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Macroeconomic costs and benefits for the EU as a first mover in climate change mitigation: a computable general equilibrium analysis

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Athens, August 2012

Introduction

As evaluated by UNEP the current country pledges (set in Cancun, 2010) to mitigate GHG emissions are globally significantly below requirements for reaching global climate change mitigation goals. The EU pledges, however, based on the 20-20-20 targets are far closer to the requirements, than the pledges of other countries. Furthermore, the EU, with the Communication for moving beyond the 20% emission reduction by 2020 (published in 26 May 2010), discusses setting 2020 targets well in the trajectory required for the global long-term goals. In other words, the EU is acting as a first mover in climate change mitigation action.

The EU policies for 2020 are considered as invariant since they are already in legislation. But, going beyond the 20% in 2020 and further pursuing strong emission reduction policies after 2020 may depend on rest of the world actions.

The first policy question is what would be the macroeconomic cost for the EU for acting unilaterally (beyond 2020), not only in the medium term, but also in the long term, until 2050. The second policy question is what would be the macroeconomic cost for the EU if the rest of the world goes later (e.g. 10-15 years after 2020) beyond the current pledges and perform emission reduction as required for reaching the mitigation goals. In this case, would it be a benefit for the EU stemming from the first move, for example by gaining a competitive position in global trade of clean technologies? Would it be preferable that the EU waits to synchronize emission reduction actions with the rest of the world (acting 10-15 years after 2020)?

This paper presents quantitative simulation results using the GEM-E3[1] computable general equilibrium model. The results are grouped into scenarios, projections to the future. The aim of the simulations is to provide quantified answers to the above mentioned policy questions.

Methodology

First mover advantage is meant as the possible trade and growth benefits stemming from technological leadership in technologies required to implement transition to a low carbon emitting economy. It is postulated that the learning (or economies of scale) achieved by the early entrant provides cost advantages which allow maintaining leadership in global markets and that the diffusion of technology worldwide diminishes the first-mover advantages over time.

The European internal market is sufficiently large and unified to allow for achieving a large part of the learning potential of the technologies. A two stage process is assumed: in a first stage, the EU adopts policies that induce large-scale commercialization of the new clean technologies in the internal market, while the rest of the world does not follow a similar policy, hence does not use the new technologies; in the second stage, the rest of the world also follows the policy and requires the new technologies. In the beginning of the second

[1] See www.e3mlab.ntua.gr for GEM-E3 model details

stage, the EU has a cost advantage because of the prior learning in the internal market and so gets a higher global market share, compared to a case in which the EU does not move first with climate policy. Later in the second stage, the rest of the world also learns the new technologies and so the EU advantage vanishes. Policy implementation in the first stage implies higher costs than business as usual in the EU.

Clean energy technologies (photovoltaic, wind, CCS, electric vehicles and heat pumps) have a potential of cost reduction if developed at a large scale. It is a result of R&D and economies of scale in mass production. Evidently, this cost reduction reduces the cost of compliance to emission reduction objectives, compared to a case without such a cost reduction. As clean energy technologies are assumed to experience cost reductions at a sector rather than at a firm level, the issues of monopoly rents from innovation and appropriation are not addressed.

The cost reduction of clean energy technologies is assumed to be related to total cumulative volume of production of these technologies, which is induced by carbon prices. The latter are endogenously determined so as to enable a region (or a group of regions) reaching an emission reduction target. In this sense, technology progress is induced by carbon prices. Under invariant emission targets, economic growth effects are lower in case of technology progress, than when learning effects are ignored. In this sense, the model simulates endogenous growth from technology progress induced by carbon prices.

The cost reduction potential is pre-determined by type of technology. Non linear learning curves are assumed to relate unit investment costs with total cumulative volumes. When a technology deploys in a single region, the magnitude of cost reductions depends on the region's market volume; certainly, cost reductions are higher when the technology deploys globally. However, the assumed non linearity is such that deploying a technology in the EU internal market is sufficient to obtain a large part of the entire cost reduction potential.

Scenario Definition

The counterfactual scenarios, quantified using GEM-E3, are based on assumptions about differentiated emission reduction targets by region. For the EU it is assumed that emission reduction is handled through an EU-wide ETS with auctioning of allowances which applies on the entire economy from 2015 onwards. The EU is supposed to follow the emission reduction pathway of the Roadmap 2050. In all counterfactual scenarios, the non EU regions are assumed to implement the 2/3 of their Copenhagen pledges in 2020 through economy-wide ETS separately cleared at a region level. They are further supposed to pursue the same climate action until 2030; this is implemented in the modelling by assuming that the carbon price level as estimated for 2020 continues to apply until 2030. Beyond 2030, the non EU regions are grouped into two ETS groups, namely the Rest of Annex I countries and the Non Annex I countries. Depending on the scenario the two groups are supposed to pursue emission reduction, with ETS carbon price clearing at the group level. All emission reductions are supposed to take place domestically and so CDM and other offsetting mechanisms are ignored.

The following table summarises the definition of the counterfactual scenarios:

Table 1: Summary of scenario definitions

% indicate GHG emissions change from 2005 levels

<table>
<tr><th colspan="2"></th><th>2020</th><th>2025 and 2030</th><th>2050</th></tr>
<tr><td rowspan="4">EU27</td><td>Reference</td><td>-15%</td><td>continuation</td><td>-35%</td></tr>
<tr><td>S1: EU acts alone</td><td>-25%</td><td>Roadmap pathway</td><td>-80%</td></tr>
<tr><td>S2: EU acts first, rest follow later</td><td>-25%</td><td>Roadmap pathway</td><td>-80%</td></tr>
<tr><td>S3: all act later</td><td>-15%</td><td>As in Reference</td><td>-80% and constant carbon budget despite delay</td></tr>
<tr><td rowspan="4">Rest of the World</td><td>Reference</td><td rowspan="4">2/3 of the Copenhagen pledges</td><td>Constant carbon price as in 2020</td><td>Constant carbon price as in 2020</td></tr>
<tr><td>S1: EU acts alone</td><td colspan="2">Constant carbon price as in 2020</td></tr>
<tr><td>S2: EU acts first, rest follow later</td><td rowspan="2">Constant carbon price as in 2020</td><td rowspan="2">-80% for rest of Annex I +xx% for Non Annex I, so as -50% for World</td></tr>
<tr><td>S3: all act later</td></tr>
</table>

The counterfactual scenarios are quantified twice, with differentiated assumptions about the technology progress feedback for the new energy technologies. For the first group of scenarios no learning effects are assumed and so the unit costs of new energy technologies follow a predetermined conservative cost reduction path. For the second group of scenarios the learning effects are assumed to take place according to cost-volume relationships and with spillover effects. In all scenarios, production of new energy technologies (photovoltaic, wind, CCS, electric vehicles and heat pumps), as well as production of biofuels (ethanol and biodiesel) is modelled as separate sectors which participate in global trade.

In case of effective learning mechanisms, it is assumed that the EU acting alone implies getting a maximum of 80% of the cost reduction potential; instead, the world pursuing climate action implies getting the entire potential of learning. Regarding the spillover effects for the new energy technologies, it is assumed that the rest of the world benefit between 5 and 10% of cost reductions despite non undertaking climate actions. The non appropriation of the innovations is supposed to last maximum 10 years.

It is further assumed that in all counterfactual scenarios the ETS, where applicable, is accompanied with structural change policies favouring penetration of clean energy technologies in power generation, increasing use of biofuels, implementation of energy efficiency (energy savings) policies and electrification in road transport. The structural policies are reflected in the model as shifts in scale parameters[2]. The energy efficiency policies increase the factor embodied productivity of energy and are enabled through a mechanism of white certificates with a total amount fixed to a predetermined share of GDP. The structural changes are implemented only if a region undertakes climate action in a scenario. The numerical values of the parameters conducting the structural changes have been calibrated, after trial and error simulations, so as to get GEM-E3 results close to the magnitude of structural changes simulated by bottom-up models (PRIMES for the EU and

[2] By scale parameters we refer to the value shares in constant elasticity of substitution production functions and to the marginal utility parameters of the linear expenditure demand functions

Prometheus for the world regions) for similar scenarios. The reduction possibilities for the non energy related greenhouse emissions are calibrated to IIASA's GAINS model projections (for non CO_2 GHGs) and to PRIMES model projections for industrial CO_2 emissions.

Scenario results

EU acting alone

In the scenarios where the EU acts alone, mainly the EU economy encounters GDP losses, because of the increase in production costs and the weakness of EU competitiveness in foreign trade. The rest of the world also encounters GDP losses, at a far lesser extent, as demand stemming from the EU decreases, relative to the Reference. The decarbonisation effort of the EU implies higher investment for producing the materials and equipment used in energy savings and cleaner energy production. Total investment in the EU is found to increase relative to the Reference: investment needed for decarbonisation over compensates the decrease in productive investment owing to lower GDP.

The results show mixed effects on the labour market. The increase in demand for products and equipment needed for decarbonisation implies higher demand for labour which exerts upwards pressures on the wage rate. The adopted recycling rule of ETS auction revenues (i.e. lower social security contributions of employers) decreases labour costs of producers which tend to increase their demand for labour driving wage rates upwards. But the GDP losses and the ensuing lower overall domestic production implies lower demand for labour which partly offsets the trends towards higher wage rates. The net result is ambiguous. The model results show higher employment but ambiguous changes in real wage rates, relative to the Reference projection. While investment increases in the EU in the context of a decarbonisation scenario, relative to the Reference, private consumption decreases, as a result of higher savings and the reduction in real wages. Consequently, households encounter welfare losses.

The cumulative welfare losses for the EU are estimated equal to 415 bn.$[3], over the period 2011-2050[4], in the scenario where EU acts alone and induced technology effects are ignored. By incorporating the technology effects, total cumulative welfare loss of the EU is reduced to 162 bn.$. The difference (253 bn.$) is a measurement of the positive external effects on welfare from induced technology progress. In terms of cumulative GDP, the positive external effects from technology amount to 1099 bn.$ (0.15% of GDP) in the context of the scenario where the EU acts alone.

The incorporation of technology learning effects is of great importance for estimating total compliance costs when the EU acts alone. The GDP losses of the EU (acting alone) are more than halved owing to induced technology progress. The progress exerts beneficial effects to domestic economy through the reduction of unit energy service costs, thanks to decreasing costs of new clean technologies, and so by reducing the cost differences from conventional

[3] All volumes and amounts are measured in dollars of year 2004
[4] All cumulative amounts refer to the time period 2011-2050

technologies. So, smaller effects on the general level of domestic prices are obtained, hence lower losses in competitiveness and lower losses in domestic production relative to imports.

Table 2: Summary of results for the "EU acting alone" scenario

	Without induced technology				With induced technology			
	2020	2030	2050	Cumulative 2005-2050	2020	2030	2050	Cumulative 2005-2050
GDP in volume (% changes from Reference)								
World	-0.05	-0.10	-0.21	-0.10	-0.04	-0.07	-0.10	-0.06
EU27	-0.07	-0.30	-1.00	-0.33	-0.06	-0.20	-0.52	-0.17
Rest Annex I	-0.06	-0.07	-0.05	-0.05	-0.06	-0.06	-0.03	-0.05
Non Annex I	0.00	-0.02	-0.02	-0.03	0.00	-0.02	0.01	-0.01
Private consumption in volume (% changes from Reference)								
World	-0.12	-0.23	-0.27	-0.20	-0.12	-0.15	-0.02	-0.08
EU27	-0.39	-0.96	-0.97	-0.74	-0.35	-0.55	0.43	-0.16
Rest Annex I	-0.08	-0.09	-0.15	-0.09	-0.08	-0.09	-0.13	-0.08
Non Annex I	-0.03	-0.06	-0.15	-0.08	-0.03	-0.04	-0.08	-0.04
Investment in volume (% changes from Reference)								
World	0.13	0.23	0.07	0.19	0.12	0.22	0.02	0.17
EU27	0.56	1.12	0.88	0.95	0.56	1.08	0.72	0.89
Rest Annex I	-0.04	-0.06	-0.16	-0.06	-0.04	-0.07	-0.20	-0.09
Non Annex I	-0.02	-0.05	-0.16	-0.07	-0.02	-0.04	-0.16	-0.06
Employment (% changes from Reference)								
World	0.01	0.03	0.04		0.01	0.02	0.03	
EU27	0.09	0.27	0.27		0.10	0.26	0.23	
Rest Annex I	-0.03	-0.02	0.01		-0.03	-0.03	-0.01	
Non Annex I	0.01	0.02	0.03		0.01	0.01	0.02	
Exports in volume (% changes from Reference)								
EU27	-0.31	-0.56	-1.22	-0.47	-0.32	-1.16	-3.35	-1.30
Rest Annex I	-0.31	-0.33	0.03	-0.24	-0.29	-0.11	0.53	0.01
Non Annex I	-0.12	-0.08	0.68	0.11	-0.12	0.07	1.15	0.34
Imports in volume (% changes from Reference)								
EU27	-0.22	-0.36	1.66	0.10	-0.21	-0.07	2.42	0.46
Rest Annex I	-0.25	-0.30	-0.72	-0.33	-0.26	-0.44	-1.05	-0.49
Non Annex I	-0.25	-0.27	-0.38	-0.18	-0.24	-0.40	-1.00	-0.42
Welfare equivalent variation (bn.$ difference from Reference)								
World	-6.0	-14.8	-27.6	-575.5	-5.6	-9.6	-5.8	-271.4
EU27	-4.6	-12.0	-15.0	-410.2	-4.2	-7.5	3.4	-154.0
Rest Annex I	-0.8	-1.4	-6.9	-90.6	-0.8	-1.2	-5.6	-73.7
Non Annex I	-0.7	-1.4	-5.7	-74.7	-0.6	-0.9	-3.6	-43.7
GHG Emissions (% changes from Reference)								
World	25.9	45.2	80.2	-1.8	25.9	45.2	80.1	-1.8
EU27	-25.0	-42.0	-78.0	-20.8	-25.0	-42.0	-78.0	-20.8
Rest Annex I	-4.7	0.5	-0.6	-1.9	-4.7	0.5	-0.7	-1.9
Non Annex I	59.8	97.9	175.6	0.1	59.8	97.9	175.5	0.1

Thus, demand for labour is higher than without the induced technology effects, real wages are maintained and the reduction in private consumption is lower. The average cumulative macroeconomic cost of emission reduction in the EU (cumulative GDP loss divided by cumulative emissions avoided) is estimated equal to 140 $/t$CO_2$ in the EU acting alone

scenario. By incorporating the induced technology progress the average emission reduction cost goes down to 66 $/tCO$_2$.

Although the EU encounters GDP losses when acting alone, both investment and employment increase relative to the Reference. Investment in the EU increases by 1% in cumulative terms. The simulation shows a clear double dividend effect in the EU: emissions decrease and employment increases. Roughly employment increases by 1 million over the period 2020-2050, compared to the Reference.

As a result of the increase in domestic production costs and the increase in real interest rates, the EU terms of trade are higher relative to the Reference to the detriment of terms of trade in other regions, notably in Non Annex I regions. The terms of trade in the EU change by 4.6% in 2050 and by 5.2% under induced technology progress, in percentage terms relative to the Reference. The world economy implications of the EU acting alone scenario are very small. The negative impacts are entirely due to the lower demand addressed to the rest of the world by the EU.

The case where the EU reducing unilaterally GHG emissions have small effects on global cumulative emissions (-1.8%) which are obviously insufficient for mitigating climate change impacts. As part of the EU production shifts to other regions, indirectly through the changes in imports and exports, part of the EU emission reduction is “leaked” in the sense of leading to increased emissions in other regions, relative to the Reference. The leakage is estimated to be 0.7% of global cumulative emissions.

All regions acting later

In this scenario, the EU synchronises ambitious climate action with the rest of the world. The economic effects in the period before 2030 are negligible, in all regions, as the pledges represent a small change from Reference and the EU pursues the same policy as in Reference. The economic consequences start to show off from 2030 onwards.

As all regions of the world simultaneously perform strong emission reduction, relative to the Reference, the impacts owing to relative competitiveness in foreign trade are rather small. Nevertheless, the relative decarbonisation effort is more intense in developed regions, rather than in developing ones, and so the former do experience weaknesses relative to the latter in foreign trade. Exports by Non Annex I countries increase and imports decrease, whereas the inverse is found for both the EU and the Rest of Annex I countries. The EU does not lose in competitiveness with respect to the rest of developed regions, contrasting the results of the EU acting alone scenario. The terms of trade of developing countries increase between 5 and 9%, relative to the Reference.

Global GDP is found lower by 2% in 2050 relative to the Reference projection, and also lower by 1% in cumulative terms over the entire projection period, in the case without induced technology progress. The impact is almost halved (-1.1% in 2050 and -0.6% cumulatively) when induced technology progress is included. This corresponds to 0.05 percentage points lower average annual rate of growth of global GDP, and to 0.03 percentage points when including induced technology progress.

The GDP losses are entirely due to the higher cost of the decarbonised energy services, compared to the conventional way energy services are produced in the Reference scenario.

Including the induced technology progress plays a great role in maintaining domestic demand as decarbonisation costs are lower. The progress helps preserving employment and restoring real wage rates. The benefits from induced technology progress amount to 11800 bn.$ in terms of cumulative global GDP and to 1309 bn.$ in terms of cumulative equivalent variation of welfare.

Table 3: Summary of the results for the "all regions acting later" scenario

	Without induced technology				With induced technology			
	2020	2030	2050	Cumulative 2005-2050	2020	2030	2050	Cumulative 2005-2050
GDP in volume (% changes from Reference)								
World	-0.05	-0.78	-1.86	-0.92	-0.05	-0.75	-0.91	-0.55
EU27	0.00	-0.49	-2.56	-1.02	0.01	-0.45	-1.61	-0.65
Rest Annex I	-0.08	-0.39	-1.47	-0.48	-0.08	-0.38	-0.99	-0.31
Non Annex I	-0.05	-1.43	-1.90	-1.38	-0.05	-1.40	-0.54	-0.79
Private consumption in volume (% changes from Reference)								
World	0.02	-1.35	-1.96	-1.18	0.02	-1.30	-0.48	-0.57
EU27	-0.04	-0.42	-2.10	-0.88	-0.03	-0.37	-0.85	-0.40
Rest Annex I	-0.03	-0.77	-0.98	-0.51	-0.03	-0.73	0.00	-0.12
Non Annex I	0.13	-2.48	-2.81	-2.11	0.13	-2.43	-0.79	-1.18
Investment in volume (% changes from Reference)								
World	-0.28	1.30	-1.20	0.19	-0.28	1.28	-1.06	0.18
EU27	0.08	1.71	-0.21	0.69	0.08	1.70	-0.42	0.59
Rest Annex I	-0.24	1.64	-0.48	0.65	-0.24	1.63	-0.68	0.55
Non Annex I	-0.67	0.61	-2.15	-0.62	-0.67	0.60	-1.61	-0.48
Employment (% changes from Reference)								
World	-0.01	0.26	0.00		-0.01	0.26	-0.05	
EU27	0.20	0.58	0.16		0.20	0.58	0.08	
Rest Annex I	-0.06	0.26	0.03		-0.06	0.26	0.01	
Non Annex I	-0.02	0.24	-0.01		-0.02	0.24	-0.06	
Exports in volume (% changes from Reference)								
EU27	-0.05	-2.13	-4.26	-2.33	-0.05	-2.03	-2.48	-1.57
Rest Annex I	-0.34	-0.03	-1.09	0.37	-0.34	-0.06	-1.12	0.30
Non Annex I	-0.24	1.21	6.55	2.87	-0.24	1.18	6.99	2.93
Imports in volume (% changes from Reference)								
EU27	-0.13	2.05	3.31	1.94	-0.13	2.01	3.00	1.71
Rest Annex I	-0.26	-0.37	1.71	0.53	-0.26	-0.36	2.63	0.87
Non Annex I	-0.24	-1.29	-0.53	-0.30	-0.24	-1.27	0.36	0.06
Welfare equivalent variation (bn.$ difference from Reference)								
World	2.3	-79.9	-150.1	-2936.0	2.3	-77.4	-40.1	-1623.4
EU27	-1.0	-8.0	-28.7	-434.2	-1.0	-7.4	-11.7	-219.2
Rest Annex I	1.1	-22.3	-45.0	-771.7	1.1	-21.5	-18.8	-445.6
Non Annex I	2.2	-49.6	-76.4	-1730.1	2.2	-48.4	-9.6	-958.6
GHG Emissions (% changes from Reference)								
World	26.9	25.2	-49.9	-28.9	26.9	25.2	-49.9	-28.9
EU27	-17.5	-30.1	-83.8	-21.1	-17.5	-30.1	-83.8	-21.1
Rest Annex I	-4.7	-13.9	-79.7	-25.1	-4.7	-13.9	-79.7	-25.1
Non Annex I	59.7	66.0	-20.9	-31.1	59.7	66.0	-20.9	-31.1

All regions benefit from technology progress as it is assumed that innovation spillover effects perform frictionless. The results confirm that the induced technology progress implies higher exports by developed countries to developing regions. The relative share of the EU is maintained at a high level in this context.

The average cost of emission reduction at world level measured as loss of cumulative GDP per unit of GHG avoided was found equal to 44$/tCO$_2$ and to 27.5$/tCO$_2$ in the cases without and with induced technology progress, respectively.

GDP losses for the EU are higher in the scenario where all regions act later than in the scenario where the EU acts alone. The losses amount to 5082bn.$ in cumulative terms without induced technology progress and 3582bn.$ with induced technology progress.

The increased losses are primarily due to the depressive effect on global GDP because the EU bears the consequences of a global increase of costs and of a global reduction in demand in the context of the scenario where all regions act for climate.

Another cause is related to the shorter time in which the EU has to meet the reduced carbon budget compared to the scenario where the EU acts alone. Energy savings as well as the substitutions in demand and in energy production need to be more intensive on an annual basis in the period 2030-2050, as the EU acts after 2030 in the scenario where all regions act later. This implies higher strains on primary production factors, in particular on the capital market, which aggravates unit production costs, thus adding on depressive effects on domestic demand. In other words, the delay in EU climate action has adverse consequences on the EU cost for complying with the given carbon budget. For this reason, and also because of the higher costs of imports, the average cost of emission reduction in the EU (measured as loss of cumulative GDP) more than doubles in the scenario where all regions act later, compared to the scenario where the EU acts alone. The impact of the induced technology progress is very beneficial for the EU and for the rest of the world, as the results show that it allows halving the average abatement cost, which however still is significantly higher than in the scenario where the EU acts alone in presence of the induced technology progress effects.

EU acting first, rest following later

In this scenario, the EU pursues ambitious decarbonisation, along the pathway defined in the Roadmap to 2050, whereas the rest of the world undertakes ambitious decarbonisation from 2030 onwards, as in the all regions acting later scenario. After 2030, when all regions participate in decarbonisation, the oil price feedback effect takes place. In the context of induced technology progress, the EU achieves before 2030 a significant part of cost reduction potential for clean energy technologies. After 2030, and while the spillover effects of innovation towards the non EU regions are still moderate, the EU has a cost advantage over the non EU regions for the new energy technologies, which are increasingly demanded by the non EU regions during the period post 2030. The cost advantage of the EU is assumed to gradually vanish over a period of 10 years, and so roughly after 2040, all regions benefit from reduced costs of new and clean energy technologies.

The numerical results show that the cumulative amount saved by the EU because of not delaying climate action is equal to 3508bn.$ (in terms of cumulative GDP), despite that the non EU regions do not decarbonise in the early stages. In a sense, this benefit from not delaying the climate actions is a first-mover advantage; obviously an important caveat is that

this benefit is valid only if we assume a finite time horizon (until 2050) and an invariantly reduced carbon budget.

Coming back to the original scenario of the EU acting before the rest of the regions joining the decarbonisation effort, and referring to the scenario case where induced technology progress is ignored, the projections show lower GDP losses for the EU and also globally, compared to the scenario where all regions act later. The benefit for the EU is estimated to be equal to 3457bn.$ and for the world 4153bn.$. A similar benefit is found also looking at equivalent welfare variation of welfare: gains of 214 bn.$ cumulatively for the EU and 304 bn.$ for the world relative to the scenario where all regions act later. Possible benefits for the EU because of early innovation obviously cannot explain these gains, since induced technology progress is not included. The cause is primarily the reduced cost of decarbonisation of the EU owing to delivering the given carbon budget over a longer period of time.

The average abatement cost of the EU, in cumulative terms, in the scenario where the EU acts first and the rest of the world follows later (with costs measured as changes in cumulative GDP) is equal to 107$/t$CO_2$, significantly down from the 200$/t$CO_2$ estimated for the scenario all acting later.

The reduction of compliance costs in the EU, thanks to not delaying climate action, spillover benefits to the rest of the world, through avoiding excess increase in EU commodity prices. This explains the GDP and welfare benefits encountered in the rest of the world, which as expected are much smaller in magnitude than the EU benefits. Global average cost of abatement (measured through changes in cumulative GDP) is found equal to 38$/t$CO_2$ down from 44$/t$CO_2$ which corresponds to the scenario where the EU delays climate action following the rest of regions.

The average abatement cost halves at world level and the reduction is even more pronounced for the EU (34 $/t$CO_2$) in the presence of induced technology progress. Compared to the case of the EU also delaying climate action in the presence of induced technology progress, the average abatement cost of the EU is 72% lower. In terms of cumulative GDP the benefits stemming from induced technology progress are estimated equal to 2649bn.$ for the EU and 11492bn.$ for the entire world.

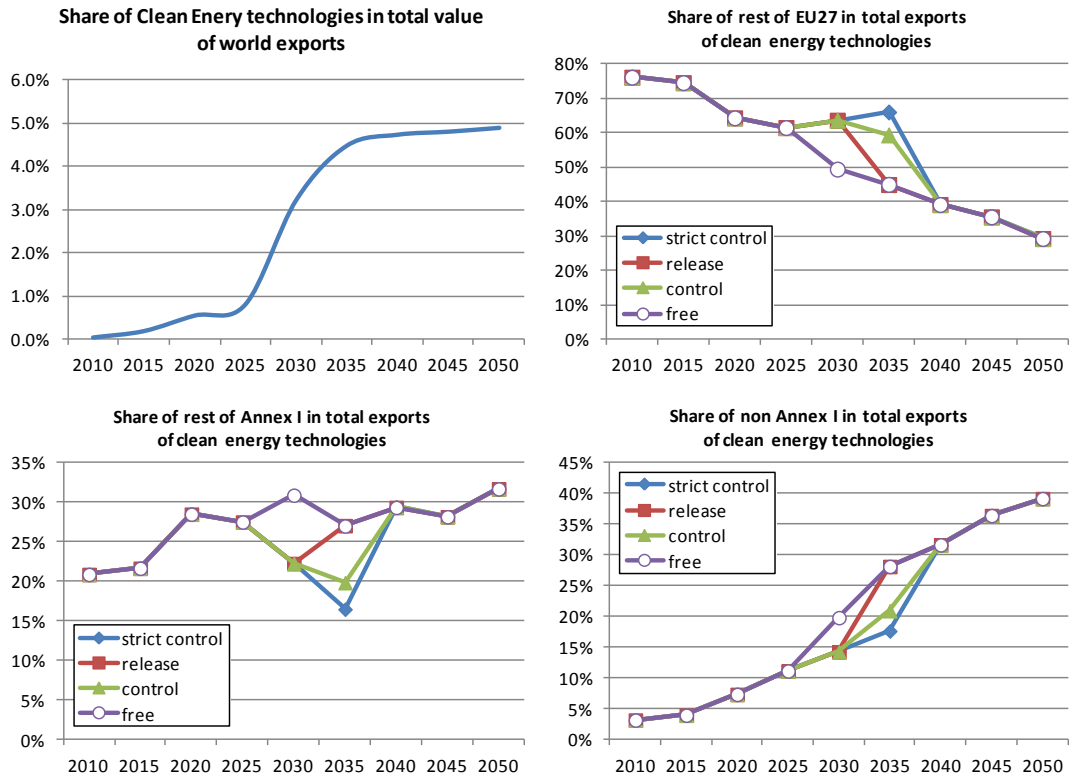
The comparative advantage of the EU stemming from earlier technology advancement in the clean energy technologies, compared to the rest of the EU, is obtained mainly because of early climate action which reduces compliance cost for the EU. The speed of technology diffusion to the rest of the world has some consequences on the EU economy of far lesser magnitude. To study this effect, with the aim at quantifying the possible first-mover advantage, four scenario variants are quantified using the model. The variants are sensitivities to the scenario where the EU acts first and the rest follow later in the presence of induced technology progress, and are defined as follows:

- Free: The EU releases the innovation rights already in 2030
- Release: The EU releases the innovation rights from 2035 onwards

- Control: The EU controls innovation rights at a certain extent and the rest of the world get half of innovation cost reductions before 2040 and the entire benefits from 2040 onwards
- Strict control: The EU succeeds to apply stricter controls and the rest of the world get the innovation cost reductions only from 2040 onwards

In all these cases, the rest of the EU regions meet their emission reduction targets, irrespectively of availability of low cost clean energy technologies, and the EU pursues the ambitious emission reduction pathway (meets the reduced carbon budget). Across the scenario variants, during the period 2030-2040, the EU increasingly limits the diffusion of innovations to the rest of the world and so the EU increases its market share in global trade for the clean energy technologies. But, by limiting the diffusion, the non EU regions face higher costs of decarbonisation, which implies lower domestic demand and higher prices.

Figure 1: Global trade of clean energy technologies



Global trade of clean energy technologies (wind, solar, CCS, electric vehicles, heat pumps) increase in the decarbonisation scenarios. A basic trend, as simulated in the projections, is the increasing share of developing countries in world trade of clean energy technologies, which is due to their lower production costs. The graphics above illustrate the impact of the various assumptions about the EU control of technology diffusion on trade.

As control of technology diffusion increases, in the four scenario variants, the EU share in global trade of clean energy technologies increases, but the increase lasts at most 10 years.

Table 4: GDP and welfare impacts of technology diffusion controls

Differences from "all acting later" scenario (with induced technology progress)

bn.$'2004	cumulative GDP			cumulative Welfare		
	EU	Rest of World	World	EU	Rest of World	World
Free	3413	1254	4667	245	133	379
Release	3231	898	4128	258	83	341
Control	2951	197	3148	274	-6	268
Strict control	2787	-155	2632	283	-51	232

The GDP and welfare impacts of clean energy technology diffusion controls by the EU depend on two counteracting mechanisms:

- By increasing controls on technology diffusion the EU succeeds in getting an additional share in trade of clean energy technology during a decade, which coincides with the starting of decarbonisation in the rest of the world; consequently the EU increases production which helps alleviating GDP losses.
- The control on diffusion limits the use of low cost clean energy technologies produced in the EU by the rest of the world; thus decarbonisation is more expensive in non EU regions, where domestic demand decreases and prices increase. Consequently, all exports by the EU addressed to rest of the world decrease and domestic EU prices increase to the extent imports contribute to domestic demand. These changes exert negative impacts on EU's GDP.

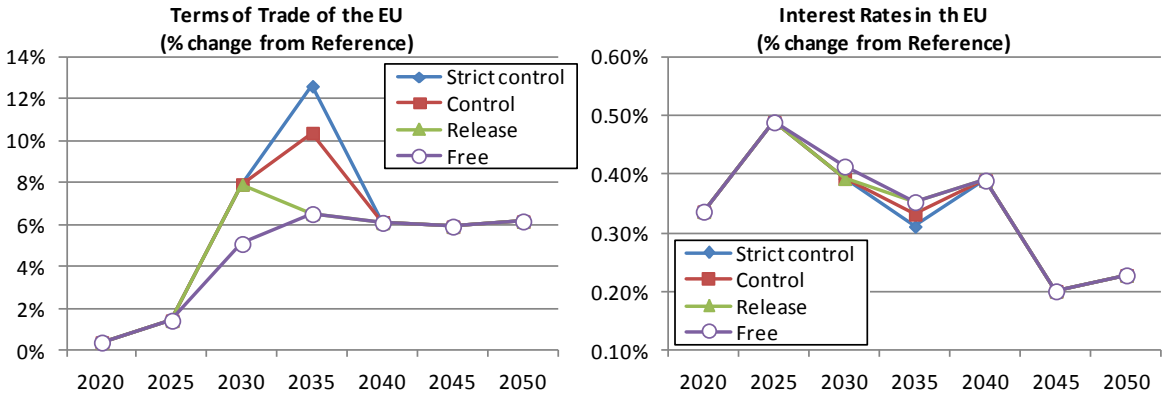
The model results show that the net effects on EU's GDP of increasing control on clean energy technology diffusion are negative, as shown in the table above. This table shows differences from the "all acting later" scenario. The first line shows the impacts of immediate diffusion of the low cost clean energy technology produced in the EU thanks to early climate action. Compared to the all acting later scenario, the EU gets a GDP benefit of 3.4 trillion $ which corresponds to the cost savings from performing the EU decarbonisation over a longer period of time. The resulting cost savings spillover the rest of world economy where an additional GDP benefit (1.25 trillion $) is collected. The first line of the same table shows a benefit also in terms of equivalent variation of welfare, which is higher for the EU (245bn.$) due to early climate action and lower for the rest of the World (133bn.$).

Although the early climate action by the EU provides first-mover advantage for EU exports of clean energy technologies (see Figure), the benefits in terms of GDP are offset by the depressive consequences of the delayed diffusion of the low cost technologies to the rest of the world and the ensuing higher costs of decarbonisation in the non EU regions. This result is obtained by assuming that the rest of the world regions perform the same decarbonisation schedule irrespective of the EU controls on technology diffusion.

The table above shows that the 3.4 trillion $ benefit of the EU owing to early climate action decreases as control on technology diffusion increases. The negative effects on the EU GDP due to higher decarbonisation costs incurred in the rest of the world dominate over the positive GDP effects owing to the EU trade advantage. The case of strict control of technology diffusion implies 626 bn.$ lower gains of the EU early climate action (in terms of cumulative GDP) compared to the free diffusion of the low cost clean energy technologies. Under strict control, the rest of the world encounters a GDP loss of 1409bn.$ compared to the case of free diffusion.

Nevertheless, the impacts of controlling technology diffusion on equivalent variation of welfare are different. The non diffusion allows the EU to obtain higher terms of trade, as high price exports increase, among which the clean energy technologies, and low price exports decrease, because of lower domestic demand in the rest of the world; the average price of EU imports also increase, because of higher costs in the rest of the world due to expensive clean technologies, but the magnitude of increase is found lower than the increase of average price of exports.

Figure 2: Terms of trade and interest rates related to control of technology diffusion



The increased terms of trade act towards relaxing the saving-investment constraint inducing slightly higher investment, lower interest rates and higher real wage rates, which explain the gains in terms of equivalent variation of welfare. This result is similar to getting a rent from monopoly rights over the clean energy technology innovation and to using the rent to increase investment and private income in the EU. As confirmed in the above table, the gains in the EU welfare increase with the intensity of diffusion control. The same table shows that the EU welfare gain is effectuated to the detriment of welfare of the rest of the world, where welfare losses increase with more intense control of diffusion. Total welfare at world level decreases with increasing controls; thus maximum global welfare occurs when EU rights are immediately diffused (free scenario variant), as the other cases involve a sort of monopoly rent taking.

In the time period after 2040, the EU gets some GDP gains in the control variants compared to the free variant. This is due to higher investment during the control period (2030-2040), thus longer term benefits are obtained as induced by higher capital

accumulation in the preceding time period. The longer term gains in the EU GDP are however small and are much lower than the GDP losses during the control period.

Table 5: Summary of results of the "EU acting first, rest following later" scenario, with strict control of technology diffusion

	Without induced technology				With induced technology			
	2020	2030	2050	Cumulative 2005-2050	2020	2030	2050	Cumulative 2005-2050
GDP in volume (% changes from Reference)								
World	-0.05	-0.80	-1.35	-0.76	-0.05	-0.78	-0.47	-0.47
EU27	-0.06	-0.69	-1.29	-0.55	-0.04	-0.70	-0.34	-0.26
Rest Annex I	-0.07	-0.36	-1.43	-0.46	-0.07	-0.32	-0.99	-0.32
Non Annex I	-0.03	-1.41	-1.30	-1.26	-0.02	-1.40	-0.08	-0.79
Private consumption in volume (% changes from Reference)								
World	-0.03	-1.35	-1.28	-0.97	-0.02	-1.21	0.10	-0.44
EU27	-0.35	-0.40	-0.45	-0.28	-0.31	0.15	0.94	0.37
Rest Annex I	-0.01	-0.73	-0.86	-0.45	-0.01	-0.70	0.02	-0.15
Non Annex I	0.12	-2.53	-1.96	-1.90	0.12	-2.45	-0.12	-1.15
Investment in volume (% changes from Reference)								
World	-0.14	1.19	-0.86	0.30	-0.14	1.15	-0.74	0.29
EU27	0.59	1.41	0.80	1.11	0.59	1.45	0.63	1.08
Rest Annex I	-0.24	1.69	-0.38	0.69	-0.24	1.61	-0.58	0.59
Non Annex I	-0.67	0.47	-1.95	-0.66	-0.67	0.42	-1.49	-0.55
Employment (% changes from Reference)								
World	0.01	0.35	0.24		0.01	0.34	0.19	
EU27	0.10	0.35	0.37		0.10	0.36	0.31	
Rest Annex I	-0.04	0.31	0.05		-0.04	0.29	0.03	
Non Annex I	0.00	0.36	0.25		0.00	0.34	0.20	
Exports in volume (% changes from Reference)								
EU27	-0.32	-2.90	-2.95	-1.72	-0.33	-3.69	-1.50	-1.53
Rest Annex I	-0.35	0.12	-0.97	0.37	-0.34	0.87	-0.87	0.66
Non Annex I	-0.07	1.75	7.51	3.17	-0.06	2.20	8.00	3.53
Imports in volume (% changes from Reference)								
EU27	-0.16	2.20	3.70	2.12	-0.14	3.64	3.83	2.71
Rest Annex I	-0.23	-0.25	2.46	0.79	-0.23	-0.40	3.19	0.99
Non Annex I	-0.31	-1.38	0.51	0.06	-0.31	-1.60	1.25	0.21
Welfare equivalent variation (bn.$ difference from Reference)								
World	-1.3	-80.4	-106.7	-2560.4	-0.8	-71.8	-4.0	-1391.7
EU27	-4.2	-6.4	-9.3	-225.0	-3.8	-0.5	9.0	63.8
Rest Annex I	1.0	-22.9	-41.9	-734.1	1.0	-21.9	-18.2	-475.4
Non Annex I	1.9	-51.1	-55.4	-1601.3	2.0	-49.4	5.2	-980.1
GHG Emissions (% changes from Reference)								
World	26.0	24.5	-49.1	-28.8	26.0	24.6	-49.1	-28.8
EU27	-25.0	-42.0	-78.0	-20.8	-25.0	-42.0	-78.0	-20.8
Rest Annex I	-4.7	-13.6	-79.7	-25.1	-4.7	-13.6	-79.7	-25.1
Non Annex I	60.0	67.5	-20.9	-31.0	60.0	67.5	-20.9	-31.0

Table 6: Comparison of controlled versus free diffusion of clean energy technology

With induced technology	Control of technology diffusion				Free technology diffusion			
	2020	2030	2050	Cumulative 2005-2050	2020	2030	2050	Cumulative 2005-2050
GDP in volume (% changes from Reference)								
World	-0.05	-0.78	-0.47	-0.47	-0.05	-0.64	-0.47	-0.41
EU27	-0.04	-0.70	-0.34	-0.26	-0.04	-0.43	-0.37	-0.17
Rest Annex I	-0.07	-0.32	-0.99	-0.32	-0.07	-0.26	-0.99	-0.29
Non Annex I	-0.02	-1.40	-0.08	-0.79	-0.02	-1.24	-0.06	-0.70
Private consumption in volume (% changes from Reference)								
World	-0.02	-1.21	0.10	-0.44	-0.02	-1.05	0.10	-0.37
EU27	-0.31	0.15	0.94	0.37	-0.31	-0.06	0.91	0.27
Rest Annex I	-0.01	-0.70	0.02	-0.15	-0.01	-0.50	0.02	-0.08
Non Annex I	0.12	-2.45	-0.12	-1.15	0.12	-2.17	-0.11	-1.01
Investment in volume (% changes from Reference)								
World	-0.14	1.15	-0.74	0.29	-0.14	1.11	-0.74	0.27
EU27	0.59	1.45	0.63	1.08	0.59	1.33	0.60	1.02
Rest Annex I	-0.24	1.61	-0.58	0.59	-0.24	1.59	-0.58	0.58
Non Annex I	-0.67	0.42	-1.49	-0.55	-0.67	0.40	-1.47	-0.55
Employment (% changes from Reference)								
World	0.01	0.34	0.19		0.01	0.33	0.20	
EU27	0.10	0.36	0.31		0.10	0.33	0.30	
Rest Annex I	-0.04	0.29	0.03		-0.04	0.29	0.03	
Non Annex I	0.00	0.34	0.20		0.00	0.33	0.21	
Exports in volume (% changes from Reference)								
EU27	-0.33	-3.69	-1.50	-1.53	-0.33	-2.38	-1.52	-1.09
Rest Annex I	-0.34	0.87	-0.87	0.66	-0.34	0.01	-0.86	0.37
Non Annex I	-0.06	2.20	8.00	3.53	-0.06	1.64	8.01	3.28
Imports in volume (% changes from Reference)								
EU27	-0.14	3.64	3.83	2.71	-0.14	2.06	3.83	2.09
Rest Annex I	-0.23	-0.40	3.19	0.99	-0.23	-0.14	3.20	1.07
Non Annex I	-0.31	-1.60	1.25	0.21	-0.31	-1.24	1.25	0.35
Welfare equivalent variation (bn.$ difference from Reference)								
World	-0.8	-71.8	-4.0	-1391.7	-0.8	-64.1	-3.9	-1244.8
EU27	-3.8	-0.5	9.0	63.8	-3.8	-2.5	8.7	26.2
Rest Annex I	1.0	-21.9	-18.2	-475.4	1.0	-18.0	-18.1	-414.8
Non Annex I	2.0	-49.4	5.2	-980.1	2.0	-43.6	5.6	-856.2
GHG Emissions (% changes from Reference)								
World	26.0	24.6	-49.1	-28.8	26.0	24.5	-49.1	-28.8
EU27	-25.0	-42.0	-78.0	-20.8	-25.0	-42.0	-78.0	-20.8
Rest Annex I	-4.7	-13.6	-79.7	-25.1	-4.7	-13.7	-79.7	-25.1
Non Annex I	60.0	67.5	-20.9	-31.0	60.0	67.5	-20.9	-31.0

So, the first-mover advantage of the EU manifested by increasing exports of clean energy technologies and permitted by delaying the diffusion of the reduced cost technologies does not imply gains in the EU GDP, because of adverse effects to the EU and of course to the rest of the world stemming from higher costs of decarbonisation in the rest of the world. However, the control of technology diffusion does permit the EU households to obtain

higher real income, more employment and higher equivalent variation of welfare, despite the GDP losses. From a global perspective the maximum gains in terms of both the GDP and the welfare are obtained in case the EU immediately diffuses the technologies to the rest of the world at the beginning (2030) of intense decarbonisation.

Irrespectively of the control policy of technology diffusion, which any way have rather small impacts in magnitude, the significant benefits in this decarbonisation scenario for the EU stem from two effects: a) the induced technology progress and b) the early climate action by the EU which allows for lower decarbonisation cost, than in case the same decarbonisation takes place in a shorter period of time. We remind that these benefits are obtained under the assumption that the EU and the rest of the world will have any way to meet a given reduced carbon budget.

Concluding remarks

The aim of the quantitative projections was to analyse the macroeconomic costs and benefits for the EU as a first mover in climate change mitigation. A general equilibrium approach has been followed using the GEM-E3 global model. A series of scenarios and sensitivity variants were quantified, which were compared against a Reference projection until 2050.

The scenario results show clear advantages for the EU as a first mover in climate change mitigation compared to a delaying of climate action, provided that in all cases the EU will have to meet a reduced carbon budget (cumulative GHG emissions until 2050 lower than in the Reference). The results confirm that irrespectively of whether or not the rest of the world will follow decarbonisation later, the EU has interest to start earlier if the EU will in any case have to meet the reduced carbon budget.

The induced technology progress plays a considerable role in reducing the decarbonisation costs and in alleviating the negative impacts on the economy. The EU has a sufficiently large internal market to achieve a considerable part of the learning potential of clean energy technologies, such as the solar, wind, CCS, electric vehicles and heat pump technologies, which have been distinctly modelled.

Getting an advantage in global trade of clean energy technologies will depend on the speed of technology diffusion in the rest of the world after the progress to be achieved in the EU thanks to early climate action. The model simulates increased market shares of the EU as a function of the strictness of control of diffusion, during a decade just after 2030. Holding monopoly rents from technology spillover has been found to positively affect households' income and welfare in the EU. The model results, and the sensitivity variants, confirm however that preventing the rest of the world from having the clean energy technology available at reduced cost in the early stage of their decarbonisation efforts has adverse effects on GDP of the EU due to the higher cost of decarbonisation in the rest of the world. The results reveal a trade-off between GDP and welfare effects for the EU; hence, whether or not to seek for first mover trade advantage requires policy consideration by the EU.

The larger and clear benefits for the EU are obtained by performing decarbonisation over a longer period of time, which in a sense can be also seen as a first mover advantage. In any case the macroeconomic costs of decarbonisation are estimated to be small in magnitude, thanks to induced technology progress. Part of the potential cost is offset by the simulated decrease in world oil prices as a result of decrease in global demand for oil, a trend which has more serious negative impacts on oil producing regions. The structural changes in all sectors imply more demand for materials, equipment and services which are more labour intensive than the displaced fossil fuels. The mechanism which simulates decarbonisation in the model, consisting in implementing a cap and trade system with auctioned emission allowances and revenue recycling for reducing social security contributions, is found to lead to a double dividend for employment and the environment.

APPENDIX A: Detailed GEM-E3 results aggregated by climate action region

Table 7: Detailed results by scenario

	World						EU27						RANNEXI						NONANNEXI					
GHG Emissions (Mt CO2 equiv.)	% changes from 2005				Mt CO2 eq.		% changes from 2005				Mt CO2 eq.		% changes from 2005				Mt CO2 eq.		% changes from 2005				Mt CO2 eq.	
	2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50	
GHG Emissions (Mt CO2 equiv.)	49.23	56.59	63.46	71.01	2,481.43		4.14	3.71	3.28	3.20	172.83		13.57	13.88	13.93	13.67	614.86		31.51	39.00	46.25	54.13	1,693.73	
Reference	28.7	48.0	65.9	85.7	2,481,428		-17.0	-25.6	-34.2	-35.8	172,829		0.3	2.6	2.9	1.1	614,865		59.8	97.7	134.5	174.4	1,693,734	
Without technology progress feedback																								
S1: EU acts alone	25.9	45.2	62.0	80.2	2,436,107	-1.8%	-25.0	-42.0	-60.0	-78.0	136,937	-20.8%	-4.7	0.5	0.9	-0.6	603,398	-1.9%	59.8	97.9	134.6	175.6	1,695,771	0.1%
S2: EU acts first, rest follow later	26.0	24.5	-20.4	-49.1	1,766,918	-28.8%	-25.0	-42.0	-60.0	-78.0	136,937	-20.8%	-4.7	-13.6	-49.4	-79.7	460,697	-25.1%	60.0	67.5	9.5	-20.9	1,169,284	-31.0%
S3: All act later	26.9	25.2	-21.7	-49.9	1,763,337	-28.9%	-17.5	-30.1	-70.5	-83.8	136,372	-21.1%	-4.7	-13.9	-49.2	-79.7	460,484	-25.1%	59.7	66.0	9.5	-20.9	1,166,480	-31.1%
With technology progress feedback																								
S1: EU acts alone	25.9	45.2	61.9	80.1	2,435,908	-1.8%	-25.0	-42.0	-60.0	-78.0	136,937	-20.8%	-4.7	0.5	0.9	-0.7	603,290	-1.9%	59.8	97.9	134.6	175.5	1,695,680	0.1%
S2: EU acts first, rest follow later	26.0	24.6	-20.4	-49.1	1,766,972	-28.8%	-25.0	-42.0	-60.0	-78.0	136,937	-20.8%	-4.7	-13.6	-49.4	-79.7	460,727	-25.1%	60.0	67.5	9.5	-20.9	1,169,307	-31.0%
S3: All act later	26.9	25.2	-21.7	-49.9	1,763,247	-28.9%	-17.5	-30.1	-70.5	-83.8	136,366	-21.1%	-4.7	-13.9	-49.2	-79.7	460,399	-25.1%	59.7	66.0	9.5	-20.9	1,166,482	-31.1%

	World						EU27						RANNEXI						NONANNEXI					
GDP (bill. $ 2004)	bill.$'04				bill.$'04		bill.$'04				bill.$'04		bill.$'04				bill.$'04		bill.$'04				bill.$'04	
	2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50	
Reference	59,908	75,685	91,962	110,655	3,288,664		14,330	16,128	18,017	20,345	709,081		27,100	32,877	37,299	41,980	1,398,358		18,478	26,679	36,646	48,330	1,181,226	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.05	-0.10	-0.10	-0.21	3,285,291	-0.1%	-0.07	-0.30	-0.30	-1.00	706,770	-0.3%	-0.06	-0.07	-0.07	-0.05	1,397,606	-0.1%	0.00	-0.02	-0.04	-0.02	1,180,915	0.0%
S2: EU acts first, rest follow later	-0.05	-0.80	-1.14	-1.35	3,263,519	-0.8%	-0.06	-0.69	-0.67	-1.29	705,172	-0.6%	-0.07	-0.36	-0.69	-1.43	1,391,948	-0.5%	-0.03	-1.41	-1.83	-1.30	1,166,398	-1.3%
S3: All act later	-0.05	-0.78	-1.34	-1.86	3,258,486	-0.9%	0.00	-0.49	-1.62	-2.56	701,817	-1.0%	-0.08	-0.39	-0.70	-1.47	1,391,700	-0.5%	-0.05	-1.43	-1.87	-1.90	1,164,969	-1.4%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.04	-0.07	-0.04	-0.10	3,286,711	-0.1%	-0.06	-0.20	-0.07	-0.52	707,894	-0.2%	-0.06	-0.06	-0.06	-0.03	1,397,698	0.0%	0.00	-0.02	-0.02	0.01	1,181,119	0.0%
S2: EU acts first, rest follow later	-0.05	-0.78	-0.62	-0.47	3,273,059	-0.5%	-0.04	-0.70	-0.02	-0.34	707,229	-0.3%	-0.07	-0.32	-0.43	-0.99	1,393,887	-0.3%	-0.02	-1.40	-1.12	-0.08	1,171,944	-0.8%
S3: All act later	-0.05	-0.75	-0.78	-0.91	3,270,427	-0.6%	0.01	-0.45	-0.95	-1.61	704,441	-0.7%	-0.08	-0.38	-0.41	-0.99	1,394,069	-0.3%	-0.05	-1.40	-1.07	-0.54	1,171,917	-0.8%

	World						EU27						RANNEXI						NONANNEXI					
Welfare equivalent variation (bill.$'04)					bill.$'04						bill.$'04						bill.$'04						bill.$'04	
	2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50		2020	2030	2040	2050	Cumul. '05-50	
Without technology progress feedback	Welfare equivalent variation (bill.$'04)						Welfare equivalent variation (bill.$'04)						Welfare equivalent variation (bill.$'04)						Welfare equivalent variation (bill.$'04)					
S1: EU acts alone	-6	-15	-21	-28	-575		-5	-12	-15	-15	-410		-1	-1	-3	-7	-91		-1	-1	-3	-6	-75	
S2: EU acts first, rest follow later	-1	-80	-117	-107	-2560		-4	-6	-6	-9	-225		1	-23	-34	-42	-734		2	-51	-76	-55	-1601	
S3: All act later	2	-80	-131	-150	-2936		-1	-8	-15	-29	-434		1	-22	-36	-45	-772		2	-50	-80	-76	-1730	
With technology progress feedback	Welfare equivalent variation (bill.$'04)						Welfare equivalent variation (bill.$'04)						Welfare equivalent variation (bill.$'04)						Welfare equivalent variation (bill.$'04)					
S1: EU acts alone	-6	-10	-8	-6	-271		-4	-7	-4	3	-154		-1	-1	-3	-6	-74		-1	-1	-1	-4	-44	
S2: EU acts first, rest follow later	-1	-72	-62	-4	-1392		-4	0	4	9	64		1	-22	-21	-18	-475		2	-49	-45	5	-980	
S3: All act later	2	-77	-72	-40	-1623		-1	-7	-6	-12	-219		1	-22	-21	-19	-446		2	-48	-46	-10	-959	

	World						EU27						RANNEXI						NONANNEXI					
GDP vol. (avg. % change per annum)																								
	10-20	20-30	30-40	40-50	10-50		10-20	20-30	30-40	40-50	10-50		10-20	20-30	30-40	40-50	10-50		10-20	20-30	30-40	40-50	10-50	
Reference	3.24	2.37	1.97	1.87	2.36		1.92	1.19	1.11	1.22	1.36		2.83	1.95	1.27	1.19	1.81		5.12	3.74	3.23	2.81	3.72	
Without technology progress feedback																								
S1: EU acts alone	3.23	2.36	1.97	1.86	2.35		1.91	1.17	1.11	1.15	1.33		2.82	1.95	1.27	1.19	1.81		5.12	3.74	3.22	2.81	3.72	
S2: EU acts first, rest follow later	3.23	2.29	1.93	1.85	2.32		1.91	1.12	1.12	1.16	1.33		2.82	1.92	1.24	1.11	1.77		5.12	3.60	3.18	2.86	3.69	
S3: All act later	3.23	2.29	1.91	1.81	2.31		1.92	1.14	1.00	1.13	1.29		2.82	1.92	1.24	1.11	1.77		5.12	3.60	3.18	2.80	3.67	
With technology progress feedback																								
S1: EU acts alone	3.23	2.36	1.97	1.86	2.36		1.91	1.17	1.13	1.18	1.35		2.82	1.95	1.27	1.19	1.81		5.12	3.74	3.23	2.81	3.72	
S2: EU acts first, rest follow later	3.23	2.29	1.98	1.88	2.35		1.91	1.12	1.18	1.19	1.35		2.82	1.93	1.26	1.13	1.78		5.12	3.60	3.25	2.91	3.72	
S3: All act later	3.23	2.29	1.96	1.85	2.33		1.92	1.14	1.06	1.15	1.32		2.82	1.92	1.27	1.13	1.78		5.12	3.60	3.26	2.86	3.71	

Private Consumption - Volume (bill. $ 2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	36,098	47,018	59,830	72,678	2,078,404		6,880	8,184	9,576	11,292	361,641		16,847	21,196	26,307	29,233	931,009		12,371	17,637	23,947	32,152	785,753	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.12	-0.23	-0.24	-0.27	2,074,327	-0.2%	-0.39	-0.96	-0.96	-0.97	358,976	-0.7%	-0.08	-0.09	-0.10	-0.15	930,205	-0.1%	-0.03	-0.06	-0.10	-0.15	785,145	-0.1%
S2: EU acts first, rest follow later	-0.03	-1.35	-1.45	-1.28	2,058,254	-1.0%	-0.35	-0.40	-0.15	-0.45	360,612	-0.3%	-0.01	-0.73	-0.64	-0.86	926,784	-0.5%	0.12	-2.53	-2.85	-1.96	770,859	-1.9%
S3: All act later	0.02	-1.35	-1.70	-1.96	2,053,949	-1.2%	-0.04	-0.42	-1.17	-2.10	358,474	-0.9%	-0.03	-0.77	-0.70	-0.98	926,276	-0.5%	0.13	-2.48	-3.01	-2.81	769,200	-2.1%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.12	-0.15	-0.07	-0.02	2,076,725	-0.1%	-0.35	-0.55	-0.06	0.43	361,051	-0.2%	-0.08	-0.09	-0.09	-0.13	930,262	-0.1%	-0.03	-0.04	-0.04	-0.08	785,412	0.0%
S2: EU acts first, rest follow later	-0.02	-1.21	-0.59	0.10	2,069,271	-0.4%	-0.31	0.15	0.73	0.94	362,963	0.4%	-0.01	-0.70	-0.09	0.02	929,568	-0.2%	0.12	-2.45	-1.66	-0.12	776,740	-1.1%
S3: All act later	0.02	-1.30	-0.78	-0.48	2,066,507	-0.6%	-0.03	-0.37	-0.38	-0.85	360,186	-0.4%	-0.03	-0.73	-0.08	0.00	929,865	-0.1%	0.13	-2.43	-1.70	-0.79	776,456	-1.2%

Total Investment - Volume (bill. $ 2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	14,124	16,714	17,853	20,999	687,991		3,807	4,084	4,342	4,662	175,123		6,200	6,766	5,430	6,485	257,569		4,118	5,864	8,081	9,852	255,299	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.13	0.23	0.40	0.07	689,320	0.2%	0.56	1.12	1.90	0.88	176,783	0.9%	-0.04	-0.06	-0.11	-0.16	257,405	-0.1%	-0.02	-0.05	-0.06	-0.16	255,133	-0.1%
S2: EU acts first, rest follow later	-0.14	1.19	0.85	-0.86	690,031	0.3%	0.59	1.41	2.37	0.80	177,076	1.1%	-0.24	1.69	1.74	-0.38	259,353	0.7%	-0.67	0.47	-0.57	-1.95	253,602	-0.7%
S3: All act later	-0.28	1.30	0.64	-1.20	689,291	0.2%	0.08	1.71	1.63	-0.21	176,330	0.7%	-0.24	1.64	1.68	-0.48	259,252	0.7%	-0.67	0.61	-0.59	-2.15	253,710	-0.6%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.12	0.22	0.36	0.02	689,171	0.2%	0.56	1.08	1.80	0.72	176,686	0.9%	-0.04	-0.07	-0.16	-0.20	257,346	-0.1%	-0.02	-0.04	-0.05	-0.16	255,139	-0.1%
S2: EU acts first, rest follow later	-0.14	1.15	0.78	-0.74	689,991	0.3%	0.59	1.45	2.25	0.63	177,018	1.1%	-0.24	1.61	1.49	-0.58	259,089	0.6%	-0.67	0.42	-0.48	-1.49	253,885	-0.6%
S3: All act later	-0.28	1.28	0.57	-1.06	689,220	0.2%	0.08	1.70	1.40	-0.42	176,153	0.6%	-0.24	1.63	1.42	-0.68	258,992	0.6%	-0.67	0.60	-0.45	-1.61	254,076	-0.5%

Exports - Volume (bill. $ 2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	-	-	-	-	-		2,327	2,571	2,824	3,061	113,518		2,783	3,226	3,653	4,083	139,606		2,694	3,473	4,248	4,994	148,818	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone					-		-0.31	-0.56	-0.54	-1.22	112,982	-0.5%	-0.31	-0.33	-0.37	0.03	139,277	-0.2%	-0.12	-0.08	0.14	0.68	148,979	0.1%
S2: EU acts first, rest follow later					-		-0.32	-2.90	-2.36	-2.95	111,565	-1.7%	-0.35	0.12	1.45	-0.97	140,129	0.4%	-0.07	1.75	5.37	7.51	153,534	3.2%
S3: All act later					-		-0.05	-2.13	-4.08	-4.26	110,873	-2.3%	-0.34	-0.03	1.54	-1.09	140,128	0.4%	-0.24	1.21	5.32	6.55	153,090	2.9%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone					-		-0.32	-1.16	-2.02	-3.35	112,044	-1.3%	-0.29	-0.11	0.04	0.53	139,617	0.0%	-0.12	0.07	0.51	1.15	149,321	0.3%
S2: EU acts first, rest follow later					-		-0.33	-3.69	-1.17	-1.50	111,776	-1.5%	-0.34	0.87	1.50	-0.87	140,527	0.7%	-0.06	2.20	5.51	8.00	154,070	3.5%
S3: All act later					-		-0.05	-2.03	-2.58	-2.48	111,742	-1.6%	-0.34	-0.06	1.36	-1.12	140,029	0.3%	-0.24	1.18	5.28	6.99	153,179	2.9%

Imports - Volume (bill. $ 2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	-	-	-	-	-		1,965	2,335	2,726	3,146	101,566		3,136	3,653	4,184	4,657	158,355		3,019	3,647	4,241	4,813	158,073	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone					-		-0.22	-0.36	-0.01	1.66	101,670	0.1%	-0.25	-0.30	-0.44	-0.72	157,827	-0.3%	-0.25	-0.27	-0.11	-0.38	157,785	-0.2%
S2: EU acts first, rest follow later					-		-0.16	2.20	3.96	3.70	103,719	2.1%	-0.23	-0.25	1.94	2.46	159,603	0.8%	-0.31	-1.38	0.88	0.51	158,160	0.1%
S3: All act later					-		-0.13	2.05	3.78	3.31	103,533	1.9%	-0.26	-0.37	1.62	1.71	159,193	0.5%	-0.24	-1.29	0.21	-0.53	157,602	-0.3%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone					-		-0.21	-0.07	0.60	2.42	102,037	0.5%	-0.26	-0.44	-0.71	-1.05	157,577	-0.5%	-0.24	-0.40	-0.49	-1.00	157,410	-0.4%
S2: EU acts first, rest follow later					-		-0.14	3.64	3.93	3.83	104,319	2.7%	-0.23	-0.40	2.43	3.19	159,921	1.0%	-0.31	-1.60	1.41	1.25	158,410	0.2%
S3: All act later					-		-0.13	2.01	3.29	3.00	103,302	1.7%	-0.26	-0.36	2.14	2.63	159,725	0.9%	-0.24	-1.27	0.81	0.36	158,161	0.1%

Terms of trade	World					EU27				rannexi				nonannexi			
	2020	2030	2040	2050	bill.$'04	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Reference	1	1	1	1		0.96	0.99	1.02	1.04	0.94	0.95	0.96	0.98	0.94	0.92	0.89	0.86
Without technology progress feedback	% changes from Reference					% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.01	0.07	0.18	0.26		0.26	0.82	1.89	4.50	0.03	0.01	-0.09	-0.55	-0.14	-0.18	-0.23	-0.65
S2: EU acts first, rest follow later	0.00	0.79	1.78	2.33		0.36	5.93	7.91	8.56	0.05	0.78	2.27	5.10	-0.23	-1.51	-0.88	-1.13
S3: All act later	0.00	1.00	1.90	2.32		0.08	4.92	9.24	9.35	0.04	1.19	2.23	4.80	-0.09	-0.98	-1.05	-1.30
With technology progress feedback	% changes from Reference					% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.01	0.08	0.17	0.12		0.28	1.43	3.34	6.37	0.02	-0.15	-0.42	-1.05	-0.14	-0.29	-0.56	-1.20
S2: EU acts first, rest follow later	0.00	0.84	1.09	1.19		0.38	7.92	6.13	6.15	0.04	0.27	1.73	4.10	-0.23	-1.83	-1.28	-1.89
S3: All act later	0.00	0.96	1.11	1.09		0.08	4.75	6.67	6.18	0.04	1.16	1.74	3.87	-0.09	-0.99	-1.39	-2.04

Employment (mill. persons)	World				EU27				RANNEXI				NONANNEXI			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Reference	3,365	3,816	4,080	4,247	223	213	196	179	375	378	371	358	2,768	3,226	3,514	3,710
Without technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.01	0.03	0.04	0.04	0.09	0.27	0.46	0.27	-0.03	-0.02	0.00	0.01	0.01	0.02	0.02	0.03
S2: EU acts first, rest follow later	0.01	0.35	0.58	0.24	0.10	0.35	0.56	0.37	-0.04	0.31	0.55	0.05	0.00	0.36	0.59	0.25
S3: All act later	-0.01	0.26	0.51	0.00	0.20	0.58	0.20	0.16	-0.06	0.26	0.56	0.03	-0.02	0.24	0.52	-0.01
With technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.01	0.02	0.03	0.03	0.10	0.26	0.43	0.23	-0.03	-0.03	-0.02	-0.01	0.01	0.01	0.01	0.02
S2: EU acts first, rest follow later	0.01	0.34	0.55	0.19	0.10	0.36	0.52	0.31	-0.04	0.29	0.53	0.03	0.00	0.34	0.55	0.20
S3: All act later	-0.01	0.26	0.48	-0.05	0.20	0.58	0.14	0.08	-0.06	0.26	0.54	0.01	-0.02	0.24	0.49	-0.06

Real Wage ($/manhour)	World				EU27				RANNEXI				NONANNEXI			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Reference	5.2	6.5	8.0	9.8	15.1	20.5	28.2	37.8	25.5	34.7	43.2	51.7	1.7	2.3	3.2	4.4
Without technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.00	-0.15	0.12	-0.10	0.00	0.00	0.81	-0.21	-0.20	-0.20	-0.19	-0.17	0.00	0.00	0.00	0.00
S2: EU acts first, rest follow later	0.00	-0.15	0.50	-0.10	0.07	0.58	1.84	0.48	-0.16	-0.29	0.32	-0.44	0.60	-0.86	-0.32	0.00
S3: All act later	0.00	-0.31	-0.25	-1.33	0.20	0.58	-1.03	-2.20	-0.20	-0.37	0.28	-0.60	0.60	-1.29	-0.63	-1.83
With technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.00	0.00	0.25	0.10	0.07	0.34	1.59	1.06	-0.20	-0.20	-0.19	-0.19	0.00	0.00	0.00	0.00
S2: EU acts first, rest follow later	0.00	-0.15	1.25	1.22	0.07	1.07	2.66	1.77	-0.16	-0.29	0.86	0.44	0.60	-0.86	0.95	1.83
S3: All act later	0.00	-0.31	0.62	0.10	0.20	0.63	-0.35	-1.06	-0.20	-0.35	0.86	0.39	0.60	-1.29	0.63	0.23

Consumer Price Index (2004=100)	World				EU27				RANNEXI				NONANNEXI			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Reference	107.3	98.5	97.5	98.3	106.0	101.2	102.5	105.4	105.5	99.5	101.6	101.5	111.2	96.9	92.0	93.3
Without technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.12	0.06	-0.15	0.16	-0.09	-0.23	-0.41	-0.93	0.12	0.10	-0.14	0.27	0.24	0.21	0.02	0.56
S2: EU acts first, rest follow later	0.09	-0.19	-0.64	1.15	-0.12	0.51	0.02	2.44	0.11	0.28	0.17	1.91	0.19	-1.16	-2.07	-0.20
S3: All act later	0.06	-0.11	0.19	2.57	-0.19	0.37	0.35	3.21	0.06	0.20	1.01	3.30	0.20	-0.76	-0.95	1.56
With technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.11	0.02	-0.25	0.01	-0.09	-0.24	-0.44	-1.03	0.11	0.03	-0.29	0.05	0.24	0.16	-0.10	0.37
S2: EU acts first, rest follow later	0.08	-0.28	-1.26	0.08	-0.13	0.83	-0.73	1.14	0.10	0.05	-0.41	0.88	0.18	-1.31	-2.63	-1.19
S3: All act later	0.06	-0.13	-0.46	1.40	-0.20	0.33	-0.59	1.65	0.06	0.17	0.43	2.23	0.20	-0.77	-1.53	0.51

GDP Deflator Index (2004=100)	World				EU27				RANNEXI				NONANNEXI			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Reference	1.13	1.04	1.04	1.07	1.13	1.10	1.13	1.16	1.14	1.06	1.09	1.12	1.12	1.00	0.95	0.97
Without technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	-0.03	-0.06	-0.36	-0.23	0.15	0.42	1.28	0.12	-0.25	-0.34	-0.88	-0.82	0.27	0.27	0.11	0.71
S2: EU acts first, rest follow later	-0.03	0.27	0.33	-0.10	0.17	2.20	3.03	4.23	-0.29	-0.36	-0.68	-1.98	0.31	0.80	1.35	1.97
S3: All act later	-0.04	0.30	0.83	0.65	0.31	2.24	1.11	3.47	-0.26	-0.19	0.09	-0.71	0.23	0.60	2.05	2.23
With technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	-0.03	-0.11	-0.44	-0.33	0.15	0.57	1.64	0.56	-0.26	-0.40	-0.99	-0.96	0.27	0.19	-0.05	0.51
S2: EU acts first, rest follow later	-0.04	0.14	-0.05	-0.75	0.17	2.91	2.22	2.99	-0.30	-0.57	-1.00	-2.54	0.31	0.60	0.98	1.35
S3: All act later	-0.04	0.28	0.44	-0.04	0.31	2.18	0.01	1.89	-0.26	-0.21	-0.21	-1.27	0.23	0.59	1.68	1.59

Interest rates	World				EU27				RANNEXI				NONANNEXI			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Reference	4.7%	4.7%	4.6%	4.7%	5.1%	4.8%	4.6%	4.4%	4.0%	4.1%	4.0%	4.1%	5.3%	5.3%	5.3%	5.3%
Without technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.13	0.09	0.06	0.04	0.34	0.56	0.67	0.59	0.02	-0.12	-0.22	-0.34	0.00	0.02	0.02	0.04
S2: EU acts first, rest follow later	0.06	0.77	-0.06	-0.41	0.34	0.54	0.61	0.50	-0.05	0.17	-0.82	-2.13	-0.09	1.80	0.75	0.96
S3: All act later	0.11	0.94	-0.04	-0.43	0.49	1.65	0.82	0.78	-0.02	0.22	-0.82	-2.13	-0.13	1.48	0.73	0.90
With technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.13	0.06	0.00	-0.06	0.34	0.43	0.43	0.30	0.02	-0.12	-0.25	-0.36	0.00	0.00	-0.06	-0.06
S2: EU acts first, rest follow later	0.06	0.73	-0.22	-0.58	0.34	0.39	0.39	0.23	-0.05	0.15	-0.85	-2.16	-0.09	1.73	0.45	0.66
S3: All act later	0.11	0.94	-0.19	-0.60	0.49	1.63	0.58	0.50	-0.02	0.22	-0.87	-2.16	-0.13	1.46	0.43	0.60

Unemployment rates	World				EU27				RANNEXI				NONANNEXI			
	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
Reference	3.5%	2.7%	2.5%	2.3%	10.1%	3.9%	2.8%	2.6%	2.8%	2.6%	2.5%	2.5%	3.0%	2.7%	2.5%	2.3%
Without technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.06	0.07	0.00	0.00	0.28	0.41	-0.14	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S2: EU acts first, rest follow later	-0.06	1.57	0.56	-0.13	0.15	-0.81	-0.64	-0.12	0.00	0.04	0.00	0.00	-0.13	2.07	0.69	-0.13
S3: All act later	-0.25	1.50	0.68	0.17	-0.92	-1.55	0.18	0.19	0.04	0.04	0.04	0.00	-0.10	2.03	0.77	0.17
With technology progress feedback	% changes from Reference				% changes from Reference				% changes from Reference				% changes from Reference			
S1: EU acts alone	0.06	0.00	-0.04	-0.04	0.19	-0.23	-0.53	-0.19	0.04	0.00	0.00	0.00	0.00	0.00	-0.04	0.00
S2: EU acts first, rest follow later	-0.06	1.46	0.16	-0.43	0.06	-1.73	-1.03	-0.31	0.00	0.04	-0.04	-0.04	-0.13	2.03	0.24	-0.48
S3: All act later	-0.25	1.50	0.20	-0.17	-0.92	-1.60	-0.14	0.00	0.04	0.04	0.00	-0.04	-0.10	2.03	0.24	-0.22

Domestic Production (in bill.$'2004)

Agriculture (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	3,550.2	4,616.6	4,799.4	7,299.3	204,985		562.6	575.2	484.0	587.1	25,085		866.1	1,008.4	889.9	1,164.6	42,757		2,121.5	3,033.0	3,425.5	5,547.7	137,143	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.02	-0.02	0.03	-0.18	204,950	0.0%	0.10	-0.53	-1.00	-8.62	24,757	-1.3%	-0.47	-0.46	-0.14	0.86	42,714	-0.1%	0.20	0.22	0.21	0.50	137,480	0.2%
S2: EU acts first, rest follow later	0.05	0.02	-1.56	-6.72	201,857	-1.5%	0.10	-1.46	-2.19	-2.77	24,771	-1.3%	-0.43	0.45	2.17	-13.16	42,763	0.0%	0.23	0.16	-2.45	-5.79	134,323	-2.1%
S3: All act later	0.11	-0.23	-2.19	-7.85	200,968	-2.0%	0.74	-0.09	-9.00	-7.78	24,164	-3.7%	-0.53	-0.19	2.81	-12.27	42,862	0.2%	0.20	-0.27	-2.59	-6.93	133,941	-2.3%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.02	0.00	0.09	-0.09	205,034	0.0%	0.07	-0.60	-1.23	-9.06	24,724	-1.4%	-0.47	-0.40	-0.04	1.01	42,740	0.0%	0.20	0.25	0.30	0.63	137,570	0.3%
S2: EU acts first, rest follow later	0.04	0.08	-1.19	-6.24	202,264	-1.3%	0.08	-1.80	-1.86	-2.21	24,770	-1.3%	-0.43	0.64	2.61	-12.61	42,883	0.3%	0.22	0.25	-2.10	-5.32	134,611	-1.8%
S3: All act later	0.11	-0.21	-1.74	-7.29	201,475	-1.7%	0.74	-0.07	-8.57	-7.06	24,216	-3.5%	-0.53	-0.18	3.35	-11.68	42,980	0.5%	0.20	-0.25	-2.16	-6.39	134,279	-2.1%

Coal (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	214.9	245.6	279.1	309.1	10,775		13.1	12.3	21.2	24.7	735		81.5	88.8	89.2	89.4	3,751		120.3	144.5	168.6	194.9	6,288	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-2.85	-3.07	-6.52	-4.31	10,394	-3.5%	-14.92	-22.67	-41.07	-25.91	569	-22.7%	-4.41	-4.27	-6.00	-4.34	3,611	-3.7%	-0.48	-0.66	-2.44	-1.55	6,215	-1.2%
S2: EU acts first, rest follow later	-2.88	1.06	8.08	4.31	11,148	3.5%	-15.17	-19.61	-40.49	-28.26	577	-21.6%	-4.50	8.05	27.63	23.02	4,201	12.0%	-0.45	-1.47	3.86	-0.15	6,371	1.3%
S3: All act later	-1.23	3.58	8.03	3.79	11,214	4.1%	-0.20	3.69	-44.49	-30.08	600	-18.4%	-3.14	9.68	27.94	23.35	4,226	12.6%	-0.05	-0.18	4.12	-0.89	6,388	1.6%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-2.87	-3.26	-6.99	-5.41	10,359	-3.9%	-15.06	-24.42	-44.02	-32.87	551	-25.1%	-4.43	-4.40	-6.31	-4.95	3,604	-3.9%	-0.48	-0.76	-2.67	-2.14	6,203	-1.3%
S2: EU acts first, rest follow later	-2.90	0.69	2.78	-5.05	10,837	0.6%	-15.31	-21.59	-44.07	-36.58	554	-24.7%	-4.52	7.74	20.94	11.67	4,086	8.9%	-0.45	-1.75	-0.92	-8.71	6,197	-1.4%
S3: All act later	-1.23	3.36	2.24	-6.33	10,843	0.6%	-0.21	3.30	-48.04	-38.33	580	-21.2%	-3.14	9.42	20.60	10.87	4,084	8.9%	-0.05	-0.36	-1.14	-10.16	6,180	-1.7%

Oil (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	2,546.9	2,792.0	3,026.3	3,304.0	123,528		281.1	241.5	226.1	225.0	11,523		723.7	649.6	618.1	566.7	30,236		1,542.0	1,900.9	2,182.1	2,512.3	81,769	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.95	-1.79	-3.98	-5.13	120,750	-2.2%	-4.42	-12.45	-32.22	-50.42	9,801	-14.9%	-0.93	-1.58	-3.82	-5.26	29,689	-1.8%	-0.33	-0.51	-1.10	-1.04	81,259	-0.6%
S2: EU acts first, rest follow later	-0.44	-13.82	-41.55	-65.81	96,739	-21.7%	-3.88	-12.69	-36.64	-59.33	9,622	-16.5%	-0.39	-15.18	-42.59	-68.29	24,853	-17.8%	0.16	-13.50	-41.76	-65.83	62,264	-23.9%
S3: All act later	-0.75	-12.23	-38.84	-60.92	98,482	-20.3%	-3.24	-8.01	-43.34	-63.72	9,421	-18.2%	-0.84	-15.59	-42.08	-67.26	24,839	-17.8%	-0.26	-11.62	-37.46	-59.24	64,222	-21.5%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.95	-1.79	-3.98	-5.14	120,748	-2.3%	-4.43	-12.46	-32.37	-50.69	9,794	-15.0%	-0.92	-1.60	-3.89	-5.38	29,680	-1.8%	-0.33	-0.50	-1.07	-1.01	81,275	-0.6%
S2: EU acts first, rest follow later	-0.44	-13.80	-41.40	-65.75	96,791	-21.6%	-3.88	-12.87	-36.65	-59.46	9,612	-16.6%	-0.39	-15.19	-42.63	-68.52	24,839	-17.8%	0.17	-13.44	-41.55	-65.69	62,340	-23.8%
S3: All act later	-0.75	-12.22	-38.65	-60.84	98,561	-20.2%	-3.24	-8.00	-43.29	-63.78	9,422	-18.2%	-0.84	-15.59	-42.12	-67.50	24,828	-17.9%	-0.26	-11.60	-37.19	-59.07	64,311	-21.4%

Biofuels (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	79.0	93.7	110.1	126.6	4,183		7.1	7.1	7.1	7.4	327		33.2	36.8	38.7	37.4	1,595		38.7	49.8	64.4	81.8	2,261	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	12.22	11.50	12.33	17.30	4,682	11.9%	113.04	111.72	124.37	158.08	667	103.8%	2.07	2.53	2.19	1.82	1,630	2.2%	2.33	3.82	6.08	11.66	2,385	5.5%
S2: EU acts first, rest follow later	12.31	264.05	202.74	187.37	10,149	142.6%	112.93	110.71	118.77	151.84	659	101.4%	2.11	186.17	109.17	39.78	2,810	76.1%	2.49	343.60	268.23	258.05	6,681	195.5%
S3: All act later	12.39	185.16	133.86	130.54	8,342	99.4%	114.47	127.22	137.26	164.84	694	112.2%	2.11	134.31	73.16	32.34	2,479	55.4%	2.38	231.08	169.96	172.34	5,168	128.6%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	12.39	11.67	12.52	17.46	4,688	12.1%	115.54	116.57	131.35	173.13	684	108.9%	1.99	2.36	2.02	1.56	1,627	2.0%	2.28	3.58	5.73	10.68	2,377	5.1%
S2: EU acts first, rest follow later	12.48	264.87	206.47	191.36	10,226	144.5%	115.42	115.17	124.94	165.71	675	106.2%	2.04	186.86	113.14	42.91	2,833	77.6%	2.44	344.00	271.55	261.55	6,718	197.2%
S3: All act later	12.41	185.55	136.94	134.95	8,420	101.3%	114.58	127.99	143.95	179.58	707	116.2%	2.12	134.65	76.16	35.49	2,504	57.0%	2.39	231.45	172.70	176.38	5,208	130.4%

Gas (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	464.5	562.6	698.1	851.3	25,479		29.3	27.6	27.5	29.7	1,301		241.0	255.1	262.9	267.6	11,176		194.1	280.0	407.7	554.1	13,002	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-1.20	-1.98	-1.77	-2.64	25,081	-1.6%	-4.51	-13.95	-14.80	-33.77	1,159	-10.9%	-1.28	-1.96	-1.01	-1.39	11,050	-1.1%	-0.62	-0.83	-1.38	-1.57	12,872	-1.0%
S2: EU acts first, rest follow later	-1.22	3.54	11.56	-7.57	26,484	3.9%	-4.69	-14.92	-6.15	-25.99	1,188	-8.7%	-1.51	-1.29	-1.55	-26.99	10,851	-2.9%	-0.34	9.76	21.21	2.80	14,444	11.1%
S3: All act later	-0.79	5.48	11.18	-7.63	26,522	4.1%	-1.07	-0.40	-18.90	-30.52	1,162	-10.7%	-1.04	-0.40	-1.88	-27.28	10,854	-2.9%	-0.43	11.41	21.63	3.08	14,505	11.6%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-1.21	-2.00	-1.94	-2.95	25,055	-1.7%	-4.53	-14.04	-16.65	-37.44	1,148	-11.8%	-1.28	-1.98	-1.16	-1.70	11,042	-1.2%	-0.62	-0.82	-1.44	-1.70	12,865	-1.0%
S2: EU acts first, rest follow later	-1.22	3.50	7.14	-14.76	25,855	1.5%	-4.71	-15.02	-9.32	-31.80	1,170	-10.1%	-1.51	-1.33	-4.67	-31.77	10,700	-4.3%	-0.35	9.72	15.86	-5.64	13,986	7.6%
S3: All act later	-0.79	5.43	6.33	-15.50	25,789	1.2%	-1.07	-0.45	-22.17	-36.42	1,144	-12.1%	-1.04	-0.44	-5.28	-32.44	10,679	-4.5%	-0.43	11.35	15.74	-6.20	13,966	7.4%

Electricity Supply (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	1,930.4	2,333.7	2,765.2	3,209.4	102,277		366.0	389.0	413.2	446.2	17,399		769.8	865.6	952.2	991.3	37,591		794.6	1,079.1	1,399.8	1,771.9	47,286	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.43	-0.06	0.81	0.79	102,520	0.2%	-0.29	1.21	6.71	5.92	17,819	2.4%	-1.01	-0.81	-0.67	-0.44	37,372	-0.6%	0.07	0.09	0.07	0.19	47,329	0.1%
S2: EU acts first, rest follow later	-0.41	0.65	3.38	-0.94	102,903	0.6%	-0.33	1.56	7.53	6.85	17,889	2.8%	-1.01	4.78	6.75	4.15	38,746	3.1%	0.14	-2.99	-0.15	-5.76	46,268	-2.2%
S3: All act later	-0.26	1.14	3.62	-0.98	103,087	0.8%	0.72	4.57	7.94	6.67	18,022	3.6%	-1.04	4.69	6.93	4.25	38,766	3.1%	0.05	-2.94	0.10	-5.84	46,298	-2.1%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.41	0.10	1.14	1.35	102,743	0.5%	-0.23	1.93	8.28	8.64	17,977	3.3%	-1.00	-0.76	-0.57	-0.27	37,395	-0.5%	0.08	0.13	0.20	0.41	47,371	0.2%
S2: EU acts first, rest follow later	-0.40	0.86	5.53	2.78	104,168	1.8%	-0.27	2.28	9.15	9.74	18,060	3.8%	-1.01	4.89	8.33	6.88	39,048	3.9%	0.14	-2.89	2.56	-1.27	47,060	-0.5%
S3: All act later	-0.25	1.23	5.99	3.05	104,561	2.2%	0.73	4.67	9.48	9.42	18,166	4.4%	-1.03	4.76	8.69	7.26	39,136	4.1%	0.05	-2.85	3.11	-0.90	47,260	-0.1%

Ferrous and non ferrous metals (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	4,064.0	4,626.4	4,973.1	5,539.5	196,756		1,182.4	1,251.6	1,235.0	1,239.2	52,635		1,299.4	1,325.4	1,234.0	1,260.4	56,631		1,582.2	2,049.4	2,504.0	3,039.9	87,491	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.01	0.24	0.52	0.35	197,235	0.2%	0.14	0.51	1.24	0.32	52,881	0.5%	-0.55	-0.30	-0.11	0.34	56,544	-0.2%	0.38	0.43	0.47	0.36	87,810	0.4%
S2: EU acts first, rest follow later	-0.09	1.46	2.87	0.13	198,811	1.0%	0.12	1.49	3.27	2.71	53,432	1.5%	-0.69	2.43	5.64	4.05	57,891	2.2%	0.26	0.81	1.31	-2.56	87,488	0.0%
S3: All act later	-0.15	1.45	2.57	-0.28	198,436	0.9%	0.22	2.09	1.42	1.40	53,048	0.8%	-0.72	2.44	5.88	4.53	57,961	2.3%	0.03	0.42	1.51	-2.97	87,426	-0.1%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.01	0.12	0.26	0.02	196,956	0.1%	0.15	0.39	0.92	-0.13	52,798	0.3%	-0.55	-0.40	-0.37	-0.06	56,471	-0.3%	0.37	0.30	0.25	0.11	87,687	0.2%
S2: EU acts first, rest follow later	-0.09	1.24	2.70	0.11	198,607	0.9%	0.13	1.33	2.36	1.23	53,199	1.1%	-0.70	2.18	4.48	2.14	57,593	1.7%	0.26	0.58	1.99	-1.18	87,815	0.4%
S3: All act later	-0.15	1.40	2.32	-0.26	198,253	0.8%	0.22	2.04	0.45	-0.12	52,809	0.3%	-0.72	2.35	4.46	2.49	57,605	1.7%	0.03	0.39	2.18	-1.45	87,839	0.4%

Chemical Products (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	5,012.1	6,023.2	7,029.9	8,024.3	262,074		1,479.5	1,605.6	2,002.1	2,370.0	77,683		1,560.4	1,617.4	1,559.2	1,497.4	67,731		1,972.1	2,800.3	3,468.6	4,156.9	116,660	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.07	-0.01	0.15	-0.13	262,069	0.0%	-0.17	-0.33	1.08	-1.95	77,462	-0.3%	-0.41	-0.22	-0.47	0.78	67,668	-0.1%	0.27	0.29	-0.10	0.58	116,939	0.2%
S2: EU acts first, rest follow later	-0.04	-0.11	0.62	-0.52	262,113	0.0%	-0.16	-0.71	0.25	-0.90	77,448	-0.3%	-0.47	-0.40	-1.22	-2.58	67,394	-0.5%	0.38	0.40	1.65	0.44	117,271	0.5%
S3: All act later	-0.05	-0.16	0.27	-1.14	261,480	-0.2%	0.20	0.01	-3.97	-4.34	75,981	-2.2%	-0.50	-0.25	0.25	-0.40	67,891	0.2%	0.13	-0.21	2.72	0.41	117,608	0.8%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.07	0.00	0.16	-0.13	262,081	0.0%	-0.17	-0.45	0.72	-2.49	77,297	-0.5%	-0.40	-0.13	-0.23	1.12	67,749	0.0%	0.27	0.33	0.01	0.76	117,035	0.3%
S2: EU acts first, rest follow later	-0.04	-0.08	0.89	-0.04	262,515	0.2%	-0.15	-1.21	0.17	-1.05	77,248	-0.6%	-0.47	-0.09	-1.50	-2.93	67,404	-0.5%	0.38	0.57	2.39	1.58	117,863	1.0%
S3: All act later	-0.05	-0.16	0.56	-0.62	261,938	-0.1%	0.20	0.02	-3.90	-4.25	76,012	-2.2%	-0.50	-0.27	-0.17	-0.90	67,766	0.1%	0.13	-0.19	3.47	1.56	118,160	1.3%

Other energy intensive (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	3,470.2	4,046.3	4,480.2	5,095.9	174,324		1,126.7	1,271.0	1,332.1	1,502.2	54,701		1,312.1	1,345.3	1,245.5	1,173.3	55,972		1,031.4	1,430.0	1,902.7	2,420.4	63,651	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.15	-0.12	0.02	-0.60	174,072	-0.1%	-0.43	-0.86	-0.97	-8.25	53,803	-1.6%	-0.20	0.01	0.29	2.45	56,132	0.3%	0.22	0.41	0.53	2.66	64,138	0.8%
S2: EU acts first, rest follow later	-0.20	-0.63	-0.58	-3.63	172,776	-0.9%	-0.44	-0.97	-0.44	-3.41	54,164	-1.0%	-0.25	0.26	1.98	8.17	56,759	1.4%	0.14	-1.16	-2.35	-9.49	61,852	-2.8%
S3: All act later	-0.12	-0.44	-1.25	-3.98	172,350	-1.1%	0.09	0.20	-6.91	-7.69	52,818	-3.4%	-0.37	-0.03	3.73	11.18	57,186	2.2%	-0.04	-1.41	-0.56	-9.02	62,346	-2.1%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.14	-0.09	0.07	-0.52	174,135	-0.1%	-0.42	-0.79	-0.90	-8.20	53,825	-1.6%	-0.19	0.03	0.34	2.53	56,147	0.3%	0.22	0.43	0.58	2.76	64,164	0.8%
S2: EU acts first, rest follow later	-0.19	-0.58	-0.27	-3.09	173,067	-0.7%	-0.43	-1.02	-0.22	-3.01	54,207	-0.9%	-0.25	0.36	2.03	8.56	56,810	1.5%	0.14	-1.08	-1.81	-8.79	62,050	-2.5%
S3: All act later	-0.12	-0.44	-0.94	-3.39	172,658	-1.0%	0.09	0.22	-6.70	-7.24	52,887	-3.3%	-0.37	-0.03	3.79	11.61	57,218	2.2%	-0.04	-1.40	0.01	-8.27	62,554	-1.7%

Electric Goods (vol. $'2004)	World						EU27						RANNEXI						NONANNEXI					
	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	3,623.2	4,392.5	4,942.2	5,975.8	186,752		878.8	1,066.4	1,020.8	992.4	39,471		1,478.1	1,573.7	1,697.7	1,710.5	71,516		1,266.3	1,752.3	2,223.7	3,272.9	75,765	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.01	0.18	0.33	0.51	187,127	0.2%	0.15	0.30	-0.80	-6.20	39,165	-0.8%	-0.30	-0.29	-0.05	1.11	71,494	0.0%	0.27	0.52	1.15	2.22	76,468	0.9%
S2: EU acts first, rest follow later	-0.07	-0.24	1.61	1.69	188,009	0.7%	0.14	-1.73	-1.91	-0.95	38,983	-1.2%	-0.40	-0.29	1.18	-13.95	70,868	-0.9%	0.18	0.70	3.54	10.66	78,158	3.2%
S3: All act later	-0.11	-0.33	1.65	2.14	188,086	0.7%	0.10	-1.63	-4.57	-3.01	38,513	-2.4%	-0.38	-0.37	1.74	-13.92	71,005	-0.7%	0.05	0.49	4.44	12.10	78,568	3.7%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.01	0.17	0.33	0.49	187,116	0.2%	0.13	-0.30	-2.31	-8.39	38,823	-1.6%	-0.28	-0.07	0.42	1.59	71,666	0.2%	0.28	0.67	1.47	2.61	76,627	1.1%
S2: EU acts first, rest follow later	-0.07	-0.30	1.84	2.22	188,248	0.8%	0.12	-3.49	-1.72	-0.93	38,699	-2.0%	-0.39	0.33	1.30	-14.06	71,049	-0.7%	0.18	1.07	3.89	11.68	78,500	3.6%
S3: All act later	-0.11	-0.34	1.89	2.76	188,406	0.9%	0.10	-1.59	-3.87	-2.25	38,645	-2.1%	-0.38	-0.39	1.64	-14.19	70,961	-0.8%	0.05	0.47	4.73	13.14	78,800	4.0%

	World						EU27						RANNEXI						NONANNEXI					
Transport equipment (vol. $'2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	3,973.8	4,823.1	5,588.7	6,390.8	206,103		1,242.0	1,511.1	1,819.7	1,921.5	65,668		1,760.6	1,907.7	2,057.1	2,223.2	81,736		971.2	1,404.3	1,711.9	2,246.2	58,699	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.14	-0.81	-1.62	-0.79	204,445	-0.8%	-0.20	-2.13	-4.83	-1.84	64,206	-2.2%	-0.06	-0.18	-0.53	-1.00	81,465	-0.3%	-0.21	-0.25	0.47	0.32	58,774	0.1%
S2: EU acts first, rest follow later	-0.13	-0.05	4.97	7.35	210,897	2.3%	-0.14	0.29	-0.58	-1.14	65,344	-0.5%	-0.05	-3.49	-0.88	-1.64	80,526	-1.5%	-0.25	4.27	17.89	23.50	65,027	10.8%
S3: All act later	-0.18	-0.71	4.58	7.20	210,122	1.9%	-0.11	-0.18	0.74	0.70	65,665	0.0%	-0.10	-3.75	-1.93	-3.11	80,015	-2.1%	-0.43	2.83	16.47	22.97	64,442	9.8%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.13	-0.73	-1.30	-0.14	204,895	-0.6%	-0.17	-1.60	-3.05	2.49	65,068	-0.9%	-0.06	-0.25	-0.70	-1.48	81,361	-0.5%	-0.22	-0.46	-0.16	-1.07	58,466	-0.4%
S2: EU acts first, rest follow later	-0.12	0.06	7.15	10.91	213,415	3.5%	-0.10	3.35	2.45	4.08	67,185	2.3%	-0.05	-4.65	0.47	0.31	80,717	-1.2%	-0.26	2.93	20.17	27.25	65,512	11.6%
S3: All act later	-0.18	-0.68	6.44	11.12	212,902	3.3%	-0.11	-0.11	2.93	4.38	66,609	1.4%	-0.10	-3.75	-0.76	-0.43	80,665	-1.3%	-0.42	2.87	18.81	28.31	65,628	11.8%

	World						EU27						RANNEXI						NONANNEXI					
Other Equipment Goods (vol. $'2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	6,469.4	7,834.0	8,866.7	10,185.2	330,300		2,073.7	2,275.2	2,330.1	2,505.1	97,411		2,361.1	2,679.2	2,526.5	2,798.7	106,319		2,034.6	2,879.7	4,010.0	4,881.4	126,570	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.08	0.32	0.69	0.52	331,483	0.4%	0.29	1.06	1.75	3.51	98,597	1.2%	0.11	0.17	0.50	-0.16	106,484	0.2%	-0.17	-0.14	0.19	-0.63	126,403	-0.1%
S2: EU acts first, rest follow later	-0.04	1.54	3.68	1.64	335,707	1.6%	0.26	0.99	1.74	1.07	98,311	0.9%	-0.01	1.83	3.33	2.39	107,722	1.3%	-0.36	1.70	5.03	1.51	129,673	2.5%
S3: All act later	-0.14	1.57	3.56	1.54	335,427	1.6%	-0.08	0.92	3.68	3.03	99,111	1.7%	0.02	1.96	2.39	1.08	107,245	0.9%	-0.41	1.71	4.23	1.04	129,070	2.0%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.08	0.29	0.62	0.43	331,351	0.3%	0.30	1.01	1.64	3.18	98,519	1.1%	0.11	0.18	0.47	-0.10	106,484	0.2%	-0.18	-0.16	0.11	-0.69	126,348	-0.2%
S2: EU acts first, rest follow later	-0.03	1.49	3.66	1.74	335,716	1.6%	0.26	0.72	1.59	0.65	98,159	0.8%	-0.01	1.98	2.90	1.71	107,561	1.2%	-0.36	1.64	5.33	2.32	129,997	2.7%
S3: All act later	-0.14	1.55	3.48	1.66	335,379	1.5%	-0.08	0.92	3.62	2.78	99,067	1.7%	0.02	1.92	1.77	0.22	106,914	0.6%	-0.41	1.69	4.48	1.91	129,398	2.2%

	World						EU27						RANNEXI						NONANNEXI					
Consumer Goods Industries (vol. $'2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	8,546.4	10,500.2	12,764.9	15,223.1	464,328		2,670.9	2,687.7	2,697.5	2,910.3	119,156		2,306.3	2,896.9	3,239.6	3,543.2	121,337		3,569.2	4,915.6	6,827.7	8,769.6	223,835	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.08	-0.06	0.04	-0.17	464,104	0.0%	-0.21	-0.21	0.00	-0.82	118,922	-0.2%	-0.01	0.06	0.36	0.61	121,571	0.2%	-0.02	-0.05	-0.09	-0.28	223,611	-0.1%
S2: EU acts first, rest follow later	-0.06	-0.95	-1.35	-3.90	458,846	-1.2%	-0.19	-0.95	-1.01	-2.06	118,291	-0.7%	0.02	0.01	0.13	-2.54	121,101	-0.2%	0.00	-1.52	-2.19	-5.05	219,455	-2.0%
S3: All act later	0.00	-0.83	-1.57	-4.51	458,187	-1.3%	0.04	-0.67	-2.09	-3.28	117,819	-1.1%	-0.04	-0.20	0.13	-2.62	121,028	-0.3%	-0.01	-1.30	-2.18	-5.68	219,340	-2.0%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.07	-0.01	0.13	-0.05	464,382	0.0%	-0.20	-0.21	-0.06	-0.95	118,887	-0.2%	-0.01	0.13	0.48	0.79	121,665	0.3%	-0.01	0.01	0.05	-0.09	223,829	0.0%
S2: EU acts first, rest follow later	-0.05	-0.88	-0.98	-3.32	459,847	-1.0%	-0.18	-1.17	-0.69	-1.74	118,312	-0.7%	0.03	0.21	0.49	-1.93	121,400	0.1%	0.00	-1.35	-1.80	-4.40	220,134	-1.7%
S3: All act later	0.00	-0.81	-1.15	-3.89	459,296	-1.1%	0.04	-0.64	-1.71	-2.86	118,014	-1.0%	-0.04	-0.19	0.53	-1.99	121,290	0.0%	-0.01	-1.28	-1.73	-5.00	219,992	-1.7%

	World						EU27						RANNEXI						NONANNEXI					
Construction (vol. $'2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	7,636.2	8,989.4	9,515.3	10,996.2	371,121		1,873.0	2,015.9	2,115.0	2,268.3	86,263		3,601.4	3,913.2	3,257.6	3,782.7	152,440		2,161.8	3,060.3	4,142.7	4,945.2	132,419	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.02	0.20	0.29	0.07	371,657	0.1%	0.30	1.17	1.68	1.04	87,041	0.9%	-0.09	-0.11	-0.17	-0.20	152,279	-0.1%	-0.03	-0.05	-0.05	-0.16	132,336	-0.1%
S2: EU acts first, rest follow later	-0.20	-0.18	1.65	0.52	372,837	0.5%	0.30	1.38	2.07	1.05	87,161	1.0%	-0.25	0.19	2.71	0.89	153,627	0.8%	-0.54	-1.67	0.60	-0.01	132,049	-0.3%
S3: All act later	-0.26	-0.32	1.48	0.31	372,404	0.3%	0.06	0.62	1.49	0.63	86,773	0.6%	-0.26	0.15	2.65	0.80	153,574	0.7%	-0.54	-1.55	0.54	-0.21	132,057	-0.3%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	0.02	0.22	0.34	0.14	371,756	0.2%	0.30	1.24	1.84	1.28	87,118	1.0%	-0.09	-0.11	-0.18	-0.19	152,272	-0.1%	-0.03	-0.03	-0.02	-0.12	132,366	0.0%
S2: EU acts first, rest follow later	-0.20	-0.17	1.91	1.03	373,374	0.6%	0.31	1.51	2.26	1.38	87,280	1.2%	-0.25	0.14	2.76	1.05	153,644	0.8%	-0.54	-1.68	1.06	0.85	132,451	0.0%
S3: All act later	-0.26	-0.32	1.76	0.88	373,049	0.5%	0.06	0.62	1.61	0.92	86,837	0.7%	-0.26	0.15	2.73	0.99	153,636	0.8%	-0.54	-1.54	1.08	0.77	132,576	0.1%

	World						EU27						RANNEXI						NONANNEXI					
Transport (vol. $'2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	4,586.1	5,418.6	6,245.0	6,971.0	237,300		1,293.3	1,421.6	1,520.8	1,592.1	62,156		1,767.7	1,947.6	2,125.9	2,173.9	85,216		1,525.1	2,049.4	2,598.3	3,205.0	89,929	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.17	-0.13	0.37	0.71	237,608	0.1%	-0.10	0.03	2.85	5.30	62,959	1.3%	-0.40	-0.39	-0.73	-1.16	84,806	-0.5%	0.02	-0.01	-0.17	-0.30	89,843	-0.1%
S2: EU acts first, rest follow later	-0.05	0.48	4.51	14.47	244,914	3.2%	0.00	0.17	2.24	2.51	62,705	0.9%	-0.31	0.45	1.65	0.90	85,880	0.8%	0.20	0.73	8.17	29.62	96,329	7.1%
S3: All act later	-0.06	0.20	3.08	9.61	242,133	2.0%	0.36	0.56	-2.54	-0.20	61,440	-1.2%	-0.45	0.14	2.44	1.86	86,135	1.1%	0.03	0.02	6.88	19.74	94,557	5.1%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.17	-0.11	0.41	0.76	237,669	0.2%	-0.07	0.11	2.93	5.42	62,996	1.4%	-0.40	-0.38	-0.69	-1.09	84,826	-0.5%	0.02	0.00	-0.16	-0.29	89,848	-0.1%
S2: EU acts first, rest follow later	-0.05	0.52	4.79	15.11	245,311	3.4%	0.03	0.22	2.49	2.91	62,782	1.0%	-0.31	0.49	1.73	1.06	85,926	0.8%	0.20	0.75	8.63	30.69	96,604	7.4%
S3: All act later	-0.06	0.21	3.38	10.21	242,561	2.2%	0.36	0.57	-2.31	0.21	61,517	-1.0%	-0.45	0.14	2.53	2.03	86,176	1.1%	0.03	0.03	7.41	20.73	94,868	5.5%

	World						EU27						RANNEXI						NONANNEXI					
Market Services (vol. $'2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	32,129.8	38,366.6	44,134.8	49,247.5	1,662,264		9,379.8	10,187.0	10,736.0	11,318.5	442,263		15,564.1	17,926.9	19,828.1	21,208.5	774,662		7,185.8	10,252.8	13,570.7	16,720.5	445,339	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.03	-0.02	0.02	-0.04	1,662,052	0.0%	-0.03	0.05	0.17	0.45	442,744	0.1%	-0.02	-0.03	-0.01	-0.09	774,465	0.0%	-0.05	-0.09	-0.06	-0.32	444,843	-0.1%
S2: EU acts first, rest follow later	-0.01	-0.73	-0.71	-0.39	1,655,505	-0.4%	-0.02	0.09	0.32	0.11	442,792	0.1%	0.00	-0.32	-0.27	-0.06	773,421	-0.2%	-0.02	-2.27	-2.15	-1.15	439,292	-1.4%
S3: All act later	0.01	-0.69	-0.79	-0.50	1,654,781	-0.5%	0.04	0.02	0.33	-0.23	442,680	0.1%	0.00	-0.34	-0.40	-0.28	772,821	-0.2%	0.02	-2.01	-2.26	-0.97	439,281	-1.4%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.02	0.01	0.10	0.08	1,662,874	0.0%	-0.02	0.13	0.34	0.76	443,208	0.2%	-0.02	-0.02	0.01	-0.05	774,563	0.0%	-0.05	-0.05	0.03	-0.20	445,103	-0.1%
S2: EU acts first, rest follow later	-0.01	-0.68	-0.33	0.31	1,659,204	-0.2%	-0.01	0.16	0.61	0.58	443,484	0.3%	0.00	-0.29	-0.05	0.34	774,316	0.0%	-0.01	-2.18	-1.48	0.09	441,403	-0.9%
S3: All act later	0.01	-0.67	-0.38	0.25	1,658,941	-0.2%	0.04	0.03	0.59	0.22	443,301	0.2%	0.00	-0.32	-0.14	0.16	773,920	-0.1%	0.02	-1.98	-1.51	0.39	441,720	-0.8%

	World						EU27						RANNEXI						NONANNEXI					
Non Market Services (vol. $'2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	19,752.6	24,918.4	30,341.0	35,659.8	1,083,313		4,637.1	5,250.1	5,869.7	6,674.5	230,354		10,542.0	13,108.7	15,583.2	17,387.6	563,127		4,573.5	6,559.5	8,888.1	11,597.7	289,832	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.04	-0.04	0.00	-0.02	1,083,077	0.0%	-0.09	-0.07	0.11	0.22	230,397	0.0%	-0.02	-0.04	-0.01	-0.06	562,971	0.0%	-0.02	-0.04	-0.04	-0.08	289,710	0.0%
S2: EU acts first, rest follow later	-0.01	-0.43	-0.55	-0.21	1,080,018	-0.3%	-0.08	0.00	0.26	0.19	230,541	0.1%	0.00	-0.10	-0.09	0.25	562,911	0.0%	0.03	-1.46	-1.90	-1.12	286,566	-1.1%
S3: All act later	0.01	-0.38	-0.57	-0.25	1,079,977	-0.3%	0.01	0.00	0.26	-0.01	230,545	0.1%	-0.01	-0.10	-0.16	0.14	562,635	-0.1%	0.05	-1.23	-1.83	-0.97	286,797	-1.0%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.04	-0.02	0.04	0.03	1,083,341	0.0%	-0.08	0.02	0.23	0.36	230,568	0.1%	-0.02	-0.03	0.00	-0.03	563,030	0.0%	-0.02	-0.03	-0.02	-0.07	289,743	0.0%
S2: EU acts first, rest follow later	-0.01	-0.40	-0.38	0.09	1,081,155	-0.2%	-0.07	0.10	0.41	0.36	230,752	0.2%	0.00	-0.08	0.00	0.40	563,196	0.0%	0.03	-1.43	-1.57	-0.54	287,207	-0.9%
S3: All act later	0.01	-0.36	-0.35	0.07	1,081,349	-0.2%	0.01	0.01	0.40	0.16	230,702	0.2%	-0.01	-0.09	-0.02	0.31	563,035	0.0%	0.05	-1.21	-1.42	-0.34	287,613	-0.8%

	World						EU27						RANNEXI						NONANNEXI					
Manufacturing (vol. '2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	42,795.2	51,235.1	4,973.1	67,430.9	2,191,759		######	13,684.5	1,235.0	15,709.0	592,986		15,679.3	17,258.7	1,234.0	17,989.4	713,681		14,588.8	20,291.9	2,504.0	33,732.6	885,091	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.03	0.02	0.10	-0.01	2,192,192	0.0%	-0.01	0.02	0.03	-1.12	592,077	-0.2%	-0.14	-0.08	0.01	0.28	713,637	0.0%	0.07	0.10	0.19	0.35	886,477	0.2%
S2: EU acts first, rest follow later	-0.10	0.05	1.42	-0.03	2,192,192	0.0%	0.00	0.04	0.46	-0.51	592,077	-0.2%	-0.23	0.09	1.51	-0.87	713,637	0.0%	-0.04	0.03	1.89	0.64	886,477	0.2%
S3: All act later	-0.13	-0.01	1.18	-0.32	2,196,491	0.2%	0.05	0.18	-0.87	-1.42	589,729	-0.5%	-0.25	0.02	1.57	-0.87	715,905	0.3%	-0.14	-0.15	2.04	0.48	890,856	0.7%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.03	0.03	0.13	0.05	2,192,672	0.0%	0.00	0.02	0.07	-0.88	592,335	-0.1%	-0.14	-0.05	0.06	0.32	713,815	0.0%	0.07	0.11	0.20	0.34	886,522	0.2%
S2: EU acts first, rest follow later	-0.10	0.05	1.82	0.68	2,192,672	0.0%	0.00	0.10	0.84	0.07	592,335	-0.1%	-0.23	0.08	1.59	-0.73	713,815	0.0%	-0.04	0.01	2.48	1.72	886,522	0.2%
S3: All act later	-0.13	-0.01	1.54	0.46	2,201,881	0.5%	0.05	0.19	-0.52	-0.90	590,880	-0.4%	-0.25	0.00	1.56	-0.69	716,054	0.3%	-0.14	-0.15	2.65	1.72	894,947	1.1%

	World						EU27						RANNEXI						NONANNEXI					
Services (vol. '2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	56,468.4	68,703.6	6,245.0	91,878.3	2,982,878		######	16,858.7	1,520.8	19,585.1	734,773		27,873.8	32,983.2	2,125.9	40,770.0	1,423,005		13,284.4	18,861.7	2,598.3	31,523.2	825,100	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.04	-0.04	0.04	0.02	2,982,737	0.0%	-0.05	0.01	0.37	0.76	736,100	0.2%	-0.04	-0.05	-0.05	-0.13	1,422,243	-0.1%	-0.03	-0.06	-0.07	-0.23	824,395	-0.1%
S2: EU acts first, rest follow later	-0.01	-0.53	-0.24	0.81	2,982,737	0.0%	-0.03	0.07	0.46	0.33	736,100	0.2%	-0.02	-0.19	-0.09	0.12	1,422,243	-0.1%	0.02	-1.66	-0.99	1.99	824,395	-0.1%
S3: All act later	0.01	-0.51	-0.41	0.36	2,976,890	-0.2%	0.06	0.06	0.07	-0.15	734,665	0.0%	-0.03	-0.22	-0.14	0.01	1,421,591	-0.1%	0.03	-1.52	-1.16	1.14	820,634	-0.5%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.04	-0.01	0.10	0.11	2,983,885	0.0%	-0.04	0.09	0.52	1.00	736,772	0.3%	-0.04	-0.04	-0.03	-0.10	1,422,419	0.0%	-0.03	-0.04	-0.01	-0.16	824,694	0.0%
S2: EU acts first, rest follow later	-0.01	-0.48	0.05	1.35	2,983,885	0.0%	-0.02	0.15	0.71	0.70	736,772	0.3%	-0.02	-0.16	0.07	0.40	1,422,419	0.0%	0.02	-1.60	-0.46	2.97	824,694	0.0%
S3: All act later	0.01	-0.49	-0.08	0.94	2,982,851	0.0%	0.06	0.07	0.29	0.20	735,519	0.1%	-0.03	-0.20	0.06	0.33	1,423,130	0.0%	0.03	-1.49	-0.55	2.19	824,201	-0.1%

	World						EU27						RANNEXI						NONANNEXI					
Energy (vol. '2004)	2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50		2020	2030	2040	2050	bill.$'04 Cumul. '05-50	
Reference	5,235.6	6,027.7	279.1	7,800.4	266,241		696.7	677.6	21.2	733.0	31,286		1,849.3	1,895.9	89.2	1,952.4	84,350		2,689.7	3,454.2	168.6	5,115.1	150,605	
Without technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.66	-0.98	-1.67	-2.02	263,427	-1.1%	-1.25	-3.55	-7.06	-12.52	30,015	-4.1%	-1.10	-1.33	-1.90	-2.10	83,352	-1.2%	-0.20	-0.30	-0.68	-0.49	150,060	-0.4%
S2: EU acts first, rest follow later	-0.41	-1.67	-12.18	-25.88	263,427	-1.1%	-1.07	-3.43	-7.71	-14.52	30,015	-4.1%	-0.93	0.80	-6.95	-19.60	83,352	-1.2%	0.13	-2.69	-15.34	-29.90	150,060	-0.4%
S3: All act later	-0.39	-1.69	-12.03	-24.77	247,646	-7.0%	0.20	1.15	-10.08	-16.09	29,899	-4.4%	-0.99	-0.19	-7.44	-19.42	81,165	-3.8%	-0.14	-3.07	-14.48	-28.06	136,582	-9.3%
With technology progress feedback	% changes from Reference						% changes from Reference						% changes from Reference						% changes from Reference					
S1: EU acts alone	-0.65	-0.93	-1.57	-1.88	263,593	-1.0%	-1.20	-3.13	-6.27	-11.18	30,154	-3.6%	-1.11	-1.32	-1.90	-2.13	83,348	-1.2%	-0.20	-0.28	-0.64	-0.45	150,091	-0.3%
S2: EU acts first, rest follow later	-0.40	-1.59	-11.85	-25.41	263,593	-1.0%	-1.01	-3.07	-6.92	-13.18	30,154	-3.6%	-0.93	0.84	-6.83	-19.39	83,348	-1.2%	0.13	-2.63	-14.99	-29.46	150,091	-0.3%
S3: All act later	-0.39	-1.66	-11.67	-24.26	248,174	-6.8%	0.20	1.21	-9.32	-14.80	30,019	-4.0%	-0.99	-0.17	-7.32	-19.17	81,230	-3.7%	-0.14	-3.04	-14.08	-27.56	136,925	-9.1%

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