Wuppertal Institute
for Climate, Environment
and Energy

Working Paper

Technical analysis and comparison of underlying scenarios for the forthcoming European Commission White Paper on a 2030 climate and energy policy framework

Based on preliminary documents of the Impact Assessment for a 2030 climate and energy policy framework

Sascha Samadi

Dr. Stefan Lechtenböhmer

Wuppertal, 17 January 2014

Table of Content

A working paper by the Wuppertal Institute
supported by WWF European Policy Office, Brussels.

1 Introduction

The EU has set itself ambitious targets with regards to a significant reduction of its greenhouse gas emissions and has presented roadmaps depicting an overall decarbonisation of its economy by the middle of the century.

In this context European policymakers and stakeholders are currently discussing the targets and the level of ambition of the 2030 climate and energy policy framework.

The Commission is expected to present its own vision for the further development of the energy and climate policy framework in its White Paper "For a 2030 climate and energy policy framework"[1].

At this decisive point in the political debate the Wuppertal Institute presents a brief working paper that analyses some of the analytical work – particularly the underlying energy and GHG emission scenarios – behind the Commission's proposals to be presented in the forthcoming White Paper.

For this analysis we draw upon two main documents. First, a draft version of the Impact Assessment accompanying the White Paper (EC 2013a), which is already publicly available and contains an overview of the results of the scenario analysis carried out for the White Paper. We combine this information with the recently published EU Reference Scenario 2013 (EC 2013b). Core assumptions and results of the new EU energy scenarios, which represent an important input for the Commission's White Paper, were obtained from these two documents and are presented in the following. These new scenarios are also compared with EU scenarios from other recent studies which have been commissioned and developed by diverse stakeholders, including the European Commission itself in the context of its Low Carbon Economy Roadmap. The scenarios from this EU Roadmap – as well as a number of other EU scenarios - have been analysed in earlier publications (e.g. Wuppertal Institute & Öko-Institut, 2012).

Due to the preliminary character of the currently available information – in advance of the publication of the White Paper and its supporting documents – and due to some gaps in the currently available scenario data our analysis presented here is mainly descriptive and needs to be updated upon availability of the final and more detailed publications.

Nevertheless, the analysis presented here provides first insights into and some reflections about the scenarios underlying the forthcoming policy proposals by the Commission. Therefore we hope that this working document will help to inform public debate about the EU climate and energy policy framework.

---

[1] The Commission has announced that it will present the White Paper on January 22nd, 2014.

In the following Chapter 2, we first make a general point about the selection of the scenarios developed for the White Paper before presenting in Chapter 3 a couple of other observations that can help to better understand and interpret the scenarios.

2 A real long term combined high RES and high efficiency scenario is missing

A very important observation is that a long-term scenario, which combines high renewable energy sources (RES) deployment with strong energy efficiency progress, is severly missing in the scenarios developed for the draft Impact Assessment. Such a scenario should be commissioned by the European Commission, evaluating the potential GHG emission reductions until the year 2050.

- It is noticeable that while the primary energy use of renewables in the new "High RES" scenario (GHG45EE RES 35) is a bit higher in 2030 than in the old "High RES" scenario from the Energy Roadmap 2050 (EC 2011), it is considerably lower in 2050 (see Figure 1). This is probably because for none of the new scenarios a high penetration of renewables was aimed for by the year 2050, but only for 2030. For the old "High RES" scenario, on the other hand, the "high renewables" philosophy was applied for the whole period until 2050. While this focus on the year 2030 in the latest scenarios may be a logical approach, it is still unfortunate as it may lead to the impression that renewables will only be able to meet about 45 % of primary energy demand by 2050. The "High RES" scenario from 2011 has already shown that 60 % would be possible and a Greenpeace/EREC commissioned scenario ("energy [r]evolution") demonstrated that even an 85 % share may be feasible by the middle of the century (see Figure 1).

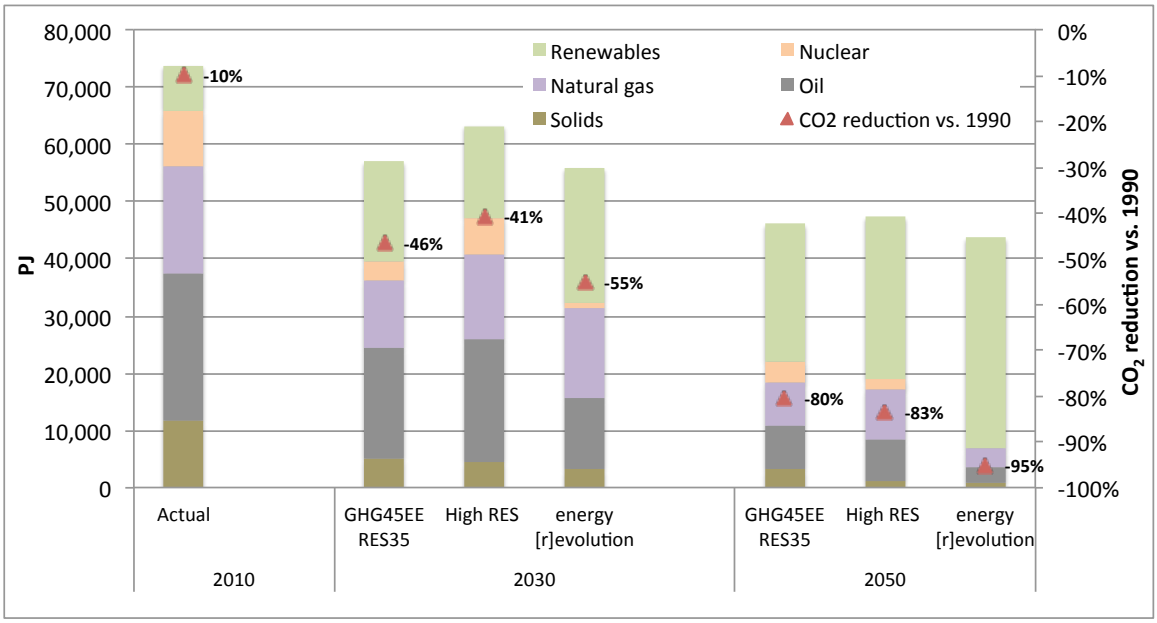

Figure 1: Primary energy use by source and energy-related CO_2 emission reductions relative to 1990 according to various scenarios in 2030 and 2050

- A comparison of the RES shares of the new (as well as the old) EU commissioned scenarios with those of the energy [r]evolution scenario indicates that even in the EU scenarios with relatively high RES shares, there may be too little a focus on the use of renewables in the heating (and cooling) sector (see Table 1).

	2010	**2030**				
	Actual	Reference 2013	GHG40	GHG45EE RES35	High RES	energy [r]evolution
Share of RES in electricity generation	19%	43%	47%	66%	60%	68%
Share of RES in heating and cooling	14%	24%	26%	35%	27%	43%
Share of RES in the transport sector	5%	12%	13%	16%	20%	17%
Share of RES in gross final energy demand	12%	24%	27%	35%	31%	42%
		2050				
		Reference 2013	GHG40	GHG45EE RES35	High RES	energy [r]evolution
Share of RES in electricity generation		50%	53%	76%	83%	96%
Share of RES in heating and cooling		27%	49%	54%	53%	91%
Share of RES in the transport sector		14%	68%	75%	73%	85%
Share of RES in gross final energy demand		29%	51%	62%	75%	90%

Table 1: Share of RES in electricity generation, heating and cooling, transport and gross final energy demand according to various scenarios in 2030 and 2050

- A combination of the expanded use of renewable energy sources and improved energy efficiency has been shown by other scenarios to be able to achieve ambitious emission reduction targets by 2050.[2] In addition, both efficiency and renewable energy sources like wind and solar energy have higher acceptance within European society than nuclear power and CCS-equipped coal power plants (European Commission 2006, p. 33; Pietzner et al. 2010, p. 38).

[2] For Europe see Greenpeace/EREC (2012) for the entire energy system and Dii (2012), ECF (2010) and BMU (2011) for analysis of only the electricity sector. Furthermore, see Greenpeace/EREC/GWEC (2012) and WWF (2011) for studies indicating that even globally, renewables and energy efficiency alone (i.e. not relying on nuclear power or CCS) could achieve deep CO_2 emission reductions of more than 80 % by 2050 (compared to 1990).

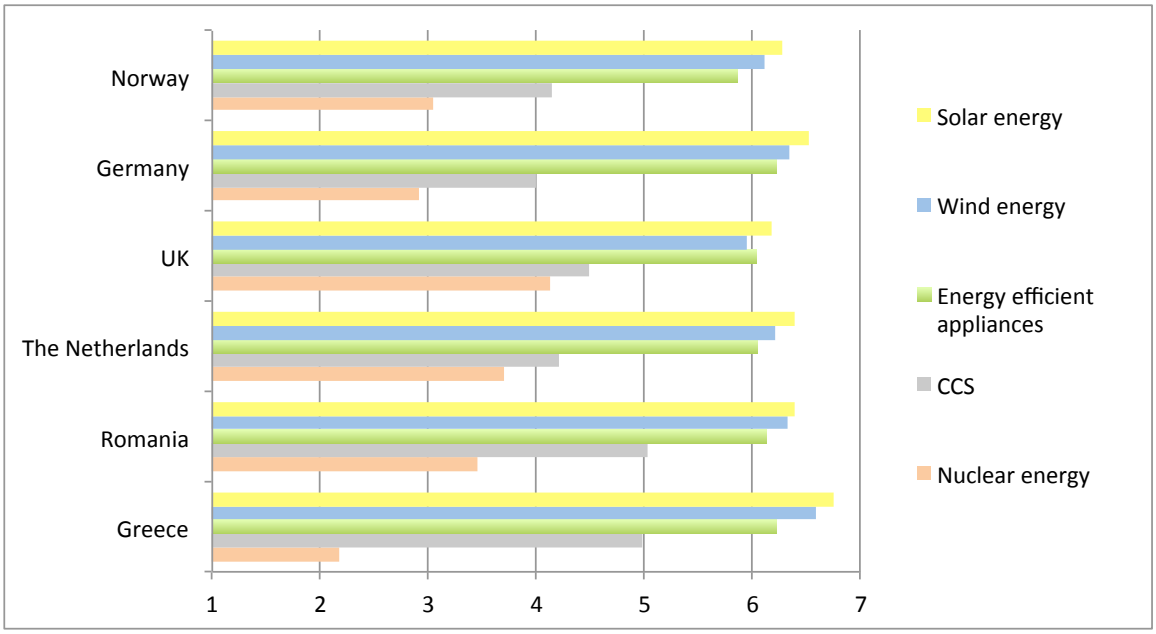

Figure 2: Results of representative polls in six EU countries asking which technologies should be used to reduce greenhouse gas emissions (mean values are shown); answers ranged from 1 (= should definitely not be used) to 7 (= should definitely be used)

Source: Pietzner et al. 2010, p. 38.

- Such an ambitious scenario would be very important for the on-going discussions about a European 2030 energy and climate framework because it would show what the energy system might look like in 2030, if a very high RES target was aimed for until 2050.
- Without such a scenario we do not really know if the current "high RES 2030" scenario of the Commission (i.e. the GHG45EE RES35 scenario) would indeed be compatible with a 2050 energy system with very high shares of renewables. It is possible that the "high RES 2030" energy system as described in the GHG45EE RES35 scenario is not well suited to be transformed into such a a 2050 energy system with very high shares of renewables. It may be that quite different technologies and infrastructure will be required in the EU already in 2030 to achieve a very high RES (and very low-CO_2) energy system in 2050. Especially in the electricity sector there could be a risk of locking in the wrong technologies and infrastructure when only RES targets for 2030 are considered. For example, the development of and investment into European electricity grids as well as energy storage solutions may turn out to be quite different until 2030 depending on what kind of energy system is aimed for by the year 2050. Looking only at

the year 2030 could effectively shut the door for a 2050 energy system containing high RES shares, calling into question the possibility of achieving long term ambitious CO_2 reduction targets – especially if nuclear power and CCS technology were to turn out not to be practical options because of a lack of social acceptance and/or because of high costs.

- The draft Impact Assessment clearly indicates that a stronger deployment of renewable energy sources as well as a stronger use of energy efficiency measures would create more jobs and would also have considerable health benefits compared to focusing on CO_2 emission reduction alone. This indicates that specific mandatory targets set by the EU for RES deployment and efficiency improvements may be beneficial as such targets would likely induce Member States to act more aggressively in these fields as well as they would provide higher investment security for renewable and efficiency projects.

It should also be noted that the available documents (EC 2013a,b) do not present a scenario with a higher 2050 domestic GHG reduction target than 80%. However, taking into account recent results of climate science, it could well be the case that faster and more significant recutions of GHG emissions in the EU will prove necessary in order for the EU to deliver its fair share of the world achieving the 2°C target, let alone a possible 1.5°C target. The fact that the Commission does not present such a more ambitious scenario prevents analysing potential challenges as well as possible co-benefits or synergies that a pathway for such a more ambitious emission reduction strategy would have.

3 Further results and observations from the analysis of the scenarios

The technical analysis of the scenarios made for this Working Paper reveals a couple of further issues and observations which are briefly presented in the following.

3.1 The role of (sustainable) biomass

The scenario in the draft Impact Assessment with the highest share of RES in final energy demand by 2030 ("GHG45EE RES35") relies to a greater extent on biomass than the "High RES" scenario of the 2011 Energy Roadmap 2050 did. The (mostly domestic) bioenergy production reaches 191 Mtoe in 2030 in the "GHG45EE RES35" scenario, while it is 181 Mtoe in the same year in the "High RES" scenario. While the IEA's "New Policy Scenario" (IEA 2013) assumes basically the same amount of biomass use in the European Union by 2030, biomass use is considerably smaller in the "energy [r]evolution scenario", indicating a more cautious approach to biomass availability (see Figure 3).

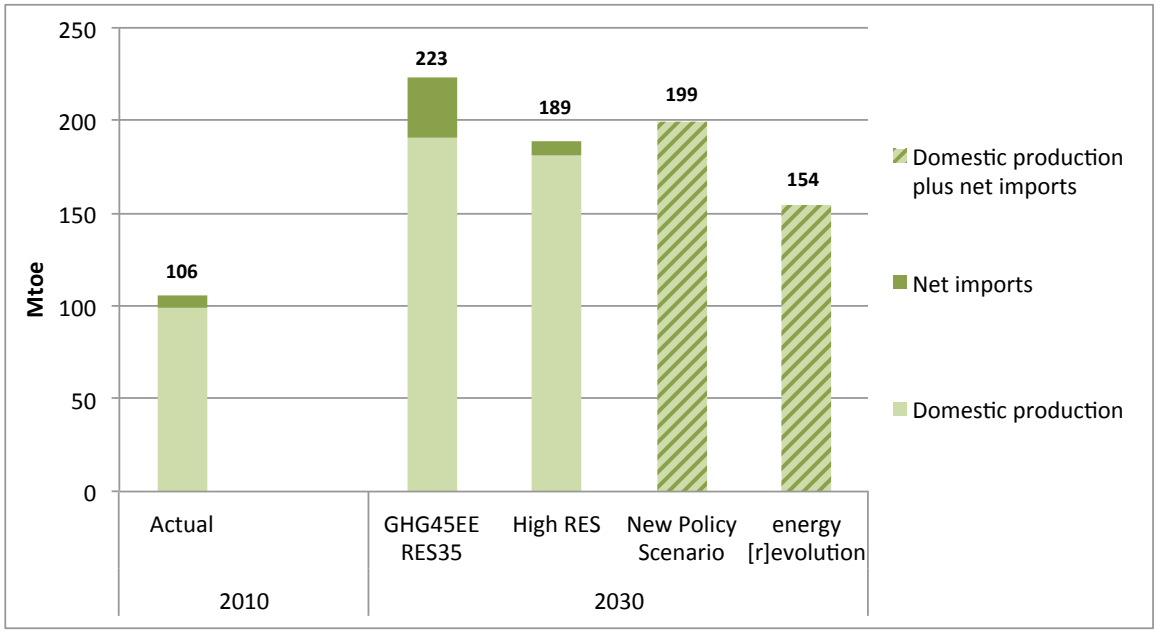

Figure 3: Comparison of biomass use in varioius EU scenarios in 2030

Note: The scenarios studies of the IEA (2013) and of Greenpeace/EREC (2012) do not provide information on whether net imports of biomass take place in their respective scenarios.

The new scenarios also assume considerably higher net bioenergy imports compared to the old scenarios from the Energy Roadmap 2050. In the "GHG45EE RES35" scenario, these imports are 32 Mtoe in 2030, while in the "High RES" scenario they were only 8 Mtoe in the same year.

It is important to note that any such biomass strategy will have to take the following into accont:

- It will become ever more important to put emphasis on making sure the biomass produced in the EU as well as the biomass that is imported is from sustainable sources.
- Assuming significant amounts of bioenergy imports further adds some uncertainty to the scenarios, as it is unclear whether other world regions will be able to (sustainably) produce more biomass than they themselves require.

3.2 Technology cost assumptions and ETS carbon prices

Technology cost assumptions

The draft Impact Assessment does not provide any information on assumptions regarding the evolution of various technologies' capital costs, levelized cost of electricity (LCOE) or discount rates used. Hopefully in the final version of the Impact Assessment (or in related documents) these important economic assumptions will be made available to the public.

In the scenarios prepared for the Energy Roadmap 2050 (EC 2011) the underlying capital cost assumptions for renewables appeared to be to some extent unrealistic or too pessimistic. Especially current and future PV cost assumptions were clearly too high. Assumptions about future cost improvements for nuclear and CCS in contrast were comparatively optimistic (Öko-Institut/Wuppertal Institute 2012).

ETS carbon prices

An interesting finding from the draft Impact Assessment is that the (long-term) EU ETS carbon price in 2050 will be much higher in those scenarios with *no* dedicated efficiency and renewables policies compared to those scenarios *with* such policies. This seems to indicate that without dedicated policies on renewables and efficiency the political feasibility of the EU's current 2050 mitigation target would be in doubt. The need for very high ETS certificate prices is certainly a key problem of any strategy that chooses to rely mostly or even entirely on emission trading without strong supporting policies for renewables and efficiency, and the latest scenario calculations for the European Commission seem to provide strong support for this view (see Figure 4).

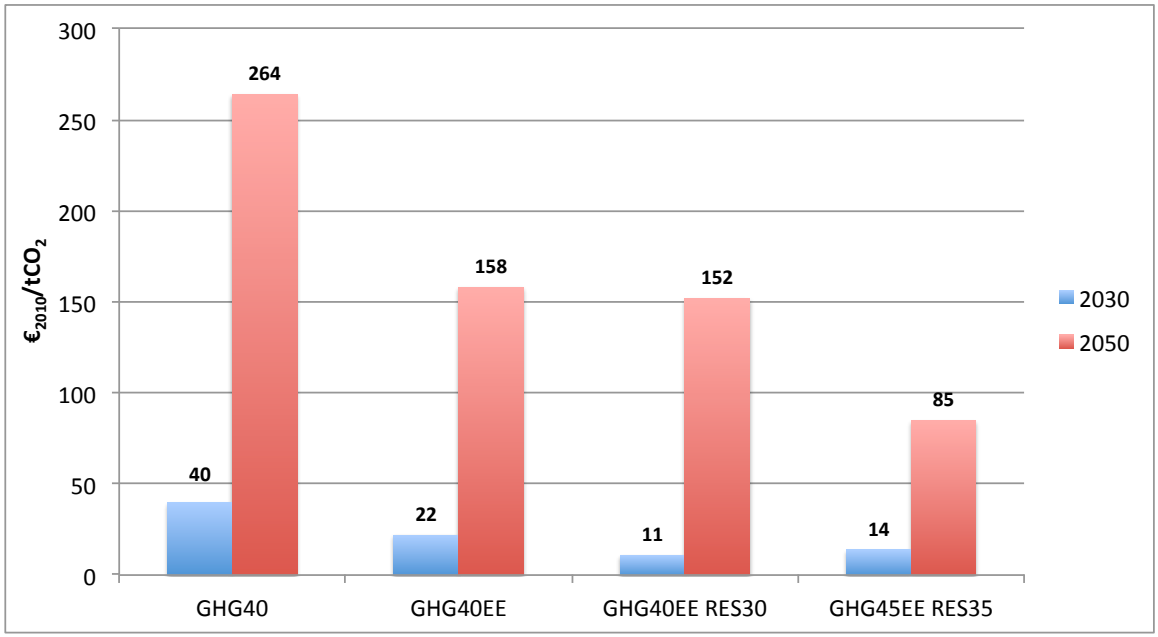

Figure 4: Comparison of EU ETS carbon prices in 2030 and 2050 in the decarbonisation scenarios of the draft Impact Assessment

3.3 Impacts on human health, GDP and employment

Health benefits

The draft Impact Assessment finds that relative to the Reference scenario, health benefits are

- higher for policy scenarios with more ambitious GHG reductions and
- higher for policy scenarios that specifically increase RES deployment and specifically enact energy efficiency policies.

Figure 5 shows the results of the calculations for the draft Impact Assessment. The reduction of air pollution costs (mostly health costs) is shown for three policy scenarios releative to the Reference scenario. As there is no scientific consensus on the exact monetization of human life years lost, the draft Impact Assessment provides a range of costs. While all policy scenarios lead to pollution cost savings for society relative to a reference development, cost savings are clearly higher for those scenarios which explicitly increase RES deployment and assume that explicit efficiency improvements are made. Specifically, pollution cost savings compared to the reference are more than twice higher (or 9.5 to 19.8 billion $€_{2010}$ higher annually) in the GHG40EE RES30 scenario than in the GHG40, despite the latter achieving the same GHG emission reduction.

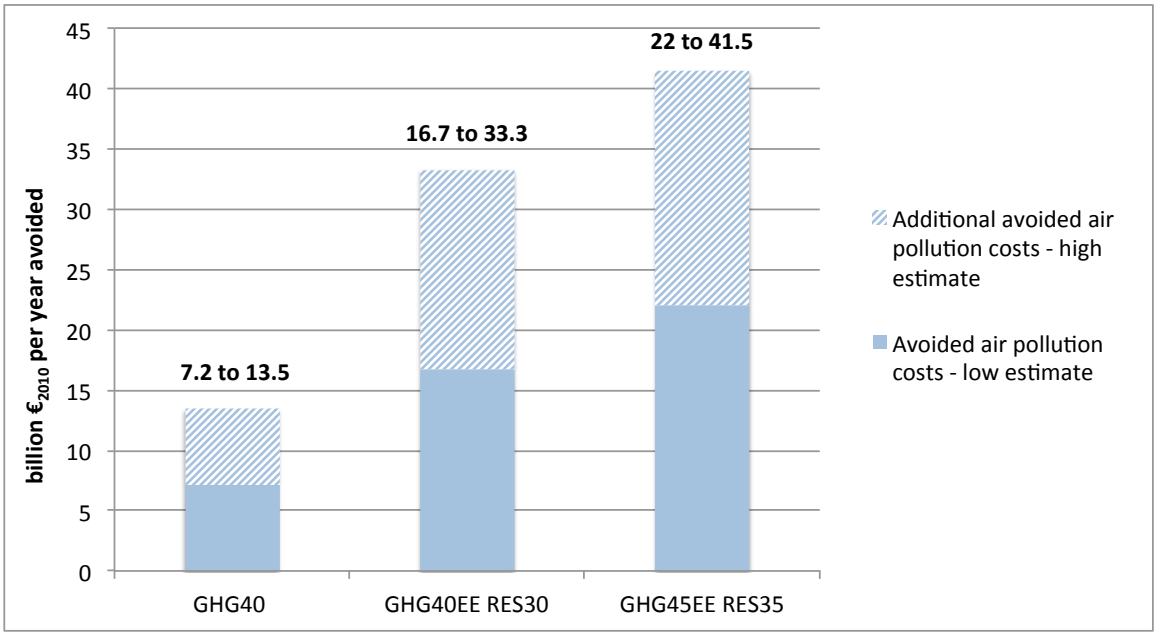

Figure 5: Comparison of annual air pollution cost savings versus the Reference scenario in various policy scenarios by 2030.

Impacts on GDP

The draft Impact Assessment discusses the results of calculations for the GDP impact (relative to the Reference scenario) of a 40 % domestic GHG emission reduction for 2030. For these calculations an applied general equilibrium model (GEM E-3) is used.

- If it is assumed that this 40 % GHG emission reduction is achieved soley by carbon pricing (which might not be the most favourable strategy, see below), GDP is in estimated to be reduced by 0.1 % to 0.45 % in 2030, depending on the specific carbon pricing and revenue recycling policies used to achieve the emission reduction.
- Interestingly, using a macroeconometric model (E3ME) the draft Impact Assessment also finds that if concrete energy efficiency policies were implemented instead of relying only on carbon pricing, GDP in 2030 would actually be around 0.5 % *higher* in the scenarios achieving a 40 or 45 % emission reduction compared to the Reference scenario.

These results showing possible positive GDP effects or only slight GDP reductions should be taken into context: The GDP changes can be regarded as negligible: While in the Reference scenario the economy of the EU-28 grows by an average annual rate of 1.53 % between 2010 and 2030, this rate would at most be reduced to 1.51 % in a scenario achieving a 40 % GHG emission reduction. Such a marginal GDP impact in case of a 40 % domestic GHG emission reduction appears to imply that the European economy could also well handle a more ambitious domestic GHG reduction target for 2030

(e.g. 45 % or 50 %). The EU should urgently commission calculations regarding the economic impact of higher GHG emission reduction targets.

In this regard it should be noted that GHG emissions in the latest EU-28 Reference scenario are expected to be 32.4 % below the 1990 level by 2030.[3] This means that a possible 40 % emission reduction target for 2030 would imply an additional GHG emission reduction of less than 8 percentage points compared to the Reference scenario.

Impacts on employment

Using the E3ME model, the draft Impact Assessment concludes that a 40 % emission reduction target leads to higher employment compared to no such target, i.e. employment in the GHG40 scenario is 0.3 % higher in 2030 than in the Reference scenario.

	--------- 000 of persons --------			% change compared to Reference	
	Reference	GHG40	GHG40EE RES30	GHG40	GHG40EE RES30
Agriculture	9 391	9 402	9 407	0.1%	0.2%
Extraction industries	500	479	498	-4.2%	-0.4%
Basic manufacturing	14 839	14 913	14 944	0.5%	0.7%
Engineering and transport equipment	15 277	15 367	15 429	0.6%	1.0%
Utilities	2 280	2 301	2 308	0.9%	1.2%
Construction	16 599	16 708	16 890	0.7%	1.8%
Distribution and retail	35 314	35 348	35 452	0.1%	0.4%
Transport	9 411	9 455	9 471	0.5%	0.6%
Communications, publishing and TV	20 307	20 384	20 440	0.4%	0.7%
Business services	41 048	41 225	41 293	0.4%	0.6%
Public services	66 735	66 797	66 814	0.1%	0.1%
Total employment	**231 701**	**232 379**	**232 947**	**0.3%**	**0.5%**

Table 2: Comparison of employment impacts of three of the scenarios developed for the draft Impact Assessment

However, even more jobs are expected in the scenario in which the 40 % emission reduction is achieved in combination with a 30 % penetration of renewables as well as ambitious explicit energy efficiency policies. In this scenario (GHG40EE RES30) employment would be 0.5 % higher in 2030 than in the Reference scenario. This translates to 1.25 million additional jobs by 2030 compared to the Reference scenario and 0.55 mil-

[3] The Reference scenario only takes into account current trends and policies as adopted in the Member States by spring 2012.

lion additional jobs compared to a scenario with the same GHG emission reduction but less renewables and less efficiency improvements (see Table 2).[4]

[4] The construction sector would benefit most in both relative as well as absolute terms in the GHG40EE RES30 scenario, increasing its employment by 1.8 % or almost 300.000 people compared to the Reference scenario.

4 References

Eichhammer, Wolfgang, 2011. Presentation in the framework of an Expert Hearing on Targets for Energy Efficiency in the Frame of the Proposed EU-Directive. EU Parliament, Brussels, 29 November 2011. Available at http://www.europarl.europa.eu/document/activities/cont/201112/20111205ATT33198/20111205ATT33198EN.pdf (Accessed 21.08.2013)

European Commission, 2011. Impact assessment accompanying the document Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committtee and the Committee of the Regions. Energy Roadmap 2050.

European Commission, 2008. EU energy trends to 2030 - Update 2007.

European Commission, 2013a. Draft Impact Assessment for a 2030 climate and energy policy framework. Joint Staff Working document – Version publicly available Dec. 2013

European Commission, 2013b. EU energy, transport and GHG emission trends to 2050, Reference Scenario 2013.

Fraunhofer ISI, 2012. Accompanying scientific report – Contribution of energy efficiency measures to climate protection within the European Union until 2050.

Greenpeace, EREC, 2012. energy [r]evolution: A sustainable EU 27 energy outlook.

Pietzner, K., Schumann, D., Tvedt, S. D., et al. (2010): ”Scrutinizing the impact of CCS communication on the general and local public: Results of the representative national surveys of public awareness, knowledge and opinions concerning CCS”, March 2010. Research report.

Wuppertal Institute & Ecofys, 2013. Potential EU energy efficiency targets for 2030. Contribution to Work package 2. Project: Climate change protection and the efficiency policies of the European Union.

Wuppertal Institute & Öko-Institut (2012): Power Sector Decarbonisation: Metastudy Final Report for the SEFEP funded project 11-0. http://www.sefep.eu/activities/projects-studies/metastudy-full.pdf

WWF, Ecofys, 2013. Re-energising Europe. Putting the EU on track for 100% renewable energy.