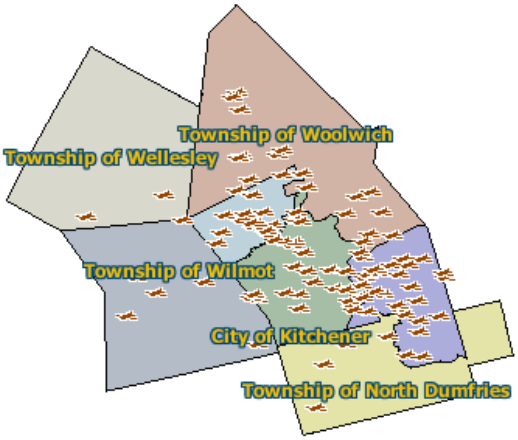
Energy Systems Planning for the Region of Waterloo, Canada



Prepared by

Energy and Environment Program
Faculty of Engineering
University of Regina
Regina, SK S4S 0A2

Prepared for

Region of Waterloo

December 2005

PROJECT TEAM

Y. P. Cai

Q.G. Lin

B. Bass

X.H. Nie

G.H. Huang

CONTENTS

Abstract

Energy system is a critical concern for the authority of a region. Currently, energy shortage has exacerbated the condition of regional energy system globally. It undermines the progress on every aspect of human development, including infrastructure building, life style, food production, human health, community development, and society welfare. Also, energy shortage causes direct impacts upon regional energy system including the generation, transmission or transportation, especially consumption of oil, natural gas, and electricity. These lead to the desire of an efficient energy management system with updated technologies for the allocation of scarce energy at various scale of a region especially at a community. CanREM (Canadian Regional Energy Model) is a technology oriented dynamic linear programming modeling system, designed to evaluate the impacts of environmental behaviors on international, national and regional energy systems by the least-cost strategy. With CanREM for the Region of Waterloo (CanREM-Waterloo), this study emphasizes on evaluating the impacts due to transportation mode shifts, accommodation-type variations, and other community development policy scenarios on the energy system. Then the abatement cost related to GHG emission reduction in this region as a response to the Kyoto commitment will be assessed.

With the data of regional planning from the Region of Waterloo, and the data of temperature drawn from the Canadian Climate Impacts Scenarios (CCIS), one Business as Usual (BAU) case and six scenarios are developed and analyzed for optimal energy allocation. The BAU case is to model regional energy system and GHG emission based on energy demand and social and economic development. Scenario 1 reflects the total energy demand and the total discounted costs according to regional planning. Scenario 2 is setup to investigate the impacts of end use demand reduction, as an adaptation to the energy shortage compared with BAU. Scenario 3 reflects the variation of energy demand in response to accommodation-type variations, as caused by re-focus of urbanization and community development in the downtown area of the region. Scenario 4 is developed to investigate the impacts of transportation mode shifts on energy system and GHG emission. Scenario 5 introduces solar energy, one of the potential renewable energies for this region, to examine its impact on the regional energy system, GHG emission, and total discounted costs. Scenario 6 reflects variations of energy demand in response to the mean temperature change only. Furthermore, three perturbation cases are developed to reflect the impacts of Kyoto target on the region’s energy system. The abatement and marginal costs related to GHG emission reductions are also presented in each scenario or case.