming way and is directly linked to greenhouse gases emissions stemming from our fossil fuels consumption. If there is a large consensus on taxing carbon dioxide to reduce GHG emissions, there is still a debate on its socially optimal price. The externality there is quite difficult to clearly identify and estimate. Even if there is strong scientific evidence on the nature of phenomenon, there is still an uncertainty on its magnitude.

Giving a price to the carbon emitted today strongly depends on expected future damage. Evaluating this damage in monetary terms requires estimating different parameters. A various academic literature attempts to tackle this task by proposing estimations for a Social Cost of Carbon (SCC). Using the Integrated Assessment Model (IAM) RICE (Regional Integrated Climate-Economy), W. Nordhaus proposed a set of different estimates (Nordhaus, 2011) for SCC and found for the year 2015 an average SCC of 43.57 $\$^{2005}$ associated with a standard deviation (SD) of 19.35 $\$^{2005}$. Some meta analyses have been conducted and Havranek & Zilberman (2014) found range of estimates that is from 0-130 $\$^{2010}$ per ton of CO_2 (tCO_2) whereas Tol (2013) found a mean estimate of $\$^{2010}$196/$tCO_2$ with a standard deviation of $\$^{2010}$ 322 / tCO_2 in its review of 600 estimates.

Empirical experiences have been put in place unilaterally or regionally by some countries to price carbon and there is some evidence of relatively high carbon price. For instance the Swedish carbon tax is up to $ 168/tCO2 and the Tokyo Cap-and-Trade carbon price reaches $ 95/tCO2 (World Bank, 2014). However the majority of prices in existing systems lie below $ 35/ tCO2. A recent study of the IMF (Parry *et al.*, 2014) calculates for the top twenty countries how much would be the price of CO2 emissions by only taking into account the domestic co-benefits from reducing other bad externalities such as local pollution, health harms and transport congestions and the authors found an average, a nationally efficient price of $ 57.5 / tCO2. In the Deep Decarbonisation report (SDSN & IDDRI, 2014), the authors proposed, at least for France, a carbon price trajectory, initially formulated by the Quinet commission[31] and which is compatible with the objectives of 75% emissions reduction by 2050 starting at EUR^{2008} 32/ tCO2 in 2010, EUR^{2008} 56/tCO2 in 2020 and EUR^{2008} 100/tCO_2 in 2030.

Proposal 2: Compensation scheme and full recycling of carbon revenue

Financing of the compensation would use partly carbon tax or price revenue directly. Part of that compensation could be permanent or long term in order to accommodate with specific situations with high irreversibility in the choices made under the no carbon price system of relative prices. The rest of the carbon revenue would be directed to general taxes or social contributions reduction, allowing for a shift of taxation from labour to environment tax. But the core of the proposal is that for a temporary period of time, (e.g. 5 years), compensation schemes would be superior to the carbon revenue.

The compensation scheme for households could consist of a general tax reform, a special fund for high energy consumers, low price or free non-transferable fuel allowances, and an investment/third party fund for retrofitting building with subsidies for retrofitting costs. Again, compensation can be designed as to initially overshoot the implied costs in order to boost households' income and to limit the number of losers and the extent of their loses.

31. La valeur tutélaire du carbone, Centre d'Analyse Stratégique (2009).

Compensation for firms can be based on sectors. For instance, high energy consumers but already efficient could have access to free of tax energy or benefit from grandfathering in the ETS (Emissions Trading System). The investment fund could be reconverted in order to reduce the cost of investment or to provide financing even to firms lacking access to financial markets because of deteriorated balance sheets. Energy efficiency investment could thus be separated from any other investment.

A more ambitious approach could be based on a general tax reform. By redefining the goals and the principles of taxation, by shifting taxation from some bases to others, the implementation of a carbon price and tax could be made more easily accepted. Over compensation, temporary in nature, can't be a permanent funding of a decrease in tax rates. But, reallocation of public spending, extra revenue from the boost on the economy, benefits from the recovery and automatic stabilizers redesign when back to normal could provide room for fiscal reform.

Proposal 3: Over compensation

Over compensation is necessary as a temporary policy to increase the acceptability of setting a price on carbon. The benefit of over compensating the cost of the carbon price would be two fold.

First, it is a response to previous failed attempt to implement in some countries a carbon price and would allow for an ambitious value for carbon. The experience of Swedish carbon price (implemented in 1991 at 27$/t, increased in 2004 to 100$/t and presently over 150$/t$CO_2$) is that a high price can be easily accepted when overall taxation is significantly reduced. Let us stress that a steep increase is also preferable (as in Sweden from 2000 to 2004) because it provides a guarantee to households and firms that the proposed deal (less general taxes against more environment taxes) is not going to be modified in the future.

Second, it would be a boost to the EU economy and a way to bypass the framework of treaties. For a 100€/t increase in carbon price, representing roughly 1.5% of GDP, the over compensation could amount to 0.5 to 1% of GDP and would be decreasing over 5 years. The total amount, from 1.4% of GDP to 3% of GDP, would be financed by a Transition fund, equivalent to European debt repaid through member states contributions over a period to define (with an order of magnitude of 20y). That financing channel would be similar in design to the European Social Fund, FEM or FEDER, except for the ability to bear debt. Repayment of the debt would be budgeted in the Budget of the European Budget. A more restricted fund, limited to euro area countries or even to a subset, implying a smaller funding (reduced to 60% if limited to euro area) could be an alternative, based on the enhanced cooperation procedure (or even open method of coordination). The flow of payment would have to be implemented from contributions of participating members to the fund. Such a fund would be close in spirit to the polish proposal of a European Investment Fund, able to raise debt.

Transition fund debt would not be accounted as public debt (as proposed in the Juncker Plan for member states participation to the European Fund for Strategic Investment[32]), in order to bypass the constraints of the TSCG and debt rules.

32. Enderlein and Pisani-Ferry make a similar proposition in their 2014 Reforms, Investment, and Growth report, an agenda for France, Germany and Europe. http://www.economie.gouv.fr/files/files/PDF/rapport_enderlein_pisani-en.pdf

1.6% nominal interest rate over 20 years would imply from 12 to 30b€/year, and at the level of the EU would necessitate an initial debt of 240b€ to 510b€. Participating Member states would be allowed to use the fund up to their share in the fund in order to finance the over compensation of the carbon price introduction. Monitoring of the overall process would be a condition for the funding and the fund would therefore act as a controlling institution.

Proposal 4: Carbon tax on imports

The last point of the proposal is a carbon tax on (extra EU, extra participating members) imports and a negative tax (subsidy) on export. Such a taxing scheme is to be thought as similar to VAT (see Laurent & Le Cacheux (2009) for a discussion). The import tax could be based on average estimates of carbon content of imported products unless the importer can provide evidence of a lower import content. The product of the carbon tax on import would be used for funding investment program in emerging countries, answering actively by this way to the protectionism accusation. Any country engaging into a carbon tax or carbon price scheme would be exempted of the carbon tax on imports. The Carbon revenue distribution and the exemption could be powerful tools for climate negotiation.

Taxing imports and neutralizing on export prices the impact of carbon price scheme inside the EU is an important objective. It allows for a specific timing of carbon pricing in Europe, one core element of the Carbon Fiscal Shock discussed here. Stepwise carbon pricing is justified for political reasons (improving credibility of the price path and the compensation package) and economic ones (boosting the EU economy to escape the deflation or stagnation trap). Carbon leakage and competiveness issues can destroy the political momentum of carbon price and climate change mitigation. Even if an international agreement can be expected in the medium term, and even if, in the medium term, carbon price can be hoped to be global, different national price paths are the rule. Moreover, details in the implementation of the carbon pricing scheme, addressing competitiveness and carbon leakage issues can complicate the interactions of different national carbon price systems. Facing this reality, border taxation of carbon appears as a necessary tool.

Box 3. Literature review on carbon leakage and boarder tax adjustments

The issue of Carbon leakage has been addressed mainly with the creation of the EU Emissions Trading Scheme and Boarder Tax Adjustment seems to be an optimal policy to fight against carbon leakage and the existence of "pollution havens". However its international acceptance has not been yet fully established and its legality within the current international trade rules is still in debate since it aims to regulate activities undertaken abroad EU. Some criticism arose to argue on the protectionist aspects of such a mechanism. This question is conceptually rather difficult to address since it is seeking to compare a counterfactual scenario (no introduction of carbon policy) with the observed data. Different approaches have been used to estimate the carbon leakage effects; the first one is based on the use of theoretical model, in general or partial equilibrium which is calibrated with existing data. Winchester, Paltsev, & Reilly (2011), Fischer & Fox (2012), Demailly & Quirion (2006), Burniaux, Chateau,

& Duval (2013) and Monjon & Quirion (2010) used this method to estimate the effect of implementing BCA on emissions and output and Branger & Quirion (2013)conducted a meta-analysis on this topic. The other methodology relies on ex-post empirical evidence to provide econometric estimates — this branch of the literature observes a significant carbon leakage. Aichele & Felbermayr (2011), Baier & Bergstrand (2009) or Ederington & Minier (2003) in particular conducted empirical studies on this issue.

More generally, four mechanisms relating to carbon leakage have been identified. The first three are negatively oriented and has been proposed by Reinaud (2008):

— The short-term competitiveness channel: the increase in price leads to a reduction in the market share of the constrained industries to the benefit of unconstrained competitors.

— The Investment channel: a unilateral mitigation action provides incentives to firms to direct capital towards countries with less stringent policies.

— The fossil fuel price channel: It can be approximate by the "rebound effect"; energy demand reduction conduct to a decrease of global energy prices which ultimately triggers higher energy demand elsewhere.

A fourth channel has been identified by Dröge, Wang, & Grubb (2009) and is linked to positive technological spill-overs: it relies on the idea that the increase in the price of energy spurred by a more stringent climate policy could stimulate technological progress, which in the end, improves the competitiveness of firms.

How to implement it in the European framework?

The right level of application of a carbon price is the EU. The EU ETS has been operational and functioning for years and backed by a strong experience. Back loading and the reserve mechanism (IDDRI, 2014) provide tool to step up carbon price and even control carbon price.[33] Moreover, implementing a border carbon tax inside EU may be heading in a direction which is not to be whished.

Deploying a high carbon price beyond ETS could be fostered at the EU level and backed European institutions. The transition fund would then be companion tool that the Commission could operate, based on its knowledge and competence of those subjects. Coordination with other funds (in particular EFSI, the Juncker Fund) would thus be accomplished smoothly.

Enhanced cooperation could be another level of organisation if time or political will is missing to implement an EU wide ambition. EU ETS operation and other instrument for carbon pricing could be dissociated (in timing) and a sub set of willing countries could engage in the Fiscal Carbon Shock, implement the transition fund (and the corresponding back loading debt). The implementation of the carbon border tax would be more difficult and could be approximated by compensation devices at a cost in term of readability and efficiency.

33. Currently, the logic of ETS is to give a price resulting from quantities of emission reduction targets. This guarantees a cost effective pricing of carbon under quantity constraints. Having CO_2 emissions resulting from a pre-determined carbon price constitute a different approach. Flexible and adaptive targets for emissions reductions achieved may end in convergence of the two logics.

Simulation

In this section we assess a policy package that combines a carbon tax of €100/tCO2 with fiscal stimulus in Europe. The carbon tax is introduced in 2015 and held constant in real terms; its revenues are recycled such that there is an overall positive stimulus (starting at 50% of revenues and reducing over time) to Europe's economies. The revenue recycling takes the form of reductions in income taxes, subsidies to energy-intensive firms and public investment in energy efficiency.

The E3ME macro-econometric simulation model from Cambridge Econometrics was used to carry out the assessment. E3ME does not assume full employment or optimal use of economic resources, meaning it is well-suited to modelling Europe's economies post-recession and the potential effects of fiscal stimulus.

The modelling finds that there could be short-term economic benefits from the policy package, of up to 1.4% of GDP. One should note that this results from a particularly large estimate of the double dividend to be expected from investment in the energy transition. Simulations made with the ThreeME model, although demonstrating similar impacts on economic activity, are comparatively smaller in magnitude (see Box 4).

In the E3ME simulation, employment could also increase by up to 0.6% in this period. There are positive economic impacts in all EU Member States, but some of the largest benefits are in countries that currently have high unemployment rates.

The modelling also finds that there are longer-term macroeconomic benefits. These benefits are smaller than the short-term impacts and are driven by reductions in fuel imports to Europe. Employment increases in the long run as there is some switching from energy-intensive to labour-intensive activities.

The long-run modelling does not factor in the higher levels of debt that are taken on at European level; these would need to be paid back at some point in the future and could reduce GDP growth at this time. However, as Europe's economies would still benefit from reduced fuel imports, it is reasonable to assume that, over the projection period as a whole, results would be positive.

CO_2 emissions fall by around 14% as a result of the carbon tax and energy efficiency measures. This reduction would put Europe close to being on track to meet its 2030 emissions target.

The policy scenario

The policy scenario is decomposed in four sub scenarios. They are:

- S1 – A pan-European carbon tax. The carbon tax is introduced at a rate of €100/tCO2 in 2015 and maintained in real terms over the projection period. It is applied to energy-related and process emissions across all sectors and replaces the EU ETS (including any revenues generated from auctioned allowances to the power sector).
- S2 – The carbon tax plus revenue recycling to households and industry. This scenario includes the same carbon tax as S1 but also includes revenue recycling to households in the form of lower income tax rates (70% of the revenues) and to industry in the form of lump-sum subsidies (25% of the revenues). In addition, there is a **short-term over-recycling of revenues**,

starting with a 50% boost in 2015, gradually declining to zero over a five-year period (Table 2).

- S3 – The carbon tax plus revenue recycling in S2 and investment in energy efficiency. In this scenario the final 5% of revenues is used to invest in household energy efficiency measures. We apply a coefficient derived from the IEA's *World Energy Outlook* to estimate additional energy savings. We assume that all the efficiency measures lead to reductions in household use of energy, principally gas but also electricity and heating oil. As in S2, there is a short-term over-compensation of revenues.
- S4 – Carbon tax, revenue recycling and BTAs. In addition to the measures in S3, in S4 we introduce Border Tax Adjustments on imports of the 'Big 6' energy-intensive industries (pulp & paper, refining, basic inorganic chemicals, cement and lime, iron and steel, aluminium). The revenues from these BTAs are assumed to be used to finance low-carbon development outside the EU and do not benefit the domestic economy.

Table 2. How the carbon tax revenues are allocated, %

Scen		2015	2016	2017	2018	2019	2020
S2	Households	105.0	98.0	91.0	84.0	77.0	70.0
	Industry	37.5	35.0	32.5	30.0	27.5	25.0
	Energy efficiency	0.0	0.0	0.0	0.0	0.0	0.0
	Total	142.5	133.0	123.5	114.0	104.5	95.0
S3-4	Households	105.0	98.0	91.0	84.0	77.0	70.0
	Industry	37.5	35.0	32.5	30.0	27.5	25.0
	Energy efficiency	7.5	7.0	6.5	6.0	5.5	5.0
	Total	150.0	140.0	130.0	120.0	110.0	100.0

Source: Eurostat.

Basic modelling approach

E3ME is a simulation model based on a post-Keynesian approach. Unlike the more common Computable General Equilibrium (CGE) modelling approach, E3ME does not assume optimisation and full utilisation of economic capacity, hence allowing for underemployment.

These features make the model a suitable tool for evaluating fiscal stimulus. By acknowledging that Europe's economies are suffering from a shortage of aggregate demand, the model can be used to estimate the effects of various measures to boost domestic consumption. The method of stimulus here (borrowing at European level to finance national spending) has some resemblance to a European programme of quantitative easing (QE). However, QE would be very unlikely to include the same targeting of spending.

Further information about the E3ME model may be found on the model website.[34]

34. http://www.e3me.com

The carbon tax is entered as an additional tax on fuel consumption, with the rate depending on the fuels' carbon contents. It is assumed that the electricity sector passes on its costs in full but other sectors may be restricted from doing so by international competition; if this is the case then they will likely suffer a loss of profitability.

It is assumed that the revenues are recycled by national administrations and there are no cross-border transfers (apart from the BTA revenues, see below). As the EU's Member States already have excise duties on fuels it is assumed that there is no increase in transaction costs and all the additional revenues are available for recycling.

The policy scenario suggests that the over-recycling of revenues comes from a central European fund and is therefore not included in national balance sheets. It follows that we have an assumption that there is no direct crowding out of economic activity and the stimulus is additional to everything else that is going on in the economy. There may, however, be indirect crowding out, for example if Member States started reaching full employment or sectors reached their production capacity; this effect is captured by the model's equations but, given current growth rates, it seems rather unlikely that output will reach capacity levels.

The BTAs are modelled as an increase in import prices. The rate of the price increase is determined by the carbon intensity of EU production and EU carbon prices; this is added as a tax on imports of the specified products from outside the EU.

Realistically, BTAs are only likely to be applied to a few selected products. In our analysis we have expanded these products to cover the entire NACE 2-digit parent sectors; even so, these sectors contribute a small share of total GVA in Europe so we would not expect large economic impacts from this measure.

The aim of the BTAs therefore is not to improve macroeconomic results but to offer protection to the specific EU industries that are exposed to competitiveness issues and 'carbon leakage'.

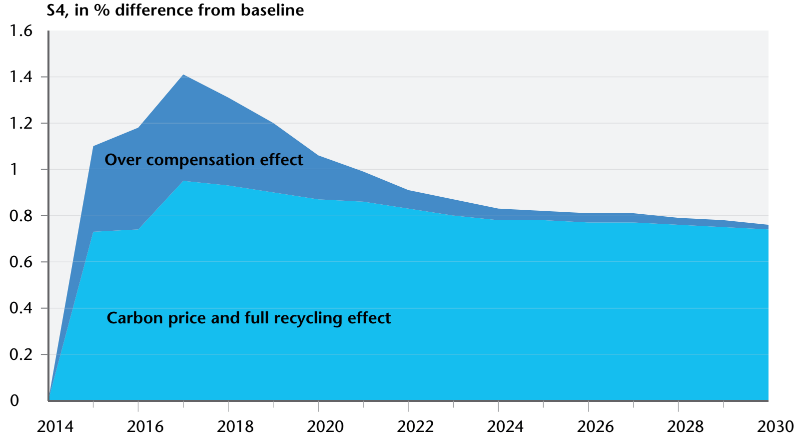
Macroeconomic impacts

Figure 5 shows the impacts of the full policy package on GDP (S4 compared to baseline, over compensation break down). There is an immediate stimulus effect worth about 1.1% of GDP, which increases up to 2017, reaching around 1.4% of GDP. Beyond 2017, the stimulus effect tails off, and GDP is around 0.8% higher than in the baseline beyond 2020.

The stimulus is financed by borrowing at the European level. In this scenario, it would remain as an outstanding debt as we have not included a repayment mechanism. However, even if the debt was repaid later in the projection period we could still expect to see a small long-term positive effect due to the restructuring that arises from the carbon tax and energy-efficiency measures.

Employment increases by around 0.6% (short run) and 0.3% (long run) compared to the baseline, following a similar pattern over time to GDP. According to our results, the policy package thus stimulates both higher levels of economic activity and employment.

Figure 5. EU28 GDP



Sources: Cambridge Econometrics, E3ME Model.

Table 3 shows the evolution of key macroeconomic indicators over the projection period. The pattern is one of increased consumption by households (due to the lower income taxes) and increased investment (primarily in energy-efficient equipment). Trade effects are quite limited in scope, although for imports this outcome represents a combination of lower fuel imports and higher imports of consumer goods (see below). Inflation increases, with the price level about 2% higher in S4 than in the baseline. It would therefore be important to ensure that low-income households are compensated for higher electricity and fuel prices.

Table 3. EU28 summary of results

S4, in % difference from baseline

	2015	2016	2017	2018	2019	2020	2025
GDP	1.1	1.2	1.4	1.3	1.2	1.1	0.8
Consumption	0.9	1.3	1.7	1.6	1.5	1.3	1.0
Investment	2.9	1.9	2.3	1.8	1.6	1.4	1.1
Exports	-0.3	-0.3	-0.3	-0.2	-0.2	-0.3	-0.3
Imports	0.8	0.3	0.6	0.4	0.4	0.3	0.0
Price index	1.7	1.9	1.9	2.0	2.0	2.1	1.9
Employment	0.6	0.5	0.6	0.6	0.5	0.5	0.3

Source: E3ME Model.

The GDP impacts are positive throughout the projection period. In the short term, there is a stimulus effect from the over-recycling of revenues. This stimulus is only effective because there are unused economic resources across Europe in the projection period; if Europe's economies were already operating at full capacity, inflation would likely be the result, rather than an increase in real activity.

However, the modelling results also show long-term benefits. These are due to some of the structural shifts that occur in the scenario. There are two main ones:

- There is a positive effect on Europe's trade balance from the reduced fuel imports—fuel consumption falls as a result of both the carbon price (S1) and the energy-efficiency measures (S3). A large share of the savings in imported fuels is spent on goods that are, at least in part, produced domestically. This boosts domestic production levels.
- There is a transfer from businesses to households—a large share of the carbon tax is paid by business, more than the 25% of revenues that is recycled back to industry. Some sectors, such as electricity generation, can pass these costs on to final consumers but others are unable to pass costs on, due to foreign competition. Lower profits in these sectors are matched by higher real household incomes. As households have lower savings rates and higher domestic consumption rates than businesses (e.g. multinationals' profits may flow abroad), this creates more activity within Europe.

Table 4. EU 28 summary of results, 2020

In % difference from baseline

	S1	S2	S3	S4
GDP	-0.7	0.9	1.1	1.1
Consumer expenditure	-1.5	1.2	1.4	1.3
Investment	-0.3	0.7	1.4	1.4
Extra-EU Exports	-0.5	-0.2	-0.2	-0.3
Extra-EU Imports	-1.1	0.1	0.3	0.2
Price index	2.1	2.1	2.0	2.1
Employment	-0.3	0.3	0.5	0.5

Source: E3ME Model.

Table 4 shows the results for each scenario in 2020, which corresponds to the end of the initial stimulus (although there are still some lagged benefits at this time). In most cases the results are quite intuitive; the carbon tax reduces GDP by 0.7% and imports fall by even more in S1. However, the effects of the revenue recycling, including the stimulus, make these impacts positive overall in the other scenarios.

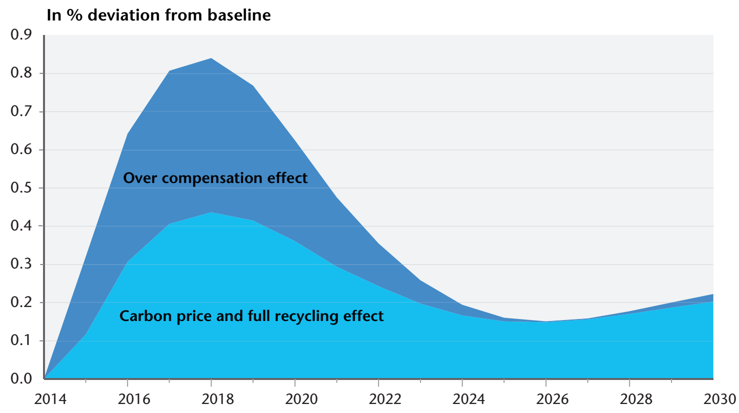
The BTAs have a limited impact on the economy as a whole. This is because the revenues from the BTAs are not spent within Europe but are instead assumed to be provided to developing countries to finance low-carbon measures. The effects of the BTA thus become a trade-off between import substitution and higher prices for final consumers. These effects very nearly cancel out overall.

Household spending is the largest component of GDP and is an important driver of the overall results. In S1, household spending falls due to the higher prices and a loss of real income, but lower income taxes result in higher spending in the other scenarios. Investment also tends to track GDP in these results but there is additional stimulus to investment through the energy-efficiency measures in S3 and S4.

Box 4. ThreeME versus E3ME, the French case

Simulations were conducted through two models in this report one at the European scale with the E3ME model (Cambridge Econometrics) and another one for France with the ThreeME model (OFCE). Even if both models highlight a positive impact of the carbon fiscal shock plan on the output, the magnitude in the results is quite different. Beyond the fact that each model has its own properties, the question of the scale and the existence of spill over effects across countries matters in the results. The ThreeME model has been developed in the framework of a research convention between OFCE and the French Environmental Agency (ADEME). It is a neo-keynesian Computable General Model (CGE) that exhibits features like stickiness in the adjustments processes of prices and quantities or a representation of the labour market through a Phillips curve which allows taking into account a dynamic dimension in its results. Its multi-sectorial structure in 37 sectors, in which 17 are only energy production activities leads to take into account the possible structural changes in the economy and then lead to a more accurate analysis.

Figure 6. French GDP, Carbon Fiscal Shock simulation using ThreeME



Source: Cambridge Econometrics, E3ME Model.

Beyond the question of the positive effect of an investment plan, the question remains whether there is the possibility for an environmental tax to lead to structural positive effect on the economy. The existence of the double-dividend has been since its formulation by Pearce (1991) discussed and even challenged on its theoretical foundations. Some theoretical articles found a loss of welfare, either through a suboptimal emissions reduction (Bovenberg & de Mooij,1994), a loss of income (Van de Bovenberg,1994) or a reduction of employment (Bovenberg, Goulder & Jacobsen, 2008). Paradoxically, empirical studies, which were mainly using CGE models to assess the impact of the introduction of a carbon tax observed a positive double-dividend. Takeda (1997) found for instance that for the Japan economy a strong double-dividend arises when recycling of revenues is associated with capital tax reduction. Fraser & Waschik (2013) got the same results for the Australian economy with several mechanism designs.

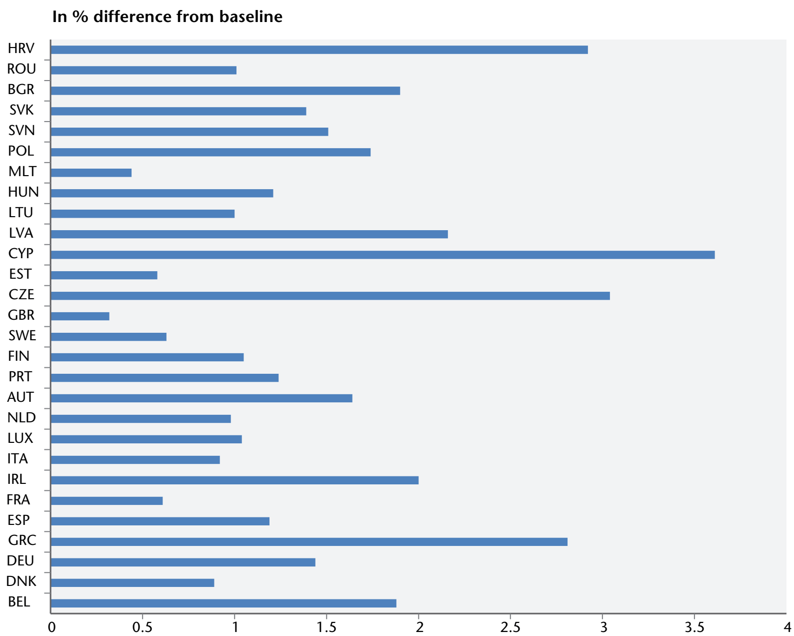
Even if the theoretical framework is not shared by all the articles on the double-dividend question, the main argument that can explain this difference in the results is that contrarily to empirical studies that take into account of some realities, the theoretical articles take as granted the optimality of the economy as a benchmark. Although environmental taxes appear to be less distortionary than pre-existing taxes, which in the end justifies this positive effect.

There are no policies designed to address employment directly, so the employment impacts are the result of changes in levels of economic activity. There is also some shift from energy-intensive to labour-intensive activities. In this analysis we have not considered whether Europe's labour markets would be able to provide the right skills to take up these additional jobs. However, from the sectorial results discussed below, we can see that the additional jobs would fall broadly into two categories: fairly low-skilled jobs in consumer services and more specialised positions in installing energy-efficient products. Policy makers may need to consider whether adequate training is provided for the latter case.

Impacts across Europe

Figure 7 shows that the GDP impacts are positive in all Member States in 2020. They are all positive and range from 0.3% in the UK to 3.6% in Cyprus.

Figure 7. S4 GDP by region, 2020



Source: E3ME Model.

There are various reasons for the differences across regions. Most notably, as the stimulus is a proportion of the carbon tax revenues, regions with higher carbon intensity get a larger stimulus. This is the result of a fairly arbitrary assumption that has been made in the modelling exercise, but explains why countries like the UK, France and Sweden see smaller impacts.

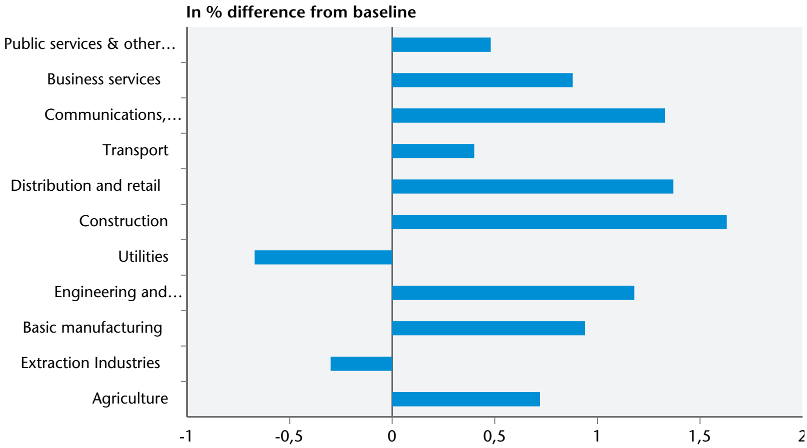
Another issue is that the countries with the most capacity available (e.g. high unemployment rates) are likely to gain more from the stimulus. In many cases these are also the more energy-intensive countries so the effects are stronger in these countries overall.

Other possible reasons for variation in outcomes include industry cost pass-through rates, household savings ratios, the share of international trade and the flexibility of labour markets. There can also be strong interactions between Member States due to their trade linkages.

Impacts on key sectors

Almost all sectors benefit from the measures. The ones that see the largest increases in output and employment are those that supply consumer services and those that produce/install energy-efficient products.

Figure 8. EU28 Output by sector, 2020



Source: E3ME Model.

The sectors that lose out are the energy extraction and utilities sectors.

Table 5 shows the impact on energy-intensive industries' (EII) output in 2020. As expected, the carbon tax has a negative impact on most EIIs (S1). Chemicals and non-metallic minerals appear the hardest hit. In the second scenario (S2) some EIIs benefit from the increase in economic activity resulting from the compensation of households and industry. The Non-metallic minerals and Basic metals sectors particularly benefit from the introduction of energy-efficiency measures, as they are part of the supply chain for energy-efficient investment goods (S3).

Non-metallic minerals benefit the most from the border tax adjustments (S4). In general, however, the BTAs have only a small impact on domestic production, even in the EIIs. This is partly a short-run effect as most existing plants will still be open and producing in 2020, regardless of import prices. Decisions on relocation of plants may frame the longer-term outcomes in these sectors but this would require a more detailed sectorial analysis.

Table 5. EU28 Output by energy-intensive sectors, 2020

In % difference from baseline

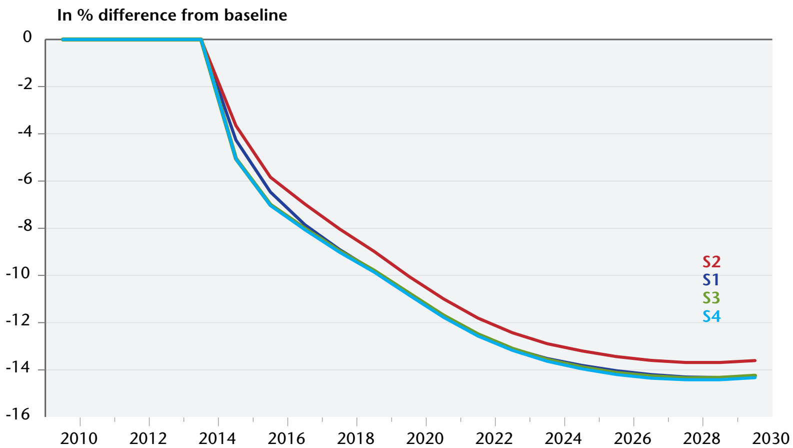
	S1	S2	S3	S4
Paper & paper products	-1.1	0.6	0.9	0.9
Manufactured fuels	-0.8	-0.7	-0.7	-0.7
Chemicals excluding pharmaceuticals	-1.4	-0.1	0.2	0.2
Non-metallic minerals	-1.6	-0.3	0.4	0.7
Basic metals	-0.3	1.4	1.8	1.9

Source: E3ME Model.

Environmental impacts

Figure 8 shows the impact on emissions levels in all four scenarios. Overall we see a reduction in emissions of around 14%.

Figure 9. EU28 CO2 emissions by scenario,



Sources: iAGS, E3ME Model.

By far the largest reduction in emissions comes from the carbon tax in S1. S2 sees some rebound, due to the higher levels of economic activity but there is a further reduction in emissions due to the energy-efficiency measures that are introduced in S3. The BTAs have only a small impact on emissions levels, due to the small changes in output that they cause.

As the carbon tax is imposed on all sectors, direct emissions fall across the whole economy. Power generation makes the largest contribution in absolute terms and the results show some increase in renewables by 2020.

Emissions from households are also reduced by the energy-efficiency measures, which reduce domestic consumption of gas.

Table 6. EU28 CO2 emissions by fuel user, 2020

In % difference from baseline

	S1	S2	S3	S4
1 Power generation	-20.5	-19.8	-17.9	-17.9
2 Rest of energy branch	-12.7	-12.6	-13.0	-13.0
3 Iron & steel	-16.3	-15.9	-15.8	-15.8
4 Non-ferrous metals	-13.6	-12.7	-12.4	-12.5
5 Chemicals	-9.4	-9.6	-9.6	-9.6
6 Non-metallic minerals	-14.8	-14.3	-14.0	-13.9
7 Ore-extraction	-21.3	-21.1	-20.9	-21.0
8 Food, drink & tobacco	-13.4	-12.8	-12.7	-12.7
9 Textiles, clothing & footwear	-17.0	-16.5	-16.5	-16.5
10 Paper & pulp	-12.5	-12.0	-11.8	-11.8
11 Engineering etc.	-17.2	-16.5	-16.3	-16.3
12 Other industry	-13.3	-12.8	-12.7	-12.8
13 Construction	-20.9	-20.5	-19.8	-19.9
14 Rail transport	-4.6	-4.5	-4.5	-4.6
15 Road transport	-10.3	-9.7	-9.6	-9.9
16 Air transport	-0.8	-0.7	-0.6	-0.8
17 Other transport services	-10.1	-10.0	-10.0	-10.0
18 Households	-11.7	-11.1	-27.1	-27.1
19 Agriculture, forestry	-28.9	-28.9	-28.8	-28.9
20 Fishing	-4.1	-4.0	-4.0	-4.1
21 Other final use	-13.3	-11.8	-11.4	-11.5
22 Non-energy use	-1.1	0.1	0.6	0.7

Sources: E3ME.

Table 7 shows the reduction in consumption of each fuel. Again, all fossil fuels are affected. Consumption of gas is reduced by the energy-efficiency measures in S3 as well as the carbon tax.

Table 7. EU28 CO_2 emissions by fuel type, 2020

In % difference from baseline

	S1	S2	S3	S4
Coal	-21.3	-20.7	-20.6	-20.6
Liquid fuels	-8.1	-7.5	-7.4	-7.6
Gas	-7.9	-7.2	-9.6	-9.6

Sources: E3ME.