15 APPENDIX II: Brief Description of Models Used in the Study[46]

The POLES and PRIMES models have been developed within a series of collaborative research projects partially funded by the European Commission, Joule Programme of DGXII. Pierre Valette Head of Unit F1 of DGXII has supervised on behalf of the European Commission. In 1998 both of the models have been successfully peer-reviewed by external referees in the context of a special procedure organised by DG XII.

15.1 The PRIMES Model

15.1.1 Introduction

The history and the status of operationality of the PRIMES energy system model for the EU-15 countries in presented in this chapter.

From the very begnning, in 1993-1994, the PRIMES energy model was designed to focus on market-related mechanisms influencing the evolution of energy demand and supply and the context for technology penetration in the market. The PRIMES model also was designed to serve as an energy policy analysis tool including the relationships between energy policy and technology assessment.

Detailed technological models, often categorised in bottom-up approaches, have been among the first ever constructed energy system models. This was also the case of the models developed in the context of DG XII, as for example EFOM and MEDEE. A continuity from older technological (or engineering explicit) energy model has been set as one of the main requirements for PRIMES.

[46] Detailed manuals of the models contained in this Appendix can be found in the full report under the project JOS3-CT95-0008.

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The older models have formulated a single, global mathematical programming (optimisation) problem that covers the energy system. Examples are EFOM, MARKAL, BESOM etc.. In policy analysis, these models have been criticised for the lack of explicit representation of markets, the absence of market-based policy instruments and the lack of realism in formulating demand and the "individual" behaviour of demanders or suppliers.

The efficiency gap problem illustrates the methodological failure of such bottom-up models, being unable to represent seemingly non cost-effective choices of consumers or producers. Micro-economic analyses suggested that the gap can be explained by specific conditions that prevail in the markets (distortions, barriers, etc.) and by the individual behaviour of economic agents (for instance, small consumers may use high subjective discount rates). In the context of technology assessment applications, it has been also stated that the lack of market mechanisms in the models may bring serious biases in the projections and the accurate estimation of future potential of technologies.

These critics, together with the need to represent the growing process of market liberalisation, motivated analysts to adopt market-oriented modelling approaches that involve explicitly market regimes and model separately the behaviour of economic agents. Such models can then incorporate detailed representations of policy instruments and structural options that may endogenously formulate the efficiency gap problem. These models are often called "new generation models" and currently prevail in policy analysis studies. Examples, which also include the modelling of energy-environment interactions, are IFFS, GEMS, GEMINI, ENPEP, NEMS (all in USA). PRIMES development for the European Union belongs to same family of models and should be characterised as a hybrid model combining engineering-orientation with economic market-driven representations.

These new generation models are often characterised as partial equilibrium models because they cover only the energy system and not the rest of the economy. They are also called generalised equilibrium models because they can formulate the behavioural conditions for the economic agents in a variety of mathematical formulations for the sub-models, and represent different market clearing regimes, reflected in the choice of algorithm for global model convergence (equilibrium). PRIMES can also be characterised as partial and generalised equilibrium model.

The development of PRIMES has required intensive research work. The modular design of the model, required first to develop the sub-models which cover demand and supply behaviour of the economic agents acting in the energy markets. The modules had to be designed simultaneously, in order to achieve consistency at the level of market integration. The cycle between construction of sub-models and integration has been repeated many times, as the overall model design proved to be more complex than initially planned. Hence, although several versions of the sub-models have been implemented (1995-1997), the integrated model ran as such