Supplementary Table 2. Sensitivity analysis

Experiment 1

In Table S2-1, the projected 2020 price for ETS emissions permits is varied with respect to the current projection of €50 (2020 permit prices above €90/tCO_2 are not considered as realistic). Results are presented for the fossil fuel and electricity industries which are in the ETS scheme; permit imports; and real macro aggregates of GDP and employment. As expected rises in the permit price result in increasing energy prices and falling energy outputs. As expected, the energy output fall is inelastic with respect to price rises, whilst as the 'dirtiest' energy source, the price rises in coal are the largest as we increase the permit price. With a higher permit price, Spanish imports of permits fall from 82 million tonnes (€10/tCO_2) to 32.4 million tonnes. The impact on the macro-economy (real GDP and employment) is muted. Side calculations show that even at a permit price of €90/tCO_2, the hypothetical cost in 2007 of the ETS emissions would have been less than 1% of Spanish total Spanish industry costs, and 6% of Spanish ETS industry costs. Moreover, the continued (although declining) issue of free ('grandfathered') permits reduces the cost impact in the ETS industries. Finally, we take the view that higher permit prices would give even greater impetus to cleaner technologies (*i.e.,* substitution of energy for capital in the production nest), thereby mitigating the negative impact on employment and growth. Although not shown, the results suggest that the rise in the ETS price from €10/tCO_2 to €90/tCO_2, has no real impact in the agricultural sector.

Table S2-1. Sensitivity analysis of the emissions trading scheme (ETS) permit price

	€10/tCO_2	**€50/tCO_2 (standard)**	**€90/tCO_2**
Macro indicators:			
Real GDP (%)	-1.9	-2.1	-2.3
Employment (%)	-2.3	-2.4	-2.5
Imports of ETS permits	82.0 million	49.0 million	32.4 million
Energy industries:			
Output (%)			
Coal	-11.2	-26.5	-34.4
Gas	-9.6	-14.7	-18.6
Electricity	-2.3	-6.1	-9.1
Petrol	-7.5	-8.4	-9.1
Price (%)			
Coal	43.2	119.8	205.24
Gas	90.6	95.6	104.5
Electricity	3.1	5.4	12.8
Petrol	31.2	32.6	34.2

GDP: gross domestic product. ETS: emissions trading scheme

Experiment 2

As a key parameter in our model, a sensitivity analysis of the elasticity of substitution between energy and capital is presented in Table S2-2. A higher elasticity allows firms more flexibility to substitute energy emitting activities for capital (*i.e.,* cleaner technologies). This leads to reduced energy demand and increased capital usage, which mitigates the adverse macroeconomic impact of the emissions reduction targets. As a result, the Spanish economy witnesses a slight relative improvement in real growth and employment resulting in a greater 'demand pull' increase in the consumer price index.

Focusing on the agricultural sector, greater capital substitution possibilities improve production and reduce supply prices (less usage of 'dirtier' energy sources). Indeed, doubling the standard elasticity of substitution results in a reduced abatement cost estimate of €67/tCO2e – a 38% cost reduction compared with the lowest substitution elasticity.

Table S2-2. Sensitivity analysis of the capital-energy substitution elasticity (σ)

	0.5 × σ	**σ (standard)**	**2 × σ**
Macro indicators			
Real GDP (%)	-2.3	-2.1	-2.0
Employment (%)	-2.8	-2.4	-2.3
Consumer price index (%)	3.1	3.4	3.8
Agricultural sector			
Agricultural output (%)	-4.7	-4.3	-4.2
Agricultural supply price (%)	8.7	7.7	7.1
Agricultural MAC	€108.9/tCO2e	€86.2/tCO2e	€67.3/tCO2e
Energy industries			
Coal output (%)	-22.1	-26.5	-33.7
Gas output (%)	-8.8	-14.7	-23.0
Electricity output (%)	-1.2	-6.1	-13.8
Petrol output (%)	-6.7	-8.4	-10.4

MAC: marginal abatement cost