EUROPEAN ELECTRICITY CO-OPERATION :
The Role of Import and Export in CO_2 Reduction

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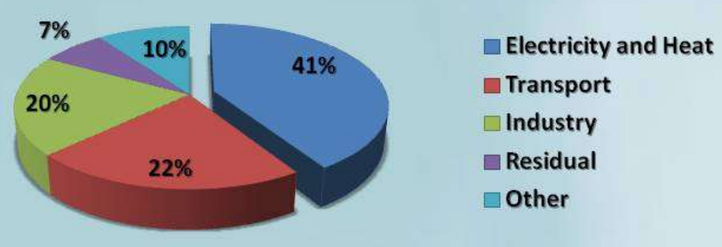
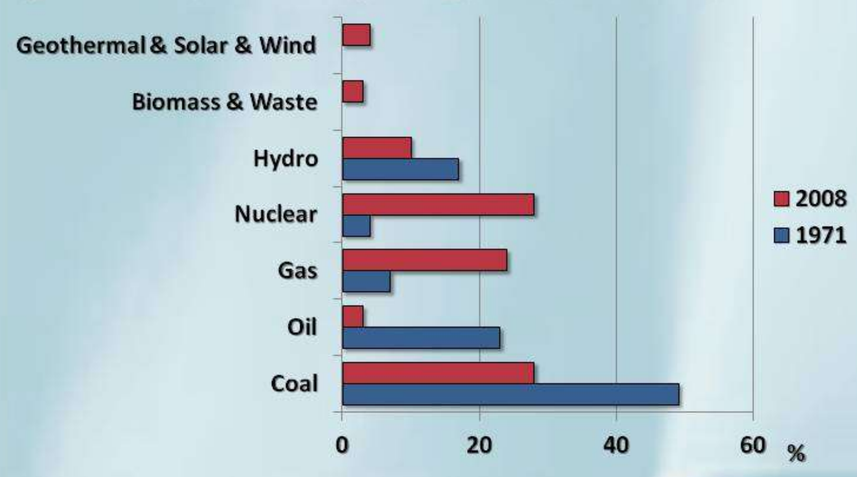
1. PROBLEM

Figure 1: World CO_2 by Sector in 2008 (IEA)



The greater part of Carbon Dioxide (CO_2) emissions comes from the production of energy, especially electricity, which the world cannot do without. In order to meet targets aimed at tackling climate change, European countries increase electricity generation from renewable energy sources and nuclear power.

Figure 2:Europe's Evolving Energy Mix (EWEA's EU)



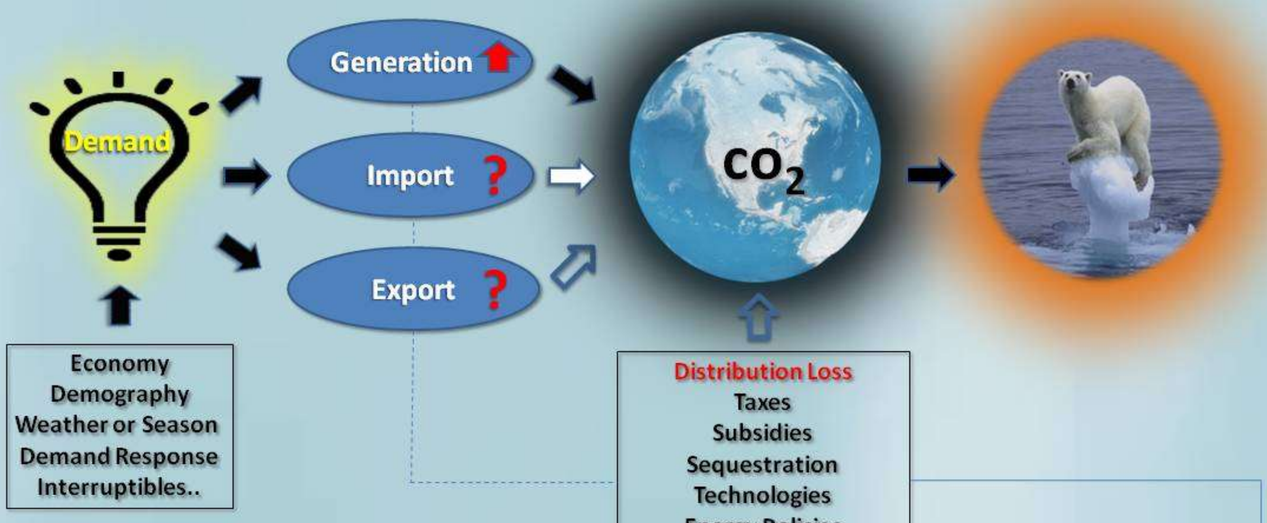
However, renewable energy has problems with regard to economic costs and instability of supply, while nuclear power generation involves issues of safety and radioactive waste management. It seems that in the future we will still rely on fossil fuels. As a result, world electricity emissions are expected to nearly triple from 2005 to 2050 (Treasury estimates from GTEM), so doing nothing is not an option.

2. WHAT CAN WE DO?

Since 1990, growth in world net electricity generation, has outpaced growth in total electricity consumption, and this surplus is expected to make up one third of electricity generation by 2035. In Europe, electricity surplus accounted for about 14.39% of generation from 1971-2007 (IEA, statistic). This suggests that import and export of electricity may prove mutually beneficial for countries. Such international trade could not only increase electricity supply for excess demand countries while providing an economic gain for excess supply countries, but also decrease levels of CO_2 emissions from electricity generation.

"This study examines whether electricity co-operation regarding import and export in Europe can reduce CO_2."

3. CONCEPTUAL FRAMEWORK



4. ECONOMETRIC MODELS

$$\Delta ln\,(CO2_{it}) = \alpha + \beta_1\,\Delta ln\,(CO2_{i,t-1}) + \beta_2\,\Delta ln\,(GC_{it}) + \beta_3\,\Delta ln\,(M_{it}) + \beta_4\,\Delta ln\,(X_{it}) + \beta_5\,EU_{it} + \mu_i + \varepsilon_{it}$$

where the explained variable is CO_2 emissions from main activity electricity plants (***CO_2***). The explanatory variables are CO_2 emissions from main activity electricity plants of the last period (***$CO_{2\ i,t-1}$***), electricity generation for country (***GC***), electricity import (***M***), electricity export (***X***) and membership of the European Union (***EU***). μ_i is unobserved variables, ε_{it} is an error term, ***i*** denotes countries and ***t*** denotes years.
Membership of the European Union (*EU*) is included in Model 1, but not in Model 2.

5. METHODOLOGY

Panel data analysis is followed by comparison of CO_2 emissions functions, using 45 European countries' yearly data from 1971 to 2007. Econometric testing for ***POLS, fixed effects*** and ***random effects*** estimation methods is used to select the appropriate method.

6. RESULTS

The Hausman test shows that random effects is not accepted, hence fixed effects is employed to explain the results for both models.

Europe (45 countries) 1971-2007 (Unbalanced Panel)	POLS		FIXED (WITHIN)		RANDOM	
	(1)	(2)	(1)	(2)	(1)	(2)
$\Delta ln(CO2_{t-1})$: lag1_CO_2 Emissions	-0.029 (0.024)	-0.028 (0.024)	-0.051** (0.025)	-0.051** (0.025)	-0.029 (0.024)	-0.028 (0.024)
$\Delta ln(GC)$: Generation for country	0.498*** (0.028)	0.499*** (0.028)	0.491*** (0.028)	0.491*** (0.028)	0.499*** (0.028)	0.499*** (0.028)
$\Delta ln(M)$: Import	0.031*** (0.011)	0.031*** (0.011)	0.031*** (0.011)	0.031*** (0.011)	0.031*** (0.011)	0.031*** (0.011)
$\Delta ln(X)$: Export	-0.021** (0.009)	-0.020** (0.009)	-0.022** (0.009)	-0.022** (0.009)	-0.021** (0.009)	-0.020** (0.009)
(EU): Membership of the European Union	0.014 (0.020)		0.025 (0.042)		0.014 (0.020)	
α_0: Constant	-0.002 (0.012)	0.003 (0.009)	-0.006 (0.017)	0.003 (0.009)	-0.002 (0.012)	0.003 (0.009)
σ_μ			0.057	0.056	0	0
σ_ε			0.344	0.344	0.344	0.344
ρ			0.026	0.026	0	0
F-Statistics	82.34***	102.84***	78.28***	97.80***		
X^2					411.72***	411.36***
Observations	1,328	1,328	1,328	1,328	1,328	1,328

notes: (1) Standard errors in ( )
(2) *** and ** illustrate significance at 1% and 5% levels respectively

7. DISCUSSION

The tiny amount of CO_2 increase from import (3.1%) may be partly the result of emissions from related processes e.g. construction, maintenance and transport. However, the increase is much lower than for electricity generation (49.1%). The decrease in CO_2 from export (-2.2%) may be due, in part, to countries exporting electricity from excess supply, and also since flue sources are not normally used to generate for export. In addition, through economies of scale, trade reduces social cost and, therefore, emissions.

The results further show that close political alliance among 19 EU members does not have an added effect on CO_2 reduction, hence their green energy policy needs to be improved to increase efficiency in the electricity market.

8. CONCLUSION

European electricity co-operation regarding import and export is highly significant in decreasing CO_2 emissions. Such international co-operation can have a positive impact on efficient management of decarbonisation of energy supply and be instrumental for governments in the fight against global warming.

"Not only for polar bears, but for all life on our planet"

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