

Macroeconomic impacts of the bio-fuel sector in Canada

Topic: Energy input-output analysis I

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The government of Canada, like many others around the world, have recently considered bio-fuels as an opportunity to address some of their policy challenges: climate change, rural development and diversification of energy supply.

The production and use of first-generation bio-fuels has been increasing rapidly throughout the world. In 2000, total world production of ethanol for fuel was less than 20 billion liters and by 2005, production had more than doubled to over 45 billion liters. This provided about 3% of the motor gasoline use in the world, with a slightly smaller percentage in North America.

Canada currently produces 1.4 billion liters of ethanol annually, with the incoming mandates creating a need for 2 billion liters in total. Capacity for at least another 300 million liters annually is being planned. The federal government's Renewable Fuels Strategy announced in December 2006 established a 5 percent threshold level of ethanol by volume in all ground transportation fuels sold in Canada by 2010 and a 2 percent federal mandate for renewable content in diesel takes effect in 2011. The amount of ethanol required to meet this commitment is 2 billion litres. This will require a substantial expansion of ethanol production in Canada. It is expected that corn and other grains, in particular wheat, will be the predominant feedstock for this expansion of the fuel ethanol sector in both Canada and the United States.

Kyoto Ratified by Canadian government in 2002. In view of that GHG emissions should be reduced to 94% at 1990 level. Canada has exceeded their Kyoto target by 34.2%. By 2012 Canada has committed to meet a Kyoto target of 556.5 Mt of greenhouse gas emissions, but since 1990 has risen steadily topping 747 Mt in 2007. Total greenhouse gas emissions in Canada in 2007 had risen to 747 Mt. This meant that Canada exceeded Kyoto target of 556.5 Mt by more than 34%. Over the past year emissions have increased in every sector. Most notable however was the 276% increase from mining emissions since 1990.

To tackle the emissions and tap the renewable sources, the Government of Canada plans to increase production and use of ethanol and other bio-fuels. By 2010, at least 35% of Canadian consumption of fuel will be E10. To meet target, ethanol production must increase from 63 m gallons to 370 m gallons.

All these developments related to the Bio fuel sector will have macro economic impacts on the Canadian economy. The paper aims at estimating the macro economic impact of the Bio fuel sector in Canada.

An input-output model of the Canadian economy is developed to estimate the macroeconomic impact of the Ethanol production in Canada. Input-Output table is prepared to include the Ethanol sector in the economic system of Canada. Several modifications have been made in the Use and Make matrix of Canada, 2003. Originally the Use and Make table of Canada consists of 697 commodities, 16 primary inputs, 286 industries, and 168 final demand categories at Worksheet level. For the purpose of the model, we have aggregated 697 commodities into 125 including 25 detail agricultural commodities. The rest of the commodities have been aggregated to 100 and 16 primary inputs have been aggregated to 11. Like commodities, the scheme of detailed agricultural sector has also been applied to industry aggregation in make and use table of Canada. The Industries are aggregated to 84 from 286, and final demand to 7 categories from 168 including private consumption, investment, change in stock, govt. expenditure, export, re-export and import. Thus Use matrix consists of 125 commodities and 84 industries, 11 primary inputs and 7 final demand categories; and Make matrix consists of 84 industries and 125 commodities. To consider bio-fuel sector in the Make and Use table of Canada 2003 we have included two new industries - bio-fuel and E10. The four new commodities have been entered in the list - ethanol, E10, DDG and

CO₂. Finally, the number of industries and commodities will be 86 and 129.

The impact matrix is estimated from an Input-output model that estimates the direct plus indirect impacts on the Canadian economy, 2003. This model has been closed to the household sector in the economy by endogenizing this sector into the model. The closed version of the model estimates the direct, indirect and induced changes in industrial output required to satisfy a change in the final for commodities. Some simulation exercises have also been attempted to reach the Kyoto target of Canada at 2012 through increased ethanol production and also the policies of reducing the demand for gasoline through increasing the demand for ethanol production. Results show that the macroeconomic impact of ethanol sector leads to increase in industrial output and employment. The agriculture sector makes necessary adjustments to meet the demand for ethanol product. The petroleum industry is also affected. The paper concludes with several policy suggestions.