

Assessing ETS price projections Sensitivity Analysis using the PRIMES model

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Introduction

- ▶ The **PRIMES** energy market model has been extensively used to project energy and GHG emissions for the EU to the horizon of 2020, 2030 and 2050
- ▶ The EU policy package is asymmetric: it combines a price driver (**EU ETS**) with bottom-up policies to meet separate targets for Renewables (**RES**) and Energy Efficiency (**EE**)
- ▶ As the degree of achieving the RES and EE targets will influence the ETS carbon prices, concerns arise about the compatibility of the three targets and the possible adverse effects on ETS prices
- ▶ We quantify **numerous sensitivity scenarios** using the PRIMES model and we report on the likely impacts of RES and EE targets on ETS prices
- ▶ **The findings suggest that energy demand, hence EE, has larger impacts on EU ETS prices than Renewables.**

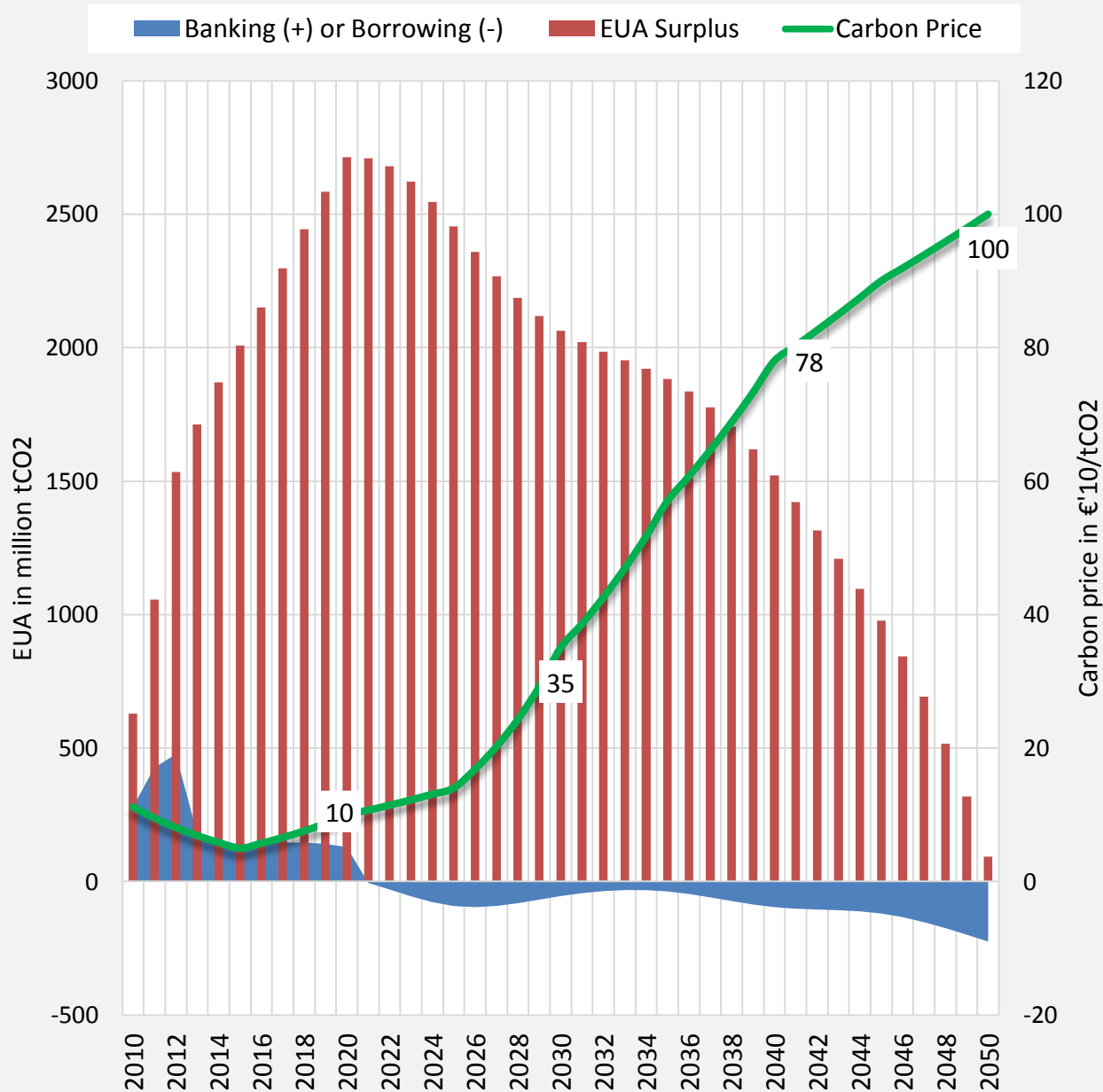
The PRIMES model

- ▶ Detailed energy demand and supply model with sectoral-modular organization.
- ▶ PRIMES simulates price-driven equilibrium in simultaneous energy and emission markets driven by actors' behaviours, technology change and policy instruments.
- ▶ Demand, supply, prices and investments are endogenously projected over long term by Member-State and for the EU as a whole, incl. the EU-wide markets for electricity and ETS.
- ▶ The modelling of behaviours is founded on micro-economics and is subject to engineering-type constraints with explicit present and future technologies
- ▶ Generally perfect anticipation is assumed for the actors but risk-averse behaviours are also modelled

ETS modelling

- ▶ PRIMES can handle simultaneous targets for GHG emissions, renewables and energy efficiency and in the modelling it distinguishes between ETS and non-ETS
- ▶ To derive ETS carbon prices, PRIMES assumes that allowances (EUA) are known until 2050
- ▶ Actors belonging to ETS sectors reduce emissions at a pace derived from a multi-period energy-related profit optimization assuming that they are price-takers in the ETS market
- ▶ Emission reduction dynamically influences EUA surpluses/deficits in ETS and PRIMES calculates carbon prices over the entire projection period using Hotelling-type modelling (surplus justified on the basis of future carbon price increases); in turn EUA prices further influence the pace of emission reduction.

Reference Scenario 2013



The Reference 2013 scenario

Projection that includes:

Achievement of Energy and Climate Policy Package by 2020

Implementation of Energy Efficiency Directive

Continued decrease of EUA until 2050 according to the 1.74% linear reduction rule (no back-loading or other corrective measures)

ETS Carbon Prices (€'10/tCO₂)

Range depending on GDP growth

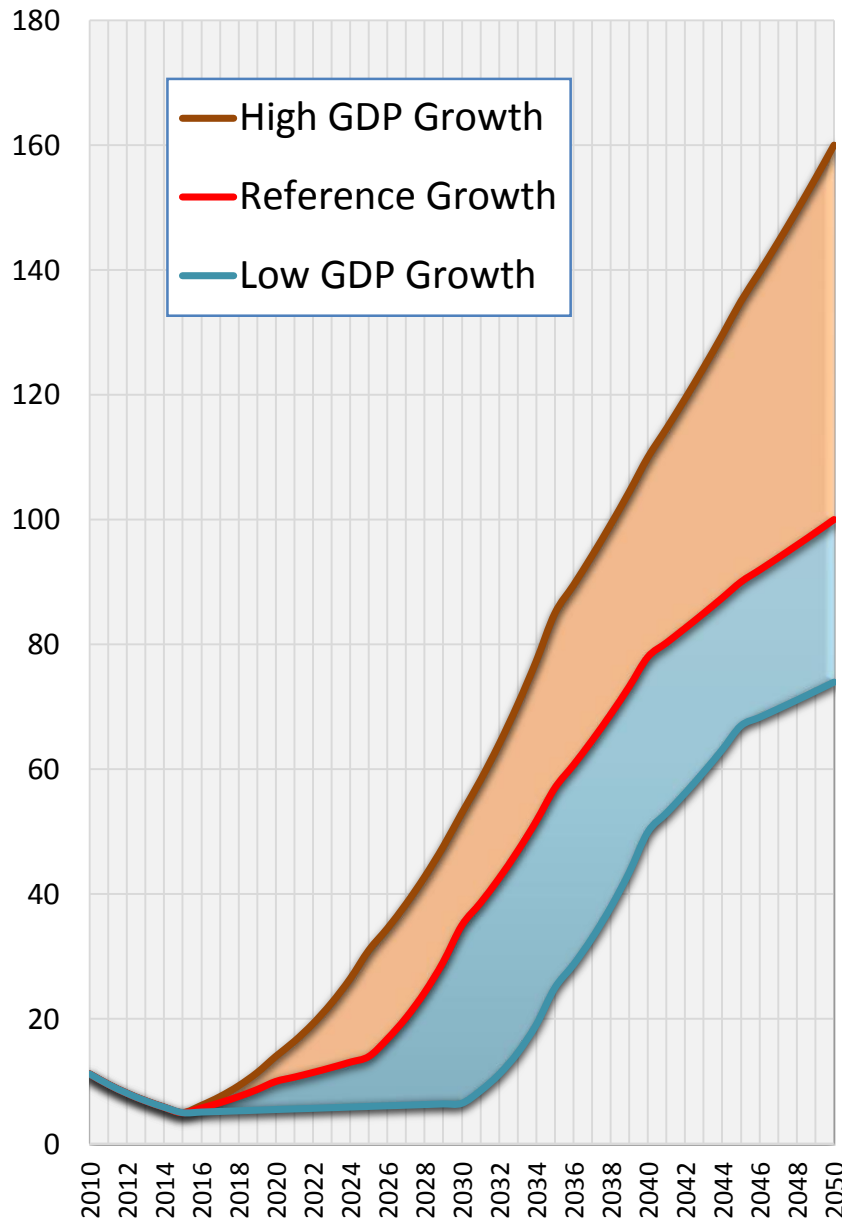
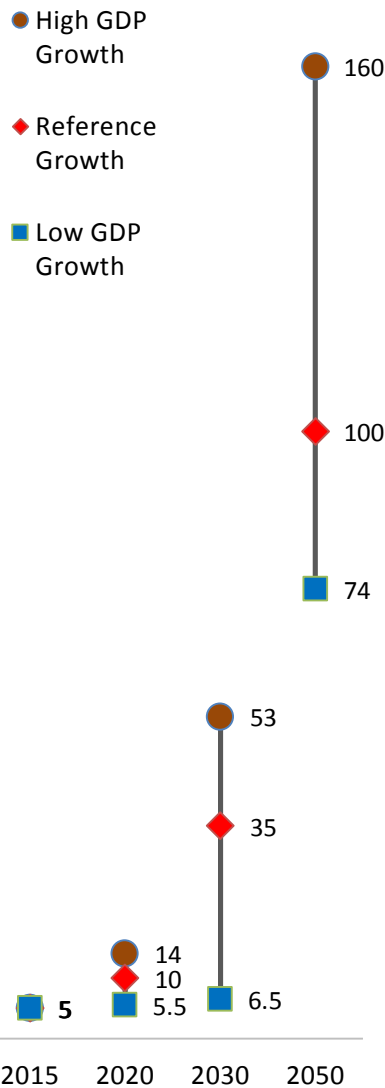
GDP Growth sensitivity

GDP growth sensitivity: ± 0.4 pp/annum relative to reference scenario (1.5% growth rate)

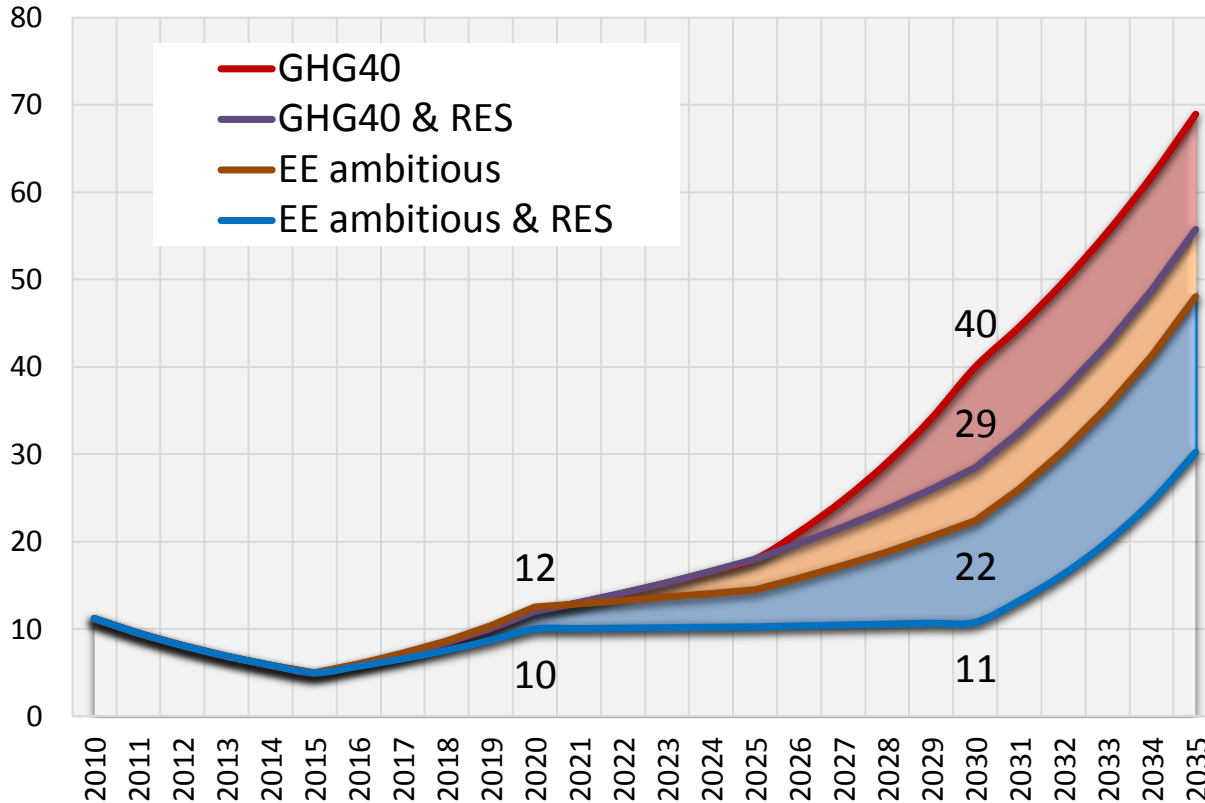
Impacts on energy demand (deviation from reference):

- $\pm 2\%$ in 2020
- $\pm 7\%$ in 2030
- $\pm 17\%$ in 2050

A mere 1% annual growth in the EU implies persistence of low ETS carbon prices until 2030



ETS Carbon Prices (€'10/tCO2)



Sensitivity analysis of a 40% GHG target for 2030

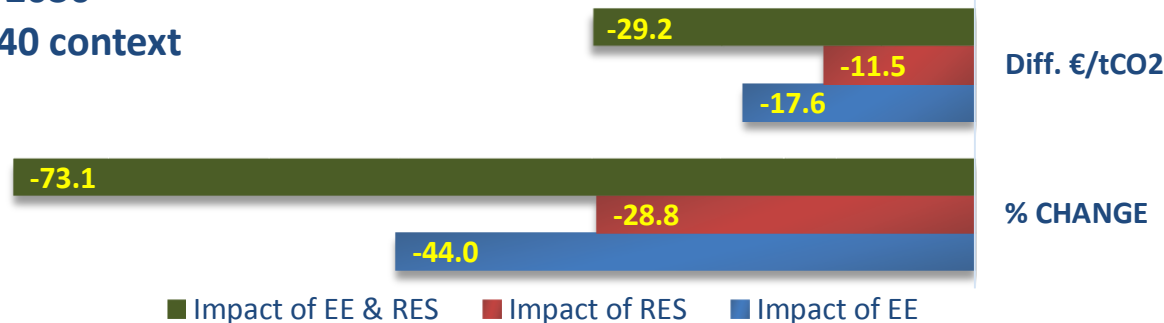
Scenarios reaching 40% GHG emission reduction in 2030 and 80% in 2050

EUA decrease linearly assuming a 2.6% reduction rule from 2021 onwards

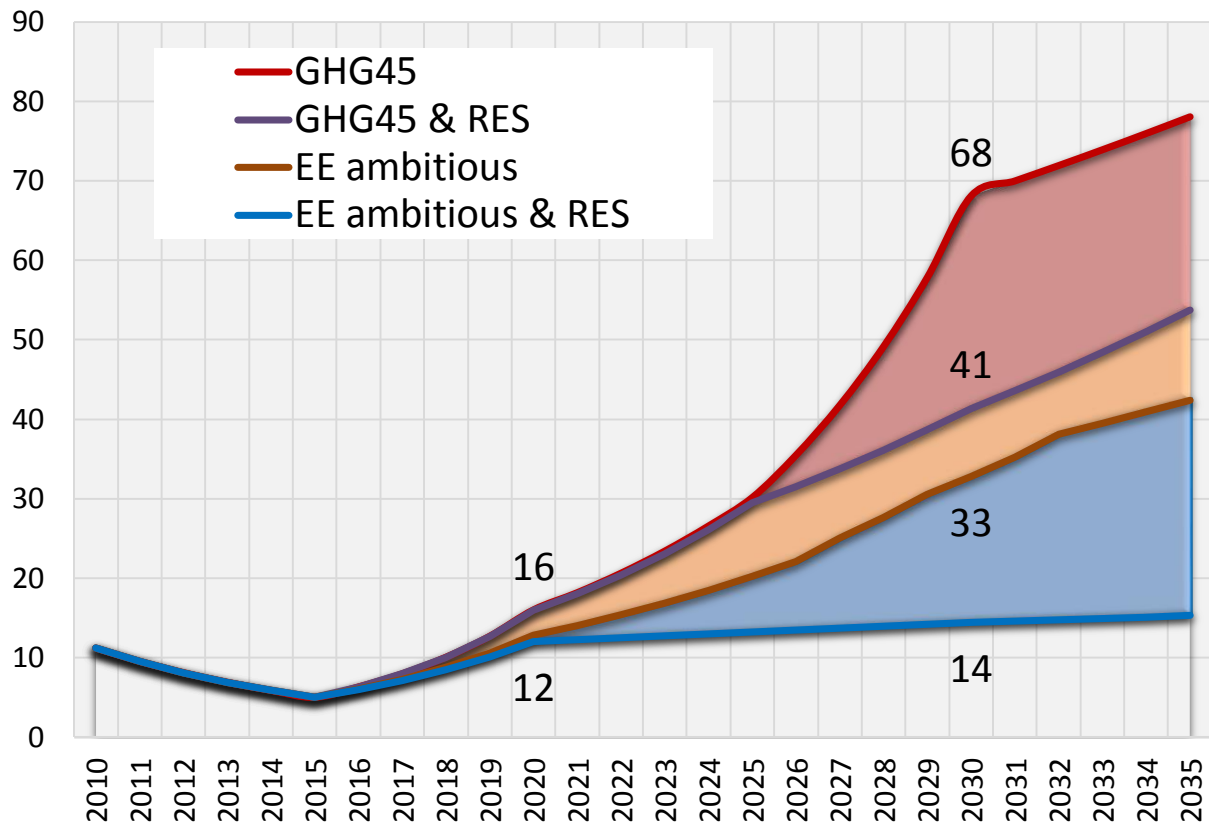
RES and EE in GHG40 are driven by carbon prices, other scenarios apply additional targets/policies for RES and/or EE

Adding combined EE and RES policies to GHG40 implies very low carbon prices until 2030. The impact of EE on carbon prices is higher than that of RES

2030 GHG40 context



ETS Carbon Prices (€'10/tCO₂)



Sensitivity analysis of a 45% GHG target for 2030

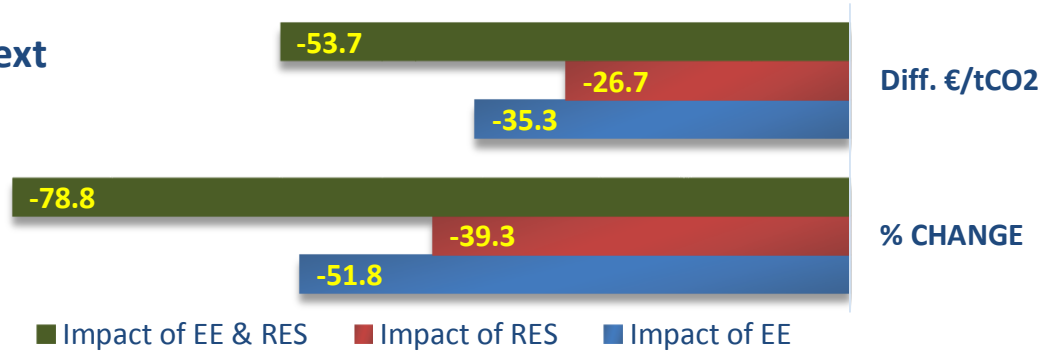
Scenarios reaching 45% GHG emission reduction in 2030 and meeting a carbon budget cumulatively up to 2050.

EUA decrease linearly assuming a 3.2% reduction rule between 2021 and 2030 and 2.3% rule after 2030

RES and EE in GHG45 are driven by carbon prices, other scenarios apply additional targets/policies for RES and/or EE

Adding combined EE and RES policies to GHG45 implies very low carbon prices until 2030 despite the 45% objective. The impact of EE on carbon prices is higher than that of RES in 2030.

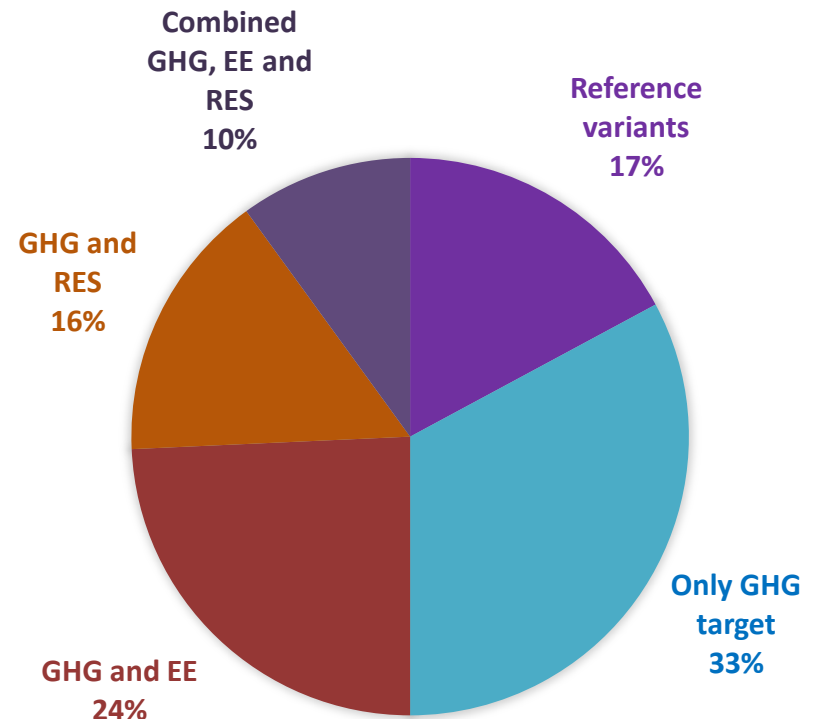
2030 GHG45 context



More extensive sensitivity analysis

- ▶ Sample of 70 scenarios quantified using PRIMES model
- ▶ Varying scenario assumptions
 - ▶ With or without GHG emission reduction targets
 - ▶ With or without additional RES targets
 - ▶ With or without additional energy efficiency (EE) policies
- ▶ Econometric analysis using cross-sectional data for 2030 derived from model projections
- ▶ Dependent variable: ETS carbon price (Log of CP)
- ▶ Explanatory variables:
 - ▶ Share of RES in electricity sector (RES-E%)
 - ▶ EE performance (% change of primary energy consumption relative to PRIMES 2007 projection) (EE%)
 - ▶ % reduction of GHG emissions relative to 1990 (GHG%)

CLASSIFICATION OF PRIMES SCENARIOS



Econometric results for 2030 model outputs

Estimations		EE%	RES-E%	GHG%	Constant	R-squared	Normality Prob.
1	Coefficient	-7.632			5.348	25.0%	0.089
	<i>t-Statistic</i>	-4.413			13.190		
2	Coefficient		-2.829		4.816	6.4%	0.005
	<i>t-Statistic</i>		-1.540		5.731		
3	Coefficient	-9.149	1.668		4.922	26.2%	0.221
	<i>t-Statistic</i>	-3.987	0.949		7.698		
4	Coefficient	-18.413	-1.591	16.245	2.273	83.7%	0.483
	<i>t-Statistic</i>	-10.157	-1.751	12.124	6.508		
5	Coefficient	-19.410		15.649	1.994	82.6%	0.381
	<i>t-Statistic</i>	-15.392		15.195	6.526		
6	Coefficient		-6.574	7.786	3.496	24.2%	0.056
	<i>t-Statistic</i>		-3.433	3.823	4.269		

EE% is statistically far more robust than RES% as explanatory variable of ETS carbon price

GHG% variable includes effects on ETS carbon prices from future EUA amounts as assumed by scenario

EE% and GHG% variables are almost sufficient to explain ETS carbon prices

According to estimation No 4, one pp increase in EE% drives 18% drop of ETS carbon prices while one pp increase in RES-E% drives only 1.6% drop of carbon prices

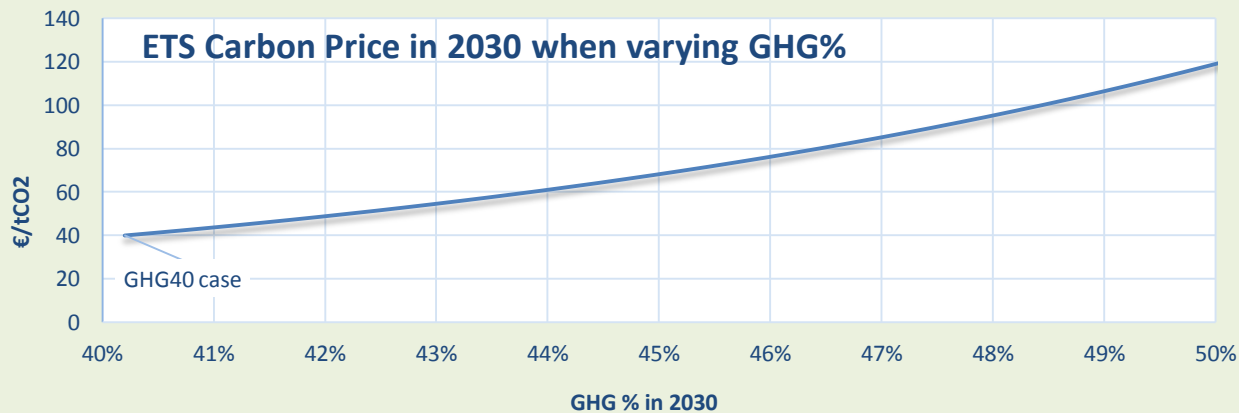
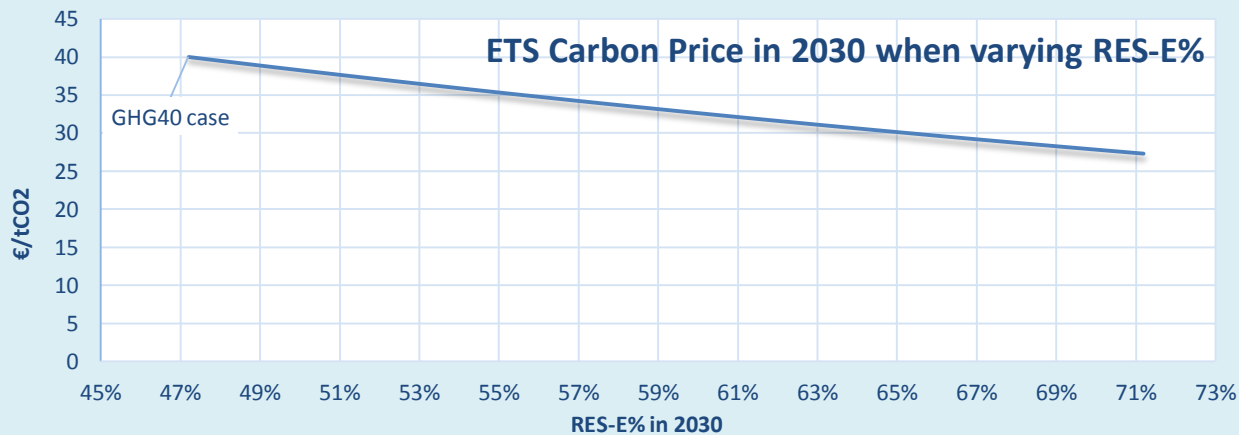
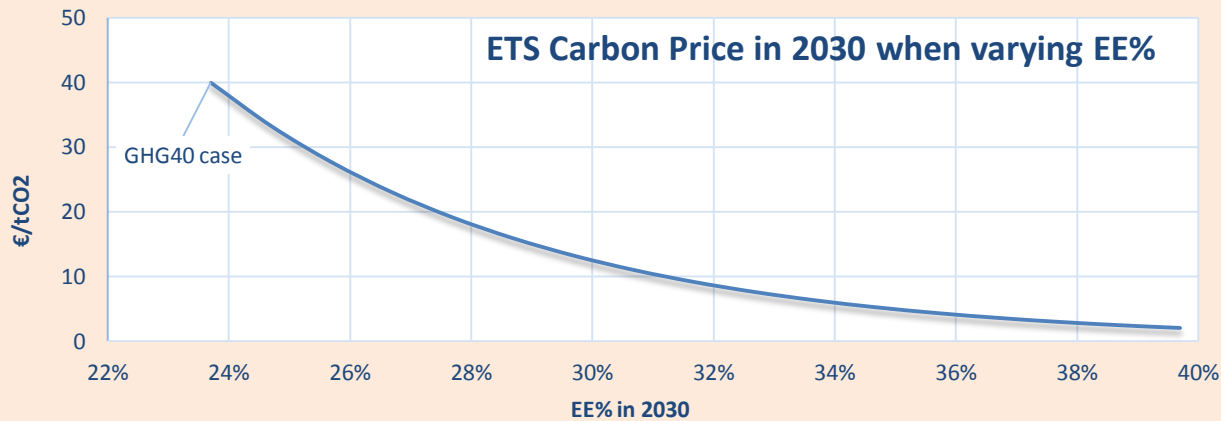
Using estimation No 4 to forecast ETS Carbon Prices in 2030

Explanatory variables are EE%, RES-E% and GHG%

Energy demand (expressed via EE%) has a non-linear effect on ETS carbon prices

RES in electricity sector (RES-E%) have a quasi-linear effect on ETS carbon prices (with RES-E% in a reasonable range)

Increase of GHG emission reduction target for 2030 drives higher ETS carbon prices in a range between 40 and above 100 €/tCO₂, unless additional EE and/or RES policies are deployed



Concluding remarks

- ▶ Energy demand has significantly higher effects on ETS carbon prices than renewables
- ▶ The pace of economic recovery in the EU is probably the most influential factor for ETS carbon prices, in the period 2020-2030
- ▶ Adopting energy efficiency (EE) and/or renewables (RES-E) policies aiming at targets above levels driven by carbon prices will reduce ETS prices, with EE having larger impacts than RES-E
- ▶ Modifying post-2020 the pace of EUA availability is a powerful tool to adjust carbon prices to reasonable levels despite co-existence of EE and/or RES policies-targets