

# Summary of E3ME Modelling

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## Introduction

Under the contract *Study for a comprehensive assessment of the macro- level and sectoral impacts of Energy Efficiency policies*, led by Cambridge Econometrics (CE) and as part of the framework consortium led by EY, the macroeconomic E3ME model has been applied by CE to assess a range of scenarios related to the Energy Efficiency 2016 Impact Assessment (SWD(2016) 405 final). This note summarises the work that was done and presents the key results at Member State level.

The starting point for the E3ME analysis was the 2016 Reference Scenario that was developed with the PRIMES model. Inputs to E3ME, including both assumptions (e.g. energy prices, economic growth rates) and the full energy balances are taken from the detailed PRIMES model spreadsheets.

The same information is taken for each of the scenarios and thus the design of the scenarios in E3ME matches that from the PRIMES model as closely as possible:

- EUCO27
- EUCO30
- EUCO+33
- EUCO+35
- EUCO+40

E3ME was also used to assess a sensitivity, which had more of a focus on renewables:

- EUCO3030

In each case, two variants of the scenarios were considered, based on assumptions about the degree of 'crowding out' (the rate at which increases in one form of economic activity lead to reductions in economic activity elsewhere in the economy). This is a key assumption, as it can directly impact on the magnitude and even direction of results<sup>1</sup>.

The first variant uses the default option in E3ME in which there is no crowding out due to financial conditions. The second variant assumes that there is partial crowding out, by limiting the amount that the construction sector can increase its output to 15% above the reference case in 2030<sup>2</sup>. In this second variant, the degree of crowding out increases in line with the level of ambition in the scenario. This more nuanced assumption is considered more realistic.

The results reported here reflect a self-financing approach to the required investment, which is:

- Households pay for investment in energy products by reducing other spending
- Businesses pay for investment in energy products by raising prices

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<sup>1</sup> It is worth noting that distributional elements of proposals on the Effort Sharing Regulation or the EU ETS Revision are not taken into account in the scenarios.

<sup>2</sup> Further details can be found in SWD(2016) 405 final.

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- Government pays for investment in energy products by raising income taxes

## Brief description of E3ME

E3ME is a macro-econometric simulation model, based on post-Keynesian economic foundations. The model is used to estimate the impacts of policy interventions across a range of different policy areas. However, it tightly integrates the energy system with the economy and so is very suitable for assessing policies that affect energy demand and supply. E3ME has been used to provide inputs for several related Impact Assessments in the past, including for the 2030 climate and energy framework. In this exercise, the inputs to E3ME are (as described above) the energy balances, prices and investment results from PRIMES, while the outputs include a range of macroeconomic and sectoral economic indicators.

When interpreting results from the scenarios it is useful to consider the interaction between investment and the rest of the economy, and of international trade:

- Higher investment levels boost rates of economic activity and lead to the creation of jobs in the construction and engineering sectors. However, the investment must be paid for (as described above) which is liable to reduce rates of economic activity elsewhere in the economy, even in scenarios with limited 'crowding out'.
- Reduced levels of imported goods, for example of fossil fuels, will also boost domestic rates of economic activity. Scenarios that reduce fossil fuel imports to Europe are therefore more likely to yield positive results for GDP.
- There is also trade within Europe in the scenarios. Countries that export energy efficient or renewable equipment may be better placed to benefit from scenarios with higher ambition levels.

The approach used in E3ME to assess the scenarios is regarded as highly empirical. The model combines an accounting framework with 30 sets of behavioural equations, within which the parameters are determined by econometric estimation based on historical time-series data that cover the period 1970-2014. Within Europe Eurostat data are used for most economic indicators and IEA data are used for energy balances and prices.

Sectoral disaggregation is an important feature of E3ME. The model is global but provides an explicit representation of each of the EU's 28 Member States. Economic activity in each country is disaggregated into 70 sectors, and energy consumption is modelled for 20 different users of 12 fuel types.

Further information about E3ME, including the full technical manual, is available from the model website, [www.e3me.com](http://www.e3me.com). More information on the assumptions and results can be found in SWD(2016) 405 final<sup>3</sup>.

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<sup>3</sup> <https://ec.europa.eu/energy/en/news/commission-proposes-new-rules-consumer-centred-clean-energy-transition>.

Table 1 Macro-economic results EUC027, 2030

	GDP in €2013bn		Employment in thousand persons	
	No crowding out	Partial crowding out	No crowding out	Partial crowding out
1 Belgium (BE)	506	506	4,974	4,974
2 Denmark (DK)	347	347	3,029	3,029
3 Germany (DE)	3,404	3,404	39,433	39,433
4 Greece (EL)	215	215	4,061	4,061
5 Spain (ES)	1,513	1,513	19,869	19,869
6 France (FR)	2,654	2,654	29,549	29,550
7 Ireland (IE)	229	229	2,234	2,234
8 Italy (IT)	1,971	1,971	25,836	25,836
9 Luxembourg (LX)	66	66	421	421
10 Netherlands (NL)	786	786	8,867	8,867
11 Austria (AT)	426	426	4,403	4,403
12 Portugal (PT)	220	220	4,915	4,915
13 Finland (FI)	242	242	2,625	2,625
14 Sweden (SW)	552	552	5,096	5,096
15 UK (UK)	3,287	3,287	32,942	32,942
16 Czech Rep. (CZ)	202	202	5,374	5,374
17 Estonia (EN)	24	24	602	602
18 Cyprus (CY)	24	24	424	424
19 Latvia (LV)	34	34	942	942
20 Lithuania (LT)	45	45	1,314	1,314
21 Hungary (HU)	179	179	3,803	3,803
22 Malta (MT)	9	9	185	185
23 Poland (PL)	645	645	15,267	15,267
24 Slovenia (SI)	49	49	926	926
25 Slovakia (SK)	103	103	2,311	2,311
26 Bulgaria (BG)	55	55	3,231	3,231
27 Romania (RO)	201	201	9,219	9,219
28 Croatia (HR)	57	57	1,688	1,688
EU28	18,045	18,045	233,542	233,542

Sources: E3ME

Table 2 Macro-economic results EUC030, 2030, % difference from EUC027

	GDP		Employment	
	No crowding out	Partial crowding out	No crowding out	Partial crowding out
1 Belgium (BE)	0.5	0.5	0.2	0.2
2 Denmark (DK)	0.2	0.2	0.1	0.1
3 Germany (DE)	0.4	0.4	0.1	0.1
4 Greece (EL)	0.7	0.7	0.5	0.5
5 Spain (ES)	0.3	0.3	0.2	0.2
6 France (FR)	0.7	0.7	0.3	0.3
7 Ireland (IE)	0.3	0.3	0.2	0.2
8 Italy (IT)	0.5	0.5	0.1	0.1
9 Luxembourg (LX)	0.5	0.5	0.0	0.0
10 Netherlands (NL)	0.3	0.3	0.1	0.1
11 Austria (AT)	0.4	0.4	0.2	0.2
12 Portugal (PT)	0.6	0.6	0.5	0.5
13 Finland (FI)	0.6	0.6	0.3	0.3
14 Sweden (SW)	0.4	0.4	0.2	0.2
15 UK (UK)	0.1	0.1	0.1	0.1
16 Czech Rep. (CZ)	0.9	0.9	0.4	0.4
17 Estonia (EN)	0.3	0.3	0.2	0.2
18 Cyprus (CY)	0.3	0.3	0.0	0.0
19 Latvia (LV)	1.0	0.9	0.3	0.3
20 Lithuania (LT)	0.7	0.7	0.3	0.3
21 Hungary (HU)	0.9	0.9	0.4	0.4
22 Malta (MT)	0.5	0.5	0.5	0.5
23 Poland (PL)	0.1	0.1	0.2	0.2
24 Slovenia (SI)	0.5	0.5	0.1	0.1
25 Slovakia (SK)	0.7	0.7	0.1	0.1
26 Bulgaria (BG)	0.4	0.4	0.0	0.0
27 Romania (RO)	0.0	0.0	0.0	0.0
28 Croatia (HR)	0.2	0.2	0.1	0.1
EU28	0.4	0.4	0.2	0.2

Sources: E3ME

Table 3 Macro-economic results EUC033, 2030, % difference from EUC027

	GDP		Employment	
	No crowding out	Partial crowding out	No crowding out	Partial crowding out
1 Belgium (BE)	1.7	1.5	0.8	0.7
2 Denmark (DK)	0.4	0.4	0.3	0.3
3 Germany (DE)	2.0	1.6	0.6	0.5
4 Greece (EL)	2.0	1.7	1.2	1.1
5 Spain (ES)	1.0	1.0	0.8	0.8
6 France (FR)	1.9	1.9	0.8	0.7
7 Ireland (IE)	1.1	1.0	0.5	0.5
8 Italy (IT)	1.6	1.5	0.7	0.6
9 Luxembourg (LX)	0.9	0.9	0.2	0.2
10 Netherlands (NL)	1.1	1.0	0.4	0.4
11 Austria (AT)	1.5	1.4	0.6	0.6
12 Portugal (PT)	1.3	1.3	1.5	1.5
13 Finland (FI)	2.1	2.1	1.2	1.2
14 Sweden (SW)	1.1	1.1	0.4	0.4
15 UK (UK)	0.7	0.7	0.5	0.5
16 Czech Rep. (CZ)	3.0	2.7	1.2	1.1
17 Estonia (EN)	1.2	1.1	0.8	0.8
18 Cyprus (CY)	0.9	0.8	0.2	0.2
19 Latvia (LV)	2.9	1.6	1.1	0.6
20 Lithuania (LT)	1.8	1.7	1.1	1.0
21 Hungary (HU)	2.5	1.8	1.2	1.0
22 Malta (MT)	0.5	0.5	0.5	0.5
23 Poland (PL)	0.8	0.6	1.0	0.9
24 Slovenia (SI)	1.8	1.7	0.6	0.6
25 Slovakia (SK)	2.5	2.2	0.3	0.2
26 Bulgaria (BG)	1.4	1.3	0.1	0.0
27 Romania (RO)	0.5	0.4	0.3	0.2
28 Croatia (HR)	0.8	0.7	0.4	0.4
EU28	1.5	1.3	0.7	0.6

Sources: E3ME

Table 4 Macro-economic results EUC035, 2030, % difference from EUC027

	GDP		Employment	
	No crowding out	Partial crowding out	No crowding out	Partial crowding out
1 Belgium (BE)	2.3	1.8	1.2	0.9
2 Denmark (DK)	0.5	0.5	0.5	0.5
3 Germany (DE)	2.8	1.6	0.9	0.7
4 Greece (EL)	2.8	1.9	1.9	1.3
5 Spain (ES)	1.5	1.5	1.2	1.1
6 France (FR)	2.9	2.5	1.1	1.0
7 Ireland (IE)	1.6	1.4	0.9	0.9
8 Italy (IT)	2.2	1.7	1.0	0.8
9 Luxembourg (LX)	1.1	1.1	0.2	0.2
10 Netherlands (NL)	1.6	1.3	0.6	0.6
11 Austria (AT)	2.3	1.9	0.9	0.8
12 Portugal (PT)	1.3	1.3	2.0	1.8
13 Finland (FI)	3.5	3.4	1.8	1.8
14 Sweden (SW)	1.2	1.1	0.4	0.3
15 UK (UK)	1.2	1.0	0.8	0.7
16 Czech Rep. (CZ)	4.4	3.4	1.9	1.5
17 Estonia (EN)	1.8	1.6	1.2	1.2
18 Cyprus (CY)	1.3	1.1	0.5	0.5
19 Latvia (LV)	4.1	1.4	1.5	0.7
20 Lithuania (LT)	2.5	2.1	1.6	1.3
21 Hungary (HU)	3.7	2.0	1.8	1.2
22 Malta (MT)	1.2	0.9	0.5	0.5
23 Poland (PL)	1.3	0.6	1.6	1.2
24 Slovenia (SI)	2.6	2.0	1.1	0.9
25 Slovakia (SK)	3.8	2.9	0.5	0.2
26 Bulgaria (BG)	1.9	1.7	0.1	0.1
27 Romania (RO)	0.6	0.2	0.4	0.3
28 Croatia (HR)	1.2	1.1	0.6	0.5
EU28	2.1	1.6	1.0	0.9

Sources: E3ME

Table 5 Macro-economic results EUC040, 2030, % difference from EUC027

	GDP		Employment	
	No crowding out	Partial crowding out	No crowding out	Partial crowding out
1 Belgium (BE)	4.4	2.3	2.2	1.4
2 Denmark (DK)	0.7	0.4	1.3	0.9
3 Germany (DE)	5.9	2.2	1.8	1.0
4 Greece (EL)	4.9	2.2	3.6	1.9
5 Spain (ES)	3.2	3.0	2.7	2.5
6 France (FR)	5.2	3.5	2.2	1.6
7 Ireland (IE)	2.9	2.4	1.8	1.6
8 Italy (IT)	4.3	2.1	1.9	1.2
9 Luxembourg (LX)	1.6	1.5	0.5	0.5
10 Netherlands (NL)	3.0	1.6	1.3	0.9
11 Austria (AT)	4.5	2.6	1.6	1.1
12 Portugal (PT)	2.0	1.5	3.5	2.8
13 Finland (FI)	7.3	6.3	3.5	3.0
14 Sweden (SW)	2.2	1.5	0.8	0.6
15 UK (UK)	2.2	1.3	1.5	1.1
16 Czech Rep. (CZ)	8.3	4.6	3.8	2.5
17 Estonia (EN)	4.0	3.1	2.3	2.2
18 Cyprus (CY)	2.8	2.1	0.9	0.9
19 Latvia (LV)	8.3	0.0	3.0	0.8
20 Lithuania (LT)	4.7	2.7	3.1	2.0
21 Hungary (HU)	6.4	1.8	3.3	1.6
22 Malta (MT)	3.1	2.2	1.1	1.1
23 Poland (PL)	3.4	0.2	3.6	2.1
24 Slovenia (SI)	4.9	2.6	2.2	1.3
25 Slovakia (SK)	7.9	4.4	1.7	0.4
26 Bulgaria (BG)	3.8	3.2	0.2	0.1
27 Romania (RO)	0.6	-1.1	0.8	0.4
28 Croatia (HR)	1.8	1.5	1.2	1.1
EU28	4.1	2.2	2.1	1.4

Sources: E3ME

Table 6 Macro-economic results EUCO3030, 2030, % difference from EUCO27

	GDP		Employment	
	No crowding out	Partial crowding out	No crowding out	Partial crowding out
1 Belgium (BE)	1.3	1.3	0.4	0.4
2 Denmark (DK)	0.4	0.4	0.3	0.3
3 Germany (DE)	1.5	1.5	0.3	0.3
4 Greece (EL)	1.2	1.2	0.7	0.7
5 Spain (ES)	1.0	1.0	0.5	0.5
6 France (FR)	1.5	1.5	0.5	0.5
7 Ireland (IE)	1.1	1.1	0.4	0.4
8 Italy (IT)	1.1	1.1	0.2	0.2
9 Luxembourg (LX)	1.0	1.0	0.0	0.0
10 Netherlands (NL)	1.0	1.0	0.2	0.2
11 Austria (AT)	1.1	1.1	0.3	0.3
12 Portugal (PT)	1.2	1.2	0.7	0.7
13 Finland (FI)	1.2	1.2	0.6	0.6
14 Sweden (SW)	0.8	0.8	0.3	0.3
15 UK (UK)	0.9	0.9	0.4	0.4
16 Czech Rep. (CZ)	2.3	2.3	0.8	0.8
17 Estonia (EN)	2.5	2.5	0.5	0.5
18 Cyprus (CY)	0.8	0.8	0.2	0.2
19 Latvia (LV)	2.1	2.0	0.5	0.5
20 Lithuania (LT)	1.3	1.3	0.5	0.5
21 Hungary (HU)	1.7	1.6	0.6	0.5
22 Malta (MT)	2.3	2.3	0.5	0.5
23 Poland (PL)	0.8	0.8	0.3	0.3
24 Slovenia (SI)	0.6	0.6	0.4	0.4
25 Slovakia (SK)	1.3	1.3	0.2	0.2
26 Bulgaria (BG)	1.6	1.6	0.0	0.0
27 Romania (RO)	1.1	1.1	0.0	0.0
28 Croatia (HR)	0.8	0.8	0.2	0.2
EU28	1.2	1.2	0.4	0.4

Sources: E3ME