ABSTRACT

The first objective of this thesis is to assess NETPLAN effectiveness as a new planning tool for meeting the requirements of power system planning. The second objective is extension of NETLAN so that it can analyze the impact of existing and proposed EPA regulations on generation portfolios during the next 40 years.

In the first half of the thesis, NEPLAN, NEMS (DOE), and ReEDs (NREL) are introduced. Comparisons among the three models include model design, solution approach, energy and transportation systems elements, objective function, and constraints in the Linear Programming problem. Based on the model comparison, the strengths and weaknesses of NETPLAN, NEMS (DOE), and ReEDs (NREL) are discussed. NETPLAN is assessed as an effective new tool for power system planning due to its uniqueness in multi-sector, multi-objective design.

In the second half of the thesis, NETPLAN is improved to enable analysis of impact of proposed environmental regulations. Compliance strategies include establishing new power plants with low emission rates, retrofitting with emission control equipment, modified dispatch strategies, fuel switching, and earlier retirement. A multi-level and multi-arc design approach is applied to model power plants retrofitted with emission-control equipment. Scenarios are developed for examining the impact of existing and proposed environmental regulations. NETPLAN results are compared with research results from NEMS (DOE), ReEDS (NREL), and NERC. The case study results demonstrate an increased need for using natural gas and renewable energy resources to meet environmental regulations.