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PROSPECTS FOR THE DIFFUSION OF NEW RENEWABLE POWER GENERATION TECHNOLOGIES IN TURKEY

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In this research, a model for energy-economy-environment integrated policy assessment is developed and calibrated to elaborate the diffusion prospects for new renewable power generation technologies in Turkey. The model aggregates energy demands, capital requirements and labor inputs under an economy-wide nested constant elasticity of substitution (CES) production function. Energy demands are separated into electric and non-electric energy as two broad categories of secondary energy forms. The supply side includes a detailed representation of energy conversion technologies through an engineering process and activity analysis framework. Supplies and demands are equilibrated within each time period, thereby having intertemporal interaction as a result of the savings-investment accumulation process inherent in the model formulation. The disaggregate energy sector representation of the model features to estimate energy-induced pollutant emissions in a detailed manner. The associated environmental submodel includes feedback links both to the energy sector and the economy. The environment-economy link is based on a willingness to pay (WTP) function which defines the willingness of consumers to pay the additional cost of more expensive renewable power generation technologies for reducing CO_2 emissions. The environment-energy link is established via emission reductions achieved through the use of new renewable power generation technologies. The comparatively high cost of these technologies is a major factor discouraging investment today. However, this effect diminishes in time due to the technological learning functions integrated into the model, which reduce unitary costs as installed cumulative capacity increases. The diffusion of new renewable power generation technologies occurs in line with associated demand for green energy as defined by the WTP of consumers.

The WTP equation is based on data gathered from a pilot survey, in which the Contingent Valuation Method was employed as a generally favored survey technique for assigning monetary values on non-marketed assets. Survey results are evaluated using multiple regression analysis and the resulting WTP equation –a function including different income categories depending on a group of randomly selected households– is integrated into the model. The income distribution dynamics used in the model is evaluated exogenously.

Emission trading certificates (as defined under the flexibility mechanisms of the Kyoto Protocol) are considered as an additional incentive to promote the expansion of renewable power generation capacity. The additional income from emission reduction is lump-sum subtracted from the overall costs of renewable electricity technologies.

The nonlinear optimization model is calibrated so as to yield aggregate economic equilibrium results for Turkey, an EU candidate country with high GDP and energy growth rates. For the last decade, there has been an annual population growth rate of 1.3%, and a dynamic economic structure with 6.2% annual average GDP growth. The country's primary energy demand has grown 3.8% annually and, if this trend continues, there will be a doubling of energy consumption by 2025 and a tripling by 2035. The per capita electricity production in Turkey is nearly 2000 kWh and thus the lowest one among EU-member and

candidate countries. A continued rapid expansion of the energy sector can be expected with the growing economy. The great renewable energy potential of the country seems to be an opportunity for new investment, challenged by economic considerations. In year 2004, 31% of electricity generation was obtained from renewables. However, the share of hydropower is absolutely dominating with 99.5%. Our focus is on the prospects for the diffusion of *new* renewable power generation technologies including the utilization of solar, wind, biomass and geothermal resources.

Results of the reference (Business-As-Usual) scenario are compared to various environmental policy scenarios with reference to the acquis of the EU. Learning rates, income distribution dynamics, emission trading certificates and emission reduction targets are particularly taken into consideration in the scenarios to evaluate the diffusion prospects of new renewable power generation technologies. The results suggest various useful policy implications for an environmentally and economically sustainable development of the country and provide long-term prospects for effective and applicable energy policy solutions to foster investment into new renewable energy technologies..