International dimensions of EU climate change policies

This policy brief summarises the insights produced by qualitative and quantitative research conducted under the CECILIA2050 project on the international dimensions of EU climate policy. The aims of the research were to understand the economic and political interactions between EU policies and the rest of the world, assess the effectiveness of these measures and determine the legal and political feasibility of policy responses in regards to diminishing the risk of carbon leakage.

Key Conclusions

Five key conclusions can be drawn from the research. More detailed results can be found in the reports that underlie this policy brief online at: http://cecilia2050.eu/publications.

- **Conclusion 1**: In a fragmented world, ambitious emissions reduction policies by sub-global coalitions may have difficulties achieving the "two degrees" target.
- **Conclusion 2**: In a fragmented world, without comparable policies in the rest of the world, the effect of ambitious EU climate policy on the competitiveness of energy-intensive and trade-exposed sectors may be negative in the long run.
- **Conclusion 3**: Current and proposed anti-leakage measures are not 'optimal' in all respects.
- **Conclusion 4**: The best way to mitigate carbon leakage and loss of competitiveness in the long run is to promote low-carbon innovation in industry.
- **Conclusion 5**: Promoting low-carbon innovation in industry may be the best policy to enhance the international competitiveness of the entire EU industry and may provide a first-mover advantage.

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Conclusion 1: In a fragmented world, ambitious emissions reduction policies by sub-global coalitions may have difficulties achieving the "two degrees" target

The future path of global climate policy is not necessarily one of ever-increasing policy convergence under a treaty (e.g. the Kyoto Protocol), resulting in emissions reduction in future commitment periods of increasing stringency and applicability. Recent UNFCCC summits have pointed in a different direction: a fragmented world in which different countries or regions pursue individual policies – often not in the form of restrictions on emissions but as incentives to promote, for example, renewable energy or energy-efficiency, which then in turn happen to have emission reducing 'side effects.' This limited 'convergence' in policy cooperation among countries may not, however, necessarily limit the 'ambition' for a low-carbon future. Some observers have argued that the rapidly declining equipment costs of renewable energy technologies and an associated scale-up of these technologies in many countries may render pre-agreed emissions reduction targets and timetables less important.

In the CECILIA2050 project it is assumed that the EU follows a clear, long-term emissions reduction path, decreasing emissions by 80% by 2050. For the rest of the world, four global scenarios or storylines were distinguished along the axes of 'ambition' and 'convergence.' Two scenarios, Global Deal and Non-Global Deal, are high in ambition but differ in the extent of policy convergence. The Middle of the Road scenario is characterised by high policy convergence but has moderate ambition. The Status Quo scenario lacks both ambition and convergence.

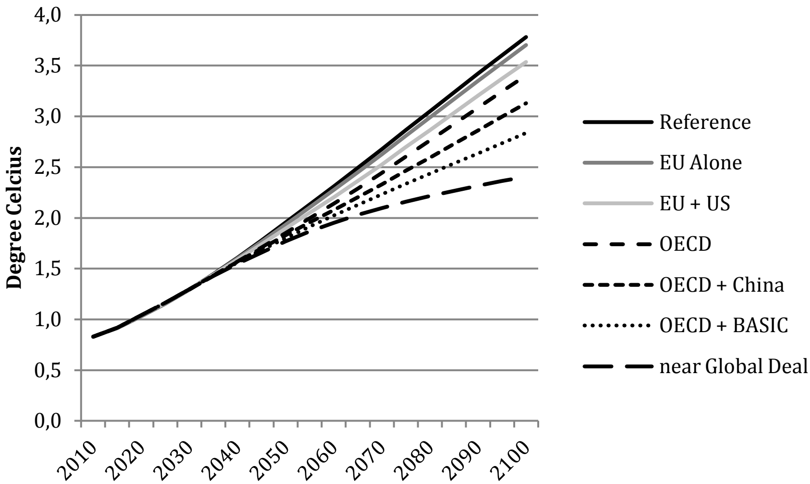
Scenario	Brief description
Global Deal	A path with high degrees of convergence and ambition. The classic optimal solution to a global problem, involving emission reduction targets and timetables for all industrialised (and eventually developing countries) enshrined in a treaty
Non-Global Deal	A path without global targets and timetables but with ambitious mitigation instruments applied in some countries, including the development of policies in the agriculture and forest sectors, such as credits for reduced emissions from deforestation and forest degradation known as "REDD." Absent an UNFCCC agreement creating a global carbon market, this path could still involve the establishment (and to a certain extent the linkage) of regional emissions trading systems. This path is broadly consistent with the IEA's World Energy Outlook 450 PPM Scenario through 2035.
Middle of the Road	A high degree of policy convergence can lack ambition: 'co-ordinated non action.' This is a path in which diplomacy prevails and countries agree on joint programs and mitigation instruments, but in which those programs and instruments are not necessarily ambitious enough. The emissions trajectory is broadly consistent with the IEA's World Energy Outlook New Policies Scenario through 2035, projecting a long term temperature rise of 4˚C.
Status Quo	This is the pessimistic or 'doomsday' scenario, which occurs as the result of continuing the status quo. This path assumes the continuation of policies and instruments currently being employed but no implementation of additional measures. It is comparable to the IEA's 6˚C scenario.

Source: Zelljadt (2014)

The effect of fragmentation on global warming

Without action in non-participating countries, global fragmentation may lead to serious risks for the climate system. Figure 1 presents the evolution of global mean temperature in this century in six different 'fragmentation' scenarios, as computed by the GCAM Integrated Assessment model. In a reference scenario (without any action also by the EU) the temperature increase in 2100 is 3.8˚C above preindustrial level. In fragmented scenarios, in which only developed countries reduce emissions by 80% in 2050 (EU alone, EU + US, OECD), the temperature increases are only slightly below that level (3.7 ˚C, 3.5˚C and 3.4˚C, respectively). Even in the most comprehensive scenario, in which only Russia, Africa and the Middle East do not cooperate (near Global Deal), the model suggests an increase in mean global temperature of 2.4˚C, which exceeds the critical threshold established by the UNFCCC to prevent "dangerous anthropogenic inference with the global climate system." The failure of the model to meet the two degree goal is likely due to two factors: (1) increasing emissions in non-participating regions due to carbon leakage and (2) a delay in the timing of mitigation (i.e. not until after 2030) in some developing regions that is assumed by the fragmented climate policy scenarios. However, additional mitigation after 2050 might lead to lower global temperatures, possibly achieving the "two degrees" target.

Figure 1: Global mean temperature change, 2010-2100 (˚C)



Source: González-Eguino et. al. (2015)

Box 1: The GCAM model

GCAM is a dynamic recursive economic partial equilibrium model driven by assumptions about population size and labor productivity that determines gross domestic production (GDP) in 32 geopolitical regions operating on 5-year time steps from 1990 to 21003. The model can be run with any combination of climate and non-climate policies in relation to a reference scenario and provided carbon price and mitigation costs. GCAM tracks emissions and atmospheric concentrations of GHGs, carbonaceous aerosols, sulfur dioxide, and reactive gases and provides estimates of the associated climate impacts. An important feature of the GCAM architecture is that the GCAM terrestrial carbon cycle model is embedded within the agriculture-land-use system model. Thus, all land uses and land covers, including the non-commercial lands, are fully integrated into the economic modelling in GCAM. This coverage gives GCAM the capability to model policies that jointly cover carbon in all activities in the energy, agriculture, forest, and other land uses.

Source: González-Eguino et. al. (2015)

Conclusion 2: In a fragmented world, without comparable policies in the rest of the world, the effect of ambitious EU climate policy on the competitiveness of energy-intensive and trade-exposed sectors may be negative in the long run.

Currently, there is no evidence that EU climate policies have reduced the competitiveness of its Energy Intensive Trade Exposed (EITE) sectors and caused carbon leakage. A number of reasons for this lack of evidence have been proposed, among others the generous endowment of free emissions allowances throughout the first and second trading periods of the EU ETS, and the relative low price of allowances throughout most of the periods.

Box 2: Distinguishing between energy, terms-of-trade and international investment carbon leakage with the GDynE model

Two intermediate simulations were run in addition to the original simulation. In the original simulation all channels of carbon leakage are simulated. In the first intermediate simulation the world market prices of fossil fuels are held constant; in the second intermediate simulation the world market prices of fossil fuels are held constant and international capital mobility is disallowed. The difference between the original simulation and the first intermediate simulation gives the 'energy' channel. The difference between the first and the second intermediate simulation gives the 'investment' channel. The third intermediate simulation gives the 'terms-of-trade' channel.

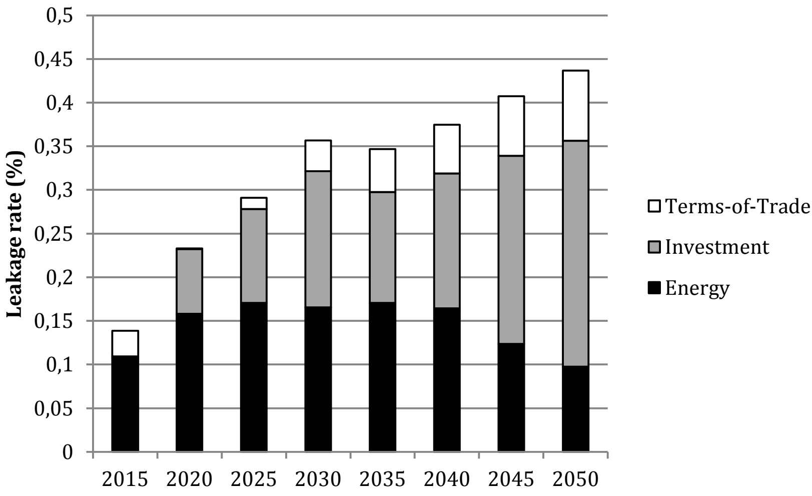
Source: Kuik. (2015)

Definition: Numerous drivers influence the operating and production patterns and locations of particular industries. However, as per the models discussed here, **carbon leakage** is understood to be the relocation of production and any corresponding emissions exclusively in reaction to climate policy measures.

However, this is no guarantee that loss of competitiveness and carbon leakage cannot occur in the future. In order to gain further insight into likely scenarios for the evolution of competitiveness within the European steel industry and carbon leakage for alternative instrument mixes and alternative levels of global participation in climate change policies, a number of simulations were run with the recursively-dynamic CGE model GDynE, which employs an innovative approach to international investment. We deconstructed the broader understanding of carbon leakage into energy, terms-of-trade and international investment channel effects. The simulations suggest that in this scenario the energy market channel dominates carbon leakage initially. However, over time the terms-of-trade effect and especially the international investment channel gain importance. Our simulations suggest that the largest increases of emissions due to carbon leakage (in absolute terms) are in China, the energy exporting countries of Asia (Middle East and Malaysia) and India.

The main conclusion from the simulations is that without any safeguards to the industry, and in the event of moderate climate ambitions in the rest of the world (Middle of the Road scenario), **an ambitious climate policy in Europe could lead to a significant loss of competitiveness of the steel sector and a high and increasing rate of carbon leakage**. An increasing part of the carbon leakage would be due to changes in international investment patterns. This so-called 'investment leakage' would be responsible for 60% of carbon leakage in 2050.

Figure 2: Carbon leakage in the Middle of the Road scenario



Source: Kuik (2015)

Granting free carbon allowances to the energy-intensive and trade-exposed industries in an *output-based* fashion after 2020 and compensating them for increased electricity prices would, according to the analysis, decrease the risk of a loss in competitiveness and reduce, but not eliminate, carbon leakage.

The possibility of a loss in competitiveness and the risk of carbon leakage would disappear if countries were to agree on coordinated ambitious action to tackle climate change. In this **Global Deal scenario there would be no carbon leakage per definition** and our simulations suggest that the competitiveness of the European steel industry might increase in the long term.

Conclusion 3: Current and proposed anti-leakage measures are not 'optimal' in all respects

Anti-leakage measures, both currently in practice and on the table, were assessed using the CECILIA2050 conceptualisation of 'optimality,' which analyses measures on the basis of three criteria: environmental effectiveness, cost-effectiveness, and feasibility. For a more detailed description of the methodology see pages 13-14 of this policy brief.

The current mechanism for supporting energy-intensive industrial sectors at significant risk of carbon leakage is 100% **free allocation of emission allowances** up to the sector's benchmark of 10% most efficient installations in a sector or a subsector in the EU. In terms of environmental effectiveness, free allocation as such should not threaten the emissions reduction targets as these are defined by the overall cap. The benchmarking rule that was introduced in the third trading period (2013-2020) is a positive aspect of the EU ETS and may provide some incentives for resource efficiency. However, in terms of contributing to innovation and technological leadership, there is no evidence that the measure of free allocation as a protective measure for sectors at significant risk of carbon leakage has induced technological innovation. Because the values used to set the benchmarks are from the years 2007-2008, and no revision is foreseen in the EU ETS Directive by 2020, there is not really an ongoing incentive to continuously reduce emissions. Therefore, free allocation with the benchmarking rule does not provide capacity for accelerating the diffusion of innovative low-carbon technologies, avoid fossil-fuel lock-in or emphasise technology competition, especially if the price of emission allowances remains at a low level.

Border carbon adjustments (BCA) are commonly regarded as effective in the literature, and they are characterised in the EU ETS Directive's preamble as an "effective carbon equalisation system" (EC, 2009, par. 25). They are further defined in Art 10b as "the inclusion in the Community scheme of importers of products which are produced by the sectors or subsectors determined in accordance with Article 10a."[2] The dynamic efficiency of the BCA instrument is uncertain and would depend on its exact design, particularly with respect to the determination of the carbon embodied in products, based on an average, predominant or best available technology. Its legal feasibility, for example with the international trade law of the World Trade Organization (WTO), requires further investigation. Its political feasibility is ambiguous. Many observers do not regard border measures as a constructive means to incentivise third countries to engage in climate friendly business, on the contrary: "border measures are likely to trigger retaliatory measures by trading partners" (Eurofer, 2014, p. 58).

Box 3: The GDynE model

GDynE is a recursive-dynamic Computable General Equilibrium (CGE) model from the family of GTAP models. The model allows for foreign investment, providing a better representation of long-term policies. It introduces international capital mobility. Regional capital stocks include capital stock physically located within the region as well as financial assets from abroad, and there is a Global Trust acting as intermediary for all the international investment. Physical capital is owned by firms and households hold financial assets directly in local firms and, through the Global Trust, they hold equity of foreign firms. Households own land and natural resources, which they lease to firms. The Global Trust holds equity in firms in all regions. Time is an explicit variable in the model equations and a dynamic representation of specific developments in the global economy can be represented. In particular, in each period the financial intermediary distributes the global funds between regions according to investors' expectations. Hence, capital progressively moves to regions with high (expected) rates of return where the gap between expected and actual rates of return falls period after period. This is particularly relevant given that both the energy efficiency and the renewable targets imply the introduction of a specific form of technical change that is transmitted by capital investment.

Source: Kuik (2015)

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[2] The sectors and subsectors determined in accordance with Article 10a are those which are at risk of carbon leakage.

Conclusion 4: The best way to mitigate carbon leakage and loss of competitiveness in the long run is to promote low-carbon innovation in industry.

Using a dynamic CGE model, the CECILIA2050 project assessed the rate of carbon leakage and the adverse impacts on industrial competitiveness in a number of scenarios over the period 2010-2050. The scenarios range from the **Global Deal** scenario where all countries participate to reach the necessary emissions reductions in 2050 that are compatible with the 450ppm GHG concentration target, to the **Status Quo** scenario, where only the EU achieves these necessary reductions. For the latter scenario, three different anti-leakage measures are modelled, two measures implementing border carbon adjustments, where 'embedded' carbon in products is based on best available technology and actual foreign emissions (**BCAbat** and **BCAnobat** respectively) and one focusing on investing in energy efficiency and renewable energy in industry through a 10% levy on carbon tax revenue (**EERW**).

Anti-leakage measures can mitigate leakage and adverse effects on competitiveness to some extent. In terms of **environmental effectiveness**, all anti-leakage measures show improvements over the EU ETS. The rate of leakage and global emissions decreases. In terms of environmental effectiveness, the gains with the BCAbat measure are very modest. The largest gains are made in the EERW policy option, where the rate of leakage decreases by 19%-points and global emissions decrease by 1,322 Mt in 2050.

In terms of **cost-effectiveness**, the EU ETS and the two BCA options are almost equal. Cost-effectiveness, as measured by the medium term CO_2 price, is higher for the EERW policy option. The impact on dynamic efficiency shows a mixed pattern. On the one hand, the long-term CO_2 price is substantially lower for the EERW policy option, but, on the other hand, the energy-intensity under EERW is (slightly) higher. It must be assumed that EERW does not necessarily lead to a decrease of energy intensity but it does lead to a larger share of primary energy being renewable.

In terms of **domestic political feasibility**, all anti-leakage measures improve the competitiveness of the EITE industry in comparison to the EU ETS policy without such measures. The BCAnobat policy offers the largest degree of protection for the EITE sectors. The competitiveness of the whole manufacturing sector is most improved by the EERW anti-leakage policy. The evidence for domestic political feasibility is therefore mixed: representatives of the EITE sector may prefer BCAnobat protection, while those of the broader manufacturing industry may prefer the EERW measure.

In terms of **international political feasibility**, it should be noted that the two BCA measures shift the carbon compliance burden to the rest of the world. The Rawls' justice criterion in this context assesses justice on the basis of the impact of the policies on the poorest region's GDP. From this perspective, the BCAnobat option is the worst (highest GDP loss for the poorest regions) and the EERW option is the best (lowest GDP loss for the poorest regions). Therefore, the EERW anti-leakage measure is likely to meet less foreign resistance than both BCA measures, especially the BCAnobat measure.

Conclusion 5: Promoting low-carbon innovation in industry may be the best policy to enhance the international competitiveness of the entire EU industry and may provide a first-mover advantage.

Constructive thinking about the integration of environmental protection and promotion of the competitiveness of industry is needed to secure sustainable growth. The EU has the chance by taking such an approach to carbon leakage and competitiveness to offer a real transformation to the European energy-intensive industries on the path to decarbonisation. Technological innovation and an integrative approach of policies incorporated in the decarbonisation thinking would enable the industry to reduce carbon and energy costs as part of the production costs and seize new real market opportunities through developing innovative value-added products.

The CECILIA2050 project showed several ways in which energy-intensive industries such as the steel sector can be incentivised and supported to improve their energy and material consumption, reduce dependency on fossil fuels technologies and invest in innovative technologies and products, which, in the long term, would reduce carbon costs as part of the production costs and improve international competitiveness. The European steel sector could thus compete internationally through innovative high value-added products rather than on energy prices and volumes.

First-mover advantage

Building new competitive industries is a strong argument for policy leaders for promoting renewable energy policies. Investments in renewable energy capacities in China and to a smaller scale in Korea may have been more driven by the 'green race' rush than by climate change mitigation concerns. The CECILIA2050 project has examined the links between renewable energy support policies and competitiveness of the wind and photovoltaic (PV) technology manufacturing sectors in Europe. The econometric study covers the promotion and export success of wind and solar PV over the period 1995-2013, and uses a balanced dataset of 49 (for wind) and 40 (for PV) countries comprising major developed and emerging countries. We find clear evidence of first mover advantage, sustained in the wind industry and temporary (at least for four years) in the solar PV industry. Hence, we find positive evidence that promoting low-carbon economy can enhance the international competitiveness of European manufacturing.

Further Reading

Antimiani, Alessandro; Costantini, Valeria; Paglialunga, Elena; Kuik, Onno; Branger, Frédéric; and Quirion, Philippe. 2015. The sun also rises: Policy instruments to mitigate the adverse effects on competitiveness and leakage. CECILIA 2050 Deliverable 5.3b. Amsterdam: Institute for Environmental Studies, VU University Amsterdam.

González-Eguino, Mikel; Capellán-Pérez, Iñigo; Arto, Iñaki; Meyer, Bernd; Ansuategi, Alberto; and Markandya, Anil. 2015. Global effects of EU climate policy under fragmentation. CECILIA 2050 Deliverable 5.4. Bilbao, BC3.

Kuik, Onno. 2015. International competitiveness and leakage: A case study of the European steel industry. CECILIA 2050 Deliverable 5.2. Amsterdam: Institute for Environmental Studies, VU University Amsterdam.

Turcea, Ioana and Kalfagianni, Agni. 2015. How to stay competitive while reducing carbon leakage: A policy analysis from the steel sector in the EU CECILIA 2050 Deliverable 5.3a. Amsterdam: Institute for Environmental Studies, VU University Amsterdam

Zelljadt, Elizabeth. 2014. Scenarios for international climate policy instruments CECILIA 2050 Deliverable D 5.1. Berlin: Ecologic Institute.

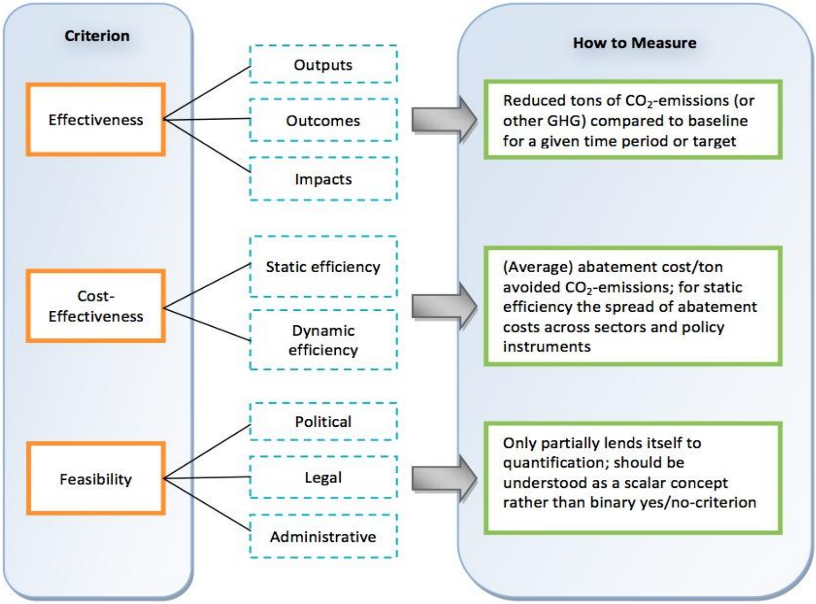
Research Background

This policy brief daws lessons from five research papers, produced by the CECILIA2050 research team and the institutions that comprise it. One paper focused on the development of global scenarios of climate policies. Two papers focused on the impacts of climate policy instrument mixes on the European steel industry and carbon leakage. One paper assessed alternative anti-leakage policy options and one paper assessed overall impacts of EU climate policies on world food, energy and technology markets. These papers may all be accessed on the CECILIA2050 website (www.cecilia2050.eu).

The CECILIA2050 concept of Optimality

In economics ‘optimality’ is generally understood to be the most favourable relationship between an outcome and the resources necessary to achieve it and the outcome itself. If the outcome itself is not predefined, an assessment of optimality would determine the level of both the outcome and resource input, as would occur in a cost-benefit analysis. In determining the optimality of EU climate policy, however, the output is already given in the form of the EU’s short and long-term GHG emission reduction targets. Optimality therefore becomes a discussion of achieving these targets with the least cost to society. Such a task is not straightforward. Finding the ‘least-cost’ pathway to meeting these targets involves inherent uncertainty and a long-term view; many technological, organisational, social or other changes required to decarbonise are still yet to be identified and developed. The capacity to absorb any changes must also be considered; public acceptance, economic and social impacts and the legal and procedural requirements of existing, expanded or new policy instruments must be considered. As such, the CECILIA2050 project has developed a broad definition of ‘optimality’ that extends beyond the purely economic concept and considers real-world constraints.

Figure: Broad Definition of 'Optimality' – Key Criteria



A comprehensive literature review determined that no universally agreed upon set of criteria exists for judging the optimality of a policy instrument or mix of instruments, however there is broad overlap between different approaches. Criteria may be broadly arranged into three categories and subcategories, as in the figure above.

The CECILIA2050 project has been set up as a three-year research project, funded by the European Union's 7th Framework Programme for Research. Running until August 2015, it brings together ten leading research institutions from eight EU countries to assess the performance of the existing climate policy mix, and to map pathways towards future climate policy instrumentation for the European Union, with a prime focus on economic instruments.

Combining Policy Instruments to Achieve Europe's 2050 Climate Targets

CECILIA2050 Policy Briefs This policy brief is part of a series that discusses the results of the CECILIA2050 project. Here, we focus on the results of WP 5, which assessed the international dimensions of EU climate policy, their economic effects and developed plausible future scenarios.

All underlying reports can be accessed at: www.cecilia2050.eu.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under Grant Agreement no. 308680 for the research project CECILIA2050.