ECONOMIC AND ENVIRONMENTAL IMPACTS OF INCREASED US EXPORTS OF NATURAL GAS

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Overview

The main objective of this paper is to examine the likely economic and environmental impacts of increased US exports of natural gas. With the shale gas boom, the US is expected to have very large natural gas resources, so the key question is would it be better to rely completely on free market resource allocations which could lead to large exports of natural gas or to limit natural gas exports so that more could be used in the US. Exports could be economically attractive because there is a very large price gap at present between US natural gas price (around $3.50/MCF) and prices in foreign markets, which can range up to $15/MCF. Even after accounting for the cost of liquefying the natural gas and shipping it to foreign markets, current price wedges leave room for considerable profit from exports. On the other side, there is potentially large domestic demand for natural gas in electricity generation, industrial applications, the transportation sector, and for other uses. There is no doubt that exporting a large amount of natural gas would increase the domestic natural gas price for all these potential uses. Higher natural gas prices would, in turn, mean higher electricity prices in addition to higher energy costs for all other sectors that use natural gas. These higher energy costs would also lead to contraction in energy intensive sectors relative to the reference case with small natural gas exports. On a global scale, more natural gas exports would benefit foreign companies and hurt domestic energy intensive industries. Foreign consumers also would benefit through lower energy costs, and US consumers would be hurt.

Thus, the question is which pathway provides the best economic and environmental outcome for the US. Our focus in this paper is on the impacts of different levels of natural gas exports on the economy and environment. We include 2.7 BCF/day of natural gas exports in the reference case because that level is already permitted, and the other simulated cases are additions of 6, 12, and 18 BCF/day of natural gas exports. These levels were chosen based on the EIA simulated levels (Energy Information Administration, January 2012) and to provide a wide range of natural gas export levels to determine how sensitive the various metrics are to the level. The export levels are compared with a reference case. Since the Renewable Fuels Standard (RFS) for biofuels and the CAFE standard for automobile and light duty vehicle fuel economy are now established US policy, we have included those policies in the reference case. However, the reality is, for this particular question, the results are not very different between a reference case with and one without these policies. Our interest is in the difference or delta caused by three levels of increased natural gas exports compared with the reference case.

We do also examine one additional policy called the Clean Energy Standard (CES). This is the CES proposed by President Obama in his first term. The CES calls for doubling the percentage of clean electricity from 40 to 80 percent by 2035. Clean electricity includes coal with carbon capture and sequestration, nuclear, solar, hydropower, biomass, and wind. Natural gas based electricity is considered 50% clean in the CES. We develop a reference with CES case and then compare that with the three levels of natural gas exports as well.

Methods

Our approach is to use a well-established bottom-up energy model named MARKAL (MARKet ALlocation). Bottom-up means that the model is built upon thousands of current and future prospective energy technologies and resources. These energy resources supply projected energy service demands for the various sectors of the economy. In addition to the standard MARKAL model, we also have adapted a version of the MARKAL-Macro model which permits us to include feedbacks between energy prices and economic activity. Thus the GDP effects of alternative energy policies are captured as well as technology and supply impacts. For these reasons, MARKAL-Macro is an ideal tool for this kind of analysis.

MARket ALlocation (MARKAL) is a widely applied, dynamic, perfect-foresight, technology-rich linear programming, energy systems, optimization model. In its standard formulation, its objective function is the minimization of the discounted total system cost which is formed by summation of capital, fuel and operating costs for resource, process, infrastructure, conversion and end use technologies. The general framework enables the calibration of a model to local, national, regional or multiregional energy systems. Model applications include, but are not limited to, climate policy, impact assessment of new technologies, taxes, subsidies, and various regulations. Further details regarding the methodology can be found in (Loulou et al., 2004).

The US EPA MARKAL is a standard MARKAL model where energy service demands are inelastic, exogenous, and model structure is linear. A database that represents a particular energy system must be developed to use with MARKAL. The U.S. EPA (2006) developed MARKAL databases that represent the US energy system at the national and regional levels. Both databases cover the period 2005 through 2055 in five-year increments and represent the sectors: resource supply, electricity production, residential, commercial, industrial and transportation sectors. The original model has now been updated to 2010 data. In this study we use the national single region US EPA MARKAL model.

Characterizations of current and future energy demands, resource supplies, and technologies within the databases were developed primarily from the Energy Information Agency's 2010 Annual Energy Outlook report, extrapolated to 2055 using National Energy Modeling System (NEMS) outputs published by DOE (2010). Additional data sources include the AP-42 emission factors from US EPA (1995), and Argonne National Laboratory's Greenhouse Gas, Regulated Emissions, and Energy Use in Transportation (GREET) model (Burnham et al., 2006). Further details regarding US EPA MARKAL can be found in Shay et. al. (2006).

One set of changes is the update of natural gas resource supply curves in the US EPA MARKAL database based on the MIT Energy Initiative report (The MIT Energy Initiative, 2011). Natural gas is expected to be available at low cost for the US, due to shale gas and other technological improvements. Due to the expectation of improvements in gas extraction techniques, the high availability case is quite plausible as suggested by the MIT Energy Initiative Report (The MIT Energy Initiative, 2011). With this expectation we make the use of high availability case supply curve in the modified MARKAL database.

Results

We will report results on GDP, primary resource mix, electricity sector price and generation source changes, transport sector impacts, impacts on selected other sectors, and impacts on domestic GHG emissions. In each case, we will compare the reference case with the three levels of natural gas exports.

Conclusions

The major conclusion of this research is that permitting natural gas exports causes a small reduction in US GDP and also increases GHG emissions and other environmental emissions such as particulates. There is loss of labor and capital income in all energy intensive sectors, and electricity prices increase. The major difference between our results and the other major studies such as NERA (2012) are that we get considerably higher natural gas price impacts just like GPCM model of RBAC Inc.(Brooks, 2012), and we do not get export revenue as large. The higher natural gas prices cause pervasive losses throughout the commercial, industrial, and residential sectors.

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