Development and evaluation of long-term scenarios for a balanced European climate and energy policy until 2030

Summary for policymakers

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Currently the EU 2030 framework for the Energy and Climate policies is under discussion, representing a key milestone of the long-term EU decarbonisation trajectory. In January 2014 the European Commission presented proposed energy and climate objectives to be met by 2030 in the communication "A policy framework for climate and energy in the period from 2020 to 2030"[1]. The Communication proposes a domestic greenhouse gas emission reduction target of 40% compared to 1990 levels and claims that such a target should lead "by itself" to a renewable energy share of at least 27%. Further the analysis shows that such a target "would require an increased level of energy savings of approximately 25% in 2030". In the subsequent Energy Efficiency Communication 2014[2] and against the background of its significant contribution to EU energy security, the European Commission "proposes a new energy efficiency target of 30% for 2030". The European Council is scheduled to take a final decision on the new climate and energy policy framework at its meeting on 23/24 October 2014.

The question is whether the EU should maintain the trio of targets – climate protection, renewable energy and energy efficiency- or whether pure "Low Carbon" target with as instrument emission trading/CO_2 price should be followed.

Within this study commissioned by the German Federal Ministry for Economic Affairs and Energy (Bundesministerium für Wirtschaft und Energie - BMWi), new calculations were conducted with the PRIMES model[3], the same instrument as used for the EU Commission's 2030 impact assessments underlying both the 2030 energy and climate Communication of January 2014 as well as the Energy Efficiency Communication of July 2014. The analysed scenario include three targets namely GHG emission reduction, renewables and energy efficiency target. For reasons of comparability it is based on the same assumptions as regards the impact assessments of the 2030 energy and climate communication and the energy efficiency communication with two exemptions:

[1] [COM(2014) 15] of 22nd January 2014: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52014DC0015:EN:NOT

[2] [COM(2014) 520] of 23rd July 2014: http://ec.europa.eu/energy/efficiency/events/doc/2014_eec_communication_adopted.pdf

[3] The PRIMES model is an energy system model developed and maintained at E3Mlab/ICCS of the National Technical University of Athens (www.e3mlab.eu).

- within the area of renewable energy and energy efficiency lower financing risks which lead to lower cost of capital were assumed due to the assumptions that lower risks apply in the case of specific targets and a specific framework with focussed measures for renewables and energy efficiency,
- the market stability reserve (MSR) for the EU-Emissions Trading Scheme (ETS) was modelled.

The new scenario analysed is within the so-called "decarbonisation" context: the scenario therefore foresee the achievement of the EU's long-term objective to achieve a cut in greenhouse gas emissions by 80% in 2050.

Introducing targets for 2030

The basis for the new scenario analysis was the main scenario of the EC Communication on Climate and Energy 2030 the GHG40 scenario. This is a scenario in which the EU meets the 2020 targets, achieves a 40% GHG emission reduction target in 2030 and achieves an 80% GHG emission reduction in 2050 with the cumulative GHG emissions remaining within a boundary deemed to be compatible with the 2°C temperature rise (in the following this is called carbon budget). The 80% GHG emission reduction target is assumed to be fully anticipated by actors in all sectors of the economy leading to the so-called enabling settings: this implies that technology development (e.g. of electric vehicles) and the behaviour of actors (e.g. lawmakers facilitating RES development and builders adapting houses to strict energy standards) is compatible with the strong emission reduction target inducing early adoption and timely development of infrastructure and technologies.

However the main driver of the GHG40 scenario of the Commission's Impact Assessment is the introduction of carbon pricing without specific measures by sector; this implies that certain non-market barriers persist.

For the current new balanced scenario it was chosen to set additionally a 30% target[4] for Energy Efficiency, following the Energy Efficiency communication, and a 30% RES target.[5]

Introducing targets for energy efficiency (EE) and renewable energy (RES) implies that specific measures to ensure the compliance with these targets need to be adopted supplementing carbon pricing; these specific instruments can ensure a more focused response to non-market barriers which support technology development, in particular where coordination of numerous actors is necessary or where there are high upfront costs. For example RES are long term solutions for the energy supply in the system which through focused policies can be developed in a timely manner to allow the EU to have a competitive advantage compared to other world regions therefore benefitting economic activity and increasing employment benefits in the EU. Long term planning in power generation and grid infrastructure is necessary as the investment cycles are very long and therefore a predictable framework facilitates the planning.

[4] The EE target is primary energy savings compared to the baseline 2007; this is the same definition used for the 20% objective for 2020 and the same as in the Energy efficiency communication.

[5] The RES target is defined as percentage RES in gross final energy consumption, as the current RES target for 2020.

For reasons of comparability the same scenario context, including for sectorial measures, was chosen as in the Commission's scenarios for the impact assessment assuming effective implementation in the future. Thus, the RES target implies strengthening of the intensity of RES policies which include grid development, facilitation of permits and obligations imposing a certain share of RES in supply portfolio. The latter is simulated in modelling terms by introducing a virtual marginal benefit quantified in € by MWh produced by RES (named "RES-value") which can be understood as a price of green certificates or equivalent measures allowing suppliers to meet their renewables obligations. Similarly, as regards energy efficiency, sectorial measures as also envisaged in the Commission's approach have been assumed aiming at improving policy effectiveness for reaching the targets.

The introduction of targets for energy efficiency and renewable energy is assumed, in the context of this scenario, to have a positive effect by reducing the risk in investments for energy efficiency and RES due to the assumption that with targets and focused measures, leading to a reduction in lending costs of capital and a reduction of uncertainty factors applied by investors on costs of equity capital. In modelling terms this is simulated by a reduction of the unit cost of capital facilitating investment in renewable energy and energy efficiency. It must however be specified that the concrete effect of the introduction of targets on the capital cost will depend on the concrete policy framework. The assumptions retained for the scenario presented in this paper are based on a framework which lowers the risk significantly, however, without weakening price signals to investors.

The reduction of capital costs following introduction of targets renders their levelized costs more competitive than other options which invest less upfront but bear higher annual running costs. Therefore overall energy system costs of achieving the additional targets are lower compared to a scenario with equal performance in terms of energy efficiency and RES driven without specific targets. This is due to the working assumption that the targets induce lower uncertainties for investors while the sector-specific measures help removing non-market barriers and thus reduce technology costs.

Introducing the MSR

It is widely recognised that the current high surplus of EUAs (allowances of EU ETS), caused by economic crisis, is expected to continue to increase until 2020 and start decreasing only slowly after 2020. This implies that carbon prices risk to remain at low levels for a rather long period of time although ETS market participants expect carbon prices to increase in the longer term. The projections based on the PRIMES model have also shown that such a risk of low certificate prices is intensified when assuming that the EU achieves 40% of GHG emission reduction by 2030 together with achieving higher shares of energy efficiency and renewables without coordination of instruments.

An early structural reform of EU ETS is needed in any case to improve predictability and continuity. It is important to avoid expectations of persisting low carbon prices followed by sharply escalating prices in the long term which is likely to induce high costs due to uncertainty. In this sense, the MSR would be highly valuable to help adjusting projections to reality and to contribute to the good functioning of the ETS market by providing adequate scarcity signals to investors to encourage continuous and steady GHG mitigation without postponing activity to the times of high prices in the long-term.

Additionally, targets for renewable energy and energy efficiency can improve ex-ante predictability of the contribution from renewables and efficiency to the overall GHG mitigation. Thereby, targets together with the MSR could increase overall predictability and consistency of instruments, thus succeeding to stabilise the ETS market and delivering continued and balanced carbon price signals, hence further influencing low carbon technology investment including for the achievement of the energy efficiency and RES targets.

Within the scenario presented here the Market Stability Reserve (MSR) mechanism is modelled explicitly for the first time in PRIMES in a stylised form; time constraints had not allowed for full representation of the MSR in the scenarios for the EC communication. The main aim was to show the impacts on 2030 certificate prices. The modelling question is therefore whether implementing the proposed Market Stability Reserve combined with a shift of back-loading allowances into the MSR would serve the purpose of EU ETS market stabilisation in the context of a scenario achieving the three targets (40% GHG, 30% energy efficiency and 30% RES). The assumptions about MSR are based on the 2030 Energy and Climate Communication; the mechanism applies from 2021[6] onwards and gradually confines EUA surplus in a range below 833 and above 400 Mt CO_2. It is additionally assumed that the back-loading allowances of 900 MtCO_2 will be taken out of the market before 2020 and directly transferred into the reserve.

Incontestably the structural reform of the EU ETS reduces the risk of holding banked allowances by those being long and provides an incentive to those being short (such as power generators) to keep up demand for allowances while investing in low-carbon technologies. As the system is automatic the stability of the ETS system will be granted under all circumstances (e.g. economic crisis or growth, strong change in international fuel prices, changes in policies), providing for regulatory security and higher predictability. Therefore, the structural reform will help smoothing the trajectory of carbon prices.

The MSR will therefore also help to keep ETS prices at continued and balanced levels if new policies and targets are introduced regarding RES and energy efficiency, as foreseen in the 40% GHG, 30% energy efficiency and 30% RES scenario. The model-based projections have shown that the structural reform of the ETS will avoid persistence of low ETS prices until 2030 but leads to a quick stabilisation of the ETS market. An example is the GHG40/EE/RES scenario of the Energy and Climate Communication which projects continuation of low ETS price until 2030, contrasting the GHG40 scenario which has not included the additional targets. The reform of the ETS allows restoring carbon prices of 2030 with significant price signals for clean investment and thus achieve a workable balance between ETS and sectorial targets for efficiency and renewables.

[6] A start in 2021 was chosen for modelling purposes. It is noticed that some countries such as Germany suggests a start of the MSR already in 2017. For the modelling result as regards 2030 prices this has negligible effects which could not be avoided in the short time available.

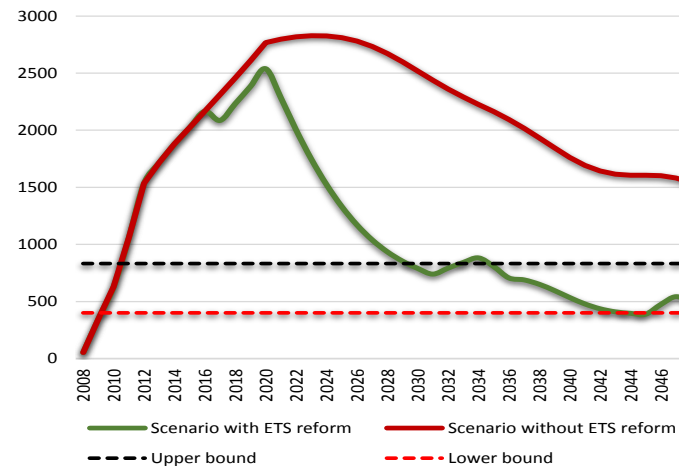
Table 1: ETS carbon prices of selected scenarios

	2010	2015	2020	2025	2030
EU ETS EUA price in EUR'2010/tCO2					
Reference 2013	11	5	10	14	35
EC GHG40	11	5	12	18	40
EC GHG40/EE/RES30	11	5	10	10	11
40/30/30/MSR	11	5	10	15	28
Total ETS auction payments in EU28, annually in billion EUR'2010					
Reference 2013		5.3	10.6	19.8	44.4
EC GHG40		5.3	12.5	23.9	43.9
EC GHG40/EE/RES30		5.3	10.4	13.1	12.0
40/30/30/MSR		5.3	9.4	18.3	28.2

The table above shows the model-based projections of ETS prices and auction payments in constant EUR. It is emphasised that the ETS carbon prices are essentially marginal costs of emission abatement and are projected to further increase post 2030 because the scenario foresees deep decarbonisation of the energy system until 2050 and in this context removing the remaining few amounts of emissions in the long term can be entailing higher marginal costs, when viewed from today's perspective. It is further emphasised that because emissions reduce drastically, the auctioning payments in ETS also reduce considerably over time beyond 2030 despite the increase of the carbon prices. In other words the burden to actors from ETS is considerably reduced in the long term while the market delivers the expected deep emission cut. It is worth noting that the new 40/30/30/MSR scenario has lower auctioning payments than any of the other scenarios shown in the table above in the time period after 2030.

The absence of the ETS reform would imply that such a balance would be visible only after 2030 which obviously would increase uncertainty surrounding clean investment in all sectors. On the other hand, the MSR also avoids strong price increases towards 2050. As can be seen in Table 15 of the Commission's impact Assessment, the GHG40 scenario leads to steep price increases in the time beyond 2030. Applying sectorial targets for efficiency and renewables already has a significant attenuation effect. The current calculations in the new balanced scenario show that implementing the MSR could have a further balancing effect and ensure a significantly more moderate development of the carbon price between 2030 and 2050.

Figure 1: EUA surplus trajectory



As shown in the figure, the back-loading in 2014-16[7] and the start of the MSR mechanism in 2021 allows for the allowance surplus to rapidly decrease within the boundaries permitted by the

[7] As can be seen in Figure 1, the surplus reduces when the back-loading quantities are put to the reserve; however in 2017-2018 when no allowances are removed and the MSR has not yet started the surplus increases again.

MSR regulation and therefore a more stable ETS market is in place before 2030, implying that the ETS prices will not fall considerably with the introduction of the additional targets in 2030; the MSR will lead to an ETS price signal that encourages continuous GHG mitigation between 2020 and 2030. If the back-loading volumes will be re-introduced in the market in 2019 and 2020, then the stabilisation of the ETS market would take place more slowly than shown in the figure.

The 40/30/30/MSR balanced scenario

The 40/30/30/MSR balanced scenario includes a 40% GHG emission reduction, a 30% RES target and a 30% EE target in 2030, as well as the Market Stability Reserve mechanism and the back-loading of 900Mt CO_2 allowances with transfer into the MSR; the scenario is in the context of overall decarbonisation settings therefore includes the 80% GHG emission reduction target for 2050, the carbon budget constraint and as it assumes foresight of the long term emission reductions it includes enabling settings in all sectors. Compared to the Commission scenarios the new 40/30/30/MSR balanced scenario also includes the agreed F-gas regulation but no further emission reductions of non-CO_2 gasses until 2030 from Reference scenario levels[8].

The approach for this scenario is to achieve a context with several objectives simultaneously met, which has inherent coherence: all sectors have significant measures in place in order to ensure their smooth development over time and the removal of non-market barriers. The projected sectorial achievements in energy efficiency and renewables provide further benefits in terms of economic activity and employment.

The scenario achieves the RES targets and the EE targets through a combination of demand side investments in energy efficiency, particularly in the residential and tertiary sectors, as well as through the increase of RES in the energy supply side.

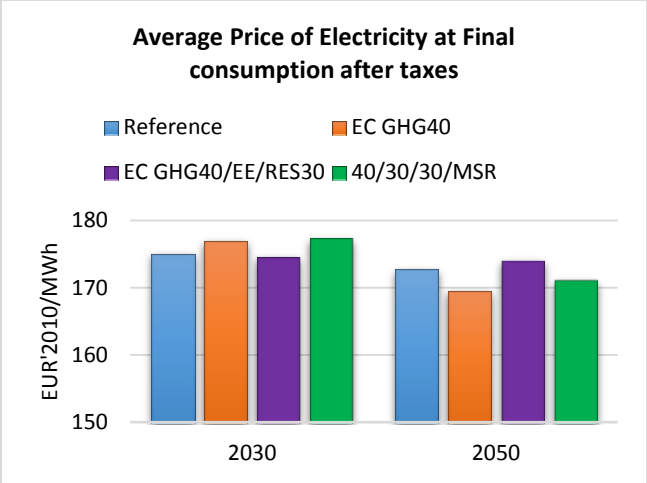
Effects on the electricity Sector

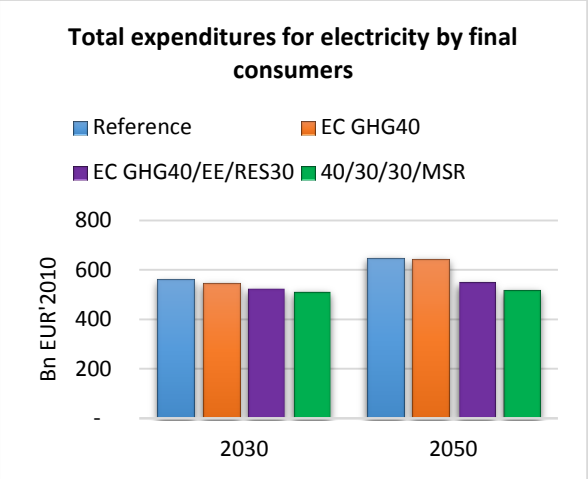
Despite the higher RES share in power generation and the higher ETS price the resulting short-term electricity prices of such a combination are only slightly higher than in similar scenarios which do not include the additional targets and the MSR, because the higher RES share in power generation combined with higher ETS prices leads to higher electricity prices for consumers. After the achievement of the targets in 2030 however the electricity prices stabilise below the peak level of 2030. The price divergence from the GHG40 scenario remains below 4% throughout the projection period.

Nonetheless, the 40/30/30/MSR involves lower expenditures for electricity by final consumers compared to all other scenarios, because of the combination of energy efficiency and the reduction of capital costs for RES.

[8] Including emission reduction of non-CO_2 gasses until 2030 would lead to approximately 41.4% reduction of overall GHG by 2030 in the context of the new 40/30/30/MSR balanced scenario, according to PRIMES model calculations.

Figure 2: Effects on average electricity prices and bills





Effects on Overall Energy System Costs

Table 2: Summary of key scenario parameters

	2030			2011-2030	
	GHG[a)]	RES[b)]	EE[c)]	Average annual costs [d)]	Difference from 40/30/30/MSR balanced
GHG40	-40.6	26.5	-25.1	2068.5	0.00%
GHG40/EE/RES30	-40.7	30.3	-30.1	2089.2	1.00%
40/30/30/MSR balanced	-40.2	29.8	-29.4	2068.5	

[a)] *Greenhouse gas emission reductions domestically in the EU compared to 1990*

[b)] *Share of renewable energy sources in gross final energy consumption*

[c)] *Primary energy savings compared to the Baseline 2007*

[d)] *Average annual energy system costs, calculated from the perspective of final users of energy inclusive of all expenditures and investment for energy purposes, excluding. auction payments and disutility (bnEUR'2010)*

The performed modelling analysis shows that by setting a reliable framework, the overall financing costs can be significantly reduced. As to the average annual system costs, the 40/30/30/MSR balanced scenario with a 30% renewable energy and a 30% energy efficiency target results amounts to €2068 billion per year until 2030. This equals the costs of the GHG40 scenario which assumes only the emission reduction target of 40% and leads to lower shares of renewable energy (27%) and energy efficiency (25%) in 2030.

Conclusions

The PRIMES-based projections confirm that there exist a workable combination of ambitious GHG target and high shares of RES and EE with a combined approach of an ETS reform based on MSR and targets for RES and EE help to ensure market stability of the ETS, continued and balanced price signals and inclusion of sectorial measures which are effective in addressing non market barriers in EE and RES.

The structural reform of the ETS, based on the MSR, is anyway necessary to induce stability of the ETS and to avoid long periods of low prices followed by strong price increases, as shown in some of the PRIMES scenarios in the absence of ETS reform.

The inclusion of the RES and EE targets help transparency and predictability, while combined with the MSR enable consistent functioning of the market with the sectoral policies.

Regarding costs it is important to consider focused measures which eventually remove barriers and facilitate reduction of capital costs in EE and RES; this is found beneficial for compliance costs of the entire system.

Clearly the combined trio-target and MSR scenario has merits regarding policy implementation, reduction of uncertainty and stability/predictability of price signals for investors thereby reducing costs of capital.