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US Dependence Upon Canadian Fossil Fuels

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Proportion of U.S. Natural Gas Supply Derived from Given Country, 2011: All Suppliers[1]

U.S.	90.4%
Canada	8.5%
Trinidad	0.5%
Qatar	0.3%
Yemen	0.2%
Egypt	0.1%
Peru	< 0.1%
Norway	< 0.1%
Nigeria	< 0.1%
	100.0%

Proportion of U.S. Crude Oil Supply Derived from Given Country, 2011: Top 10 Suppliers[2]

U.S.	38.7%
Canada	14.8%
Saudi Arabia	8.1%
Mexico	7.5%
Venezuela	5.9%
Nigeria	5.2%
Iraq	3.1%
Colombia	2.6%
Angola	2.3%
Russia	1.8%
All others (34)	9.9%
	100.0%

Introduction. The energy relationship between Canada and the U.S. is a much-discussed topic within business, government, and the media, prompted in part by the controversy surrounding the proposed Keystone XL cross-border oil pipeline. Having noticed differing statistics regarding the nature of the relationship, we here attempt to provide an accurate picture of the extent to which the U.S. depends upon Canada as a supplier of fossil fuels. Much data can be found online, both at agency websites [e.g., U.S. Energy Information Administration (EIA), National Energy Board of Canada (NEB), Statistics Canada] and at industry association sites (e.g., Canadian Association of Petroleum Producers). In general, we relied upon the data produced by a given nation to understand the situation within that nation (e.g., EIA data for things internal to the U.S.). With respect to cross-border flows, we strove to reconcile the differing values provided by each nation for a given statistic, such as the annual volume of crude oil imported by the U.S. from Canada. Reconciliation of values involves conversion of volumetric units (e.g., cubic meters / day vs. thousand barrels / day) as well as accounting for different definitions (e.g., "pentanes" are included as a crude oil component in NEB data, but not in EIA data). While an exact reconciliation could never be achieved, we were able to come close, and we thus have confidence that the trends and values shown in this article are valid.

In overview, the tables in the left sidebar show the sources of fossil fuels consumed within the U.S. in 2011. For *natural gas*, the vast majority was derived from U.S. domestic production. By a wide margin, Canada was the largest foreign supplier, and only a small volume (1.1 percent) was derived from offshore locations, reflecting the higher cost of transporting natural gas in the form of refrigerated LNG (liquefied natural gas). Canada was also the largest foreign supplier of *crude oil*, but a large group of significant suppliers is evident. U.S. domestic production was again the largest fraction, and the NAFTA bloc accounted for 61 percent of total supply.

Natural Gas. Figure 1 delves more deeply into the overall supply and disposition of natural gas within Canada and the U.S. over the course of a year. The figure shows that the overall market is about five times larger in the U.S. [i.e., 25,505 billion cubic feet (Bcf) in the U.S. vs. 5,492 Bcf in Canada]. The dashed blue arrows are used to aggregate the major sources of supply within each country, and the solid red arrows show the major uses. The size in Bcf of

Figure 1: Net Natural Gas Flow at National Level, Canada and the U.S., 2011,[3] Bcf (billion cubic feet)

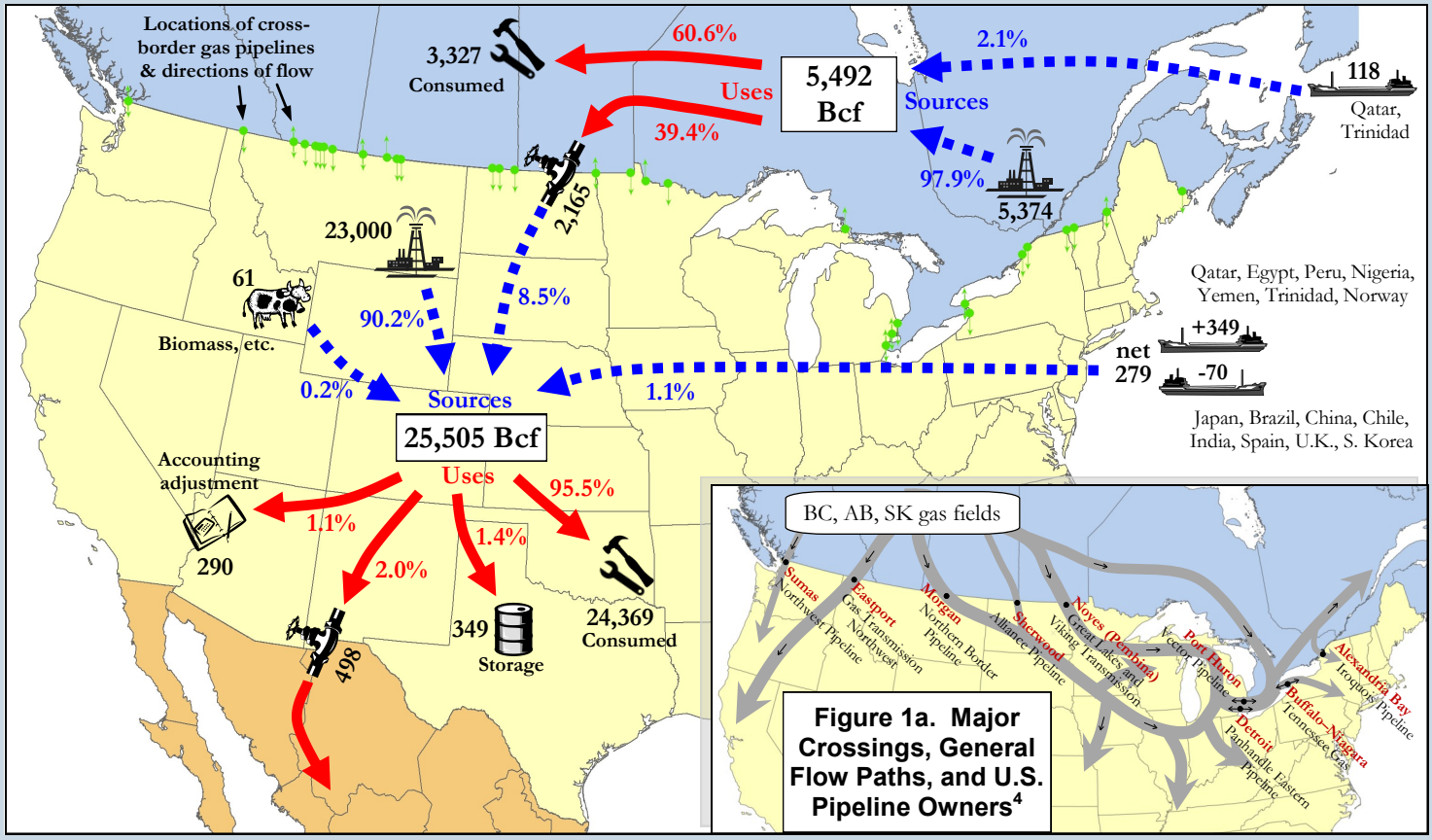

Figure 1a. Major Crossings, General Flow Paths, and U.S. Pipeline Owners[4]

each source and use is identified, as are the relative magnitudes of the sources and uses [e.g., 0.2 percent (61 Bcf) of natural gas in the U.S. is derived from unconventional sources, such as landfill capture and biomass processing]. The figure shows an annual *net* flow of 2,165 Bcf into the U.S. from Canada. From the U.S. perspective, that volume represents 8.5 percent of supply, whereas from the Canadian perspective that same volume represents 39.4 percent of use. We emphasize that the value is a "net" flow, in that the two countries share a pipeline network that is interconnected at 31 distinct crossing points, as identified by the green dots arrayed along the border. Gas moves north and south across the border in response to the magnitude and location of the specific demands upon the network at any point in time. However, the predominant flow is southbound, as seen in Figure 1a. That figure identifies nine main crossing points that together account for over 70 percent of the cross-border flow. Significant Canada-bound flows occur at Detroit and Port Huron. Each point is labeled in red with the port-of-entry name used by U.S. Customs, and black labels identify the owners of the U.S. pipelines that serve each crossing. Pipeline ownership often changes at the border.

Figure 2: Changes in Source of U.S. Gas Supply over Time[5]

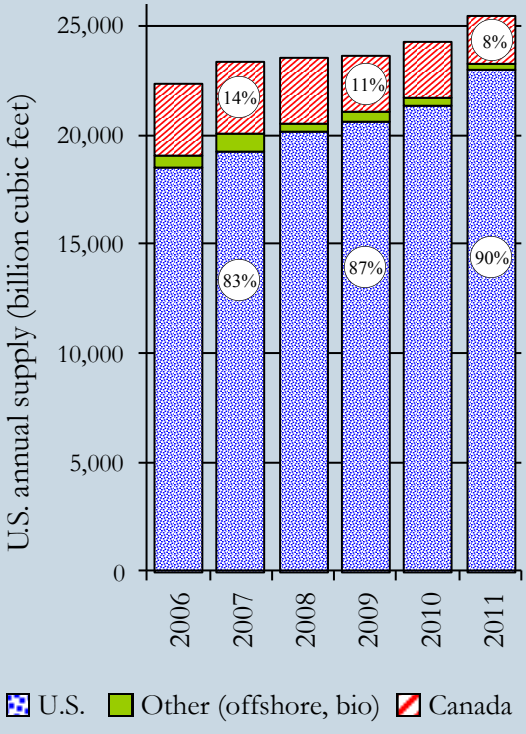

Figure 3: Net Petroleum Flow at National Level, Canada and the U.S., 2011,[6] tbd (thousand barrels / day)

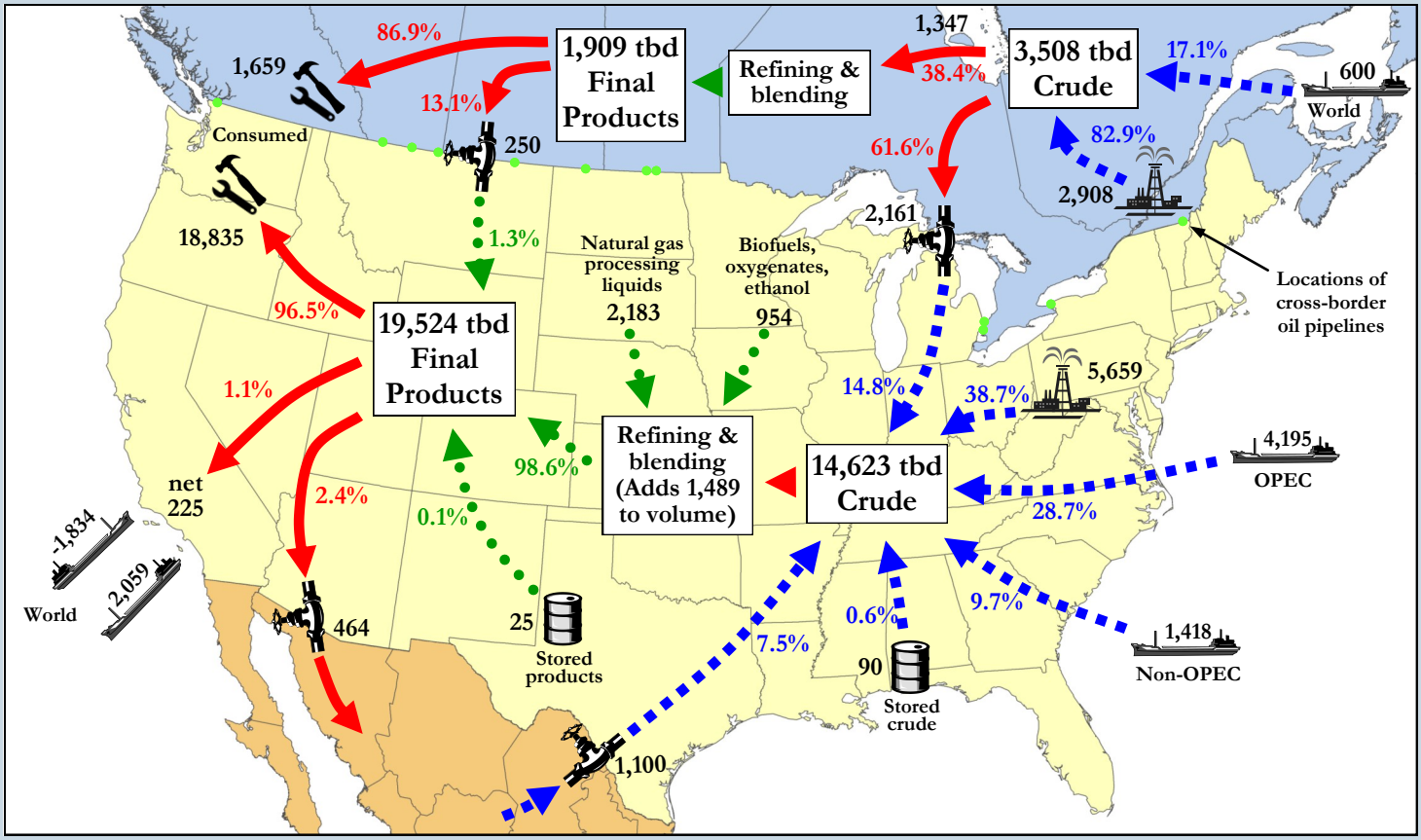

Figure 4: Changes in Source of U.S. Crude Supply over Time[7]

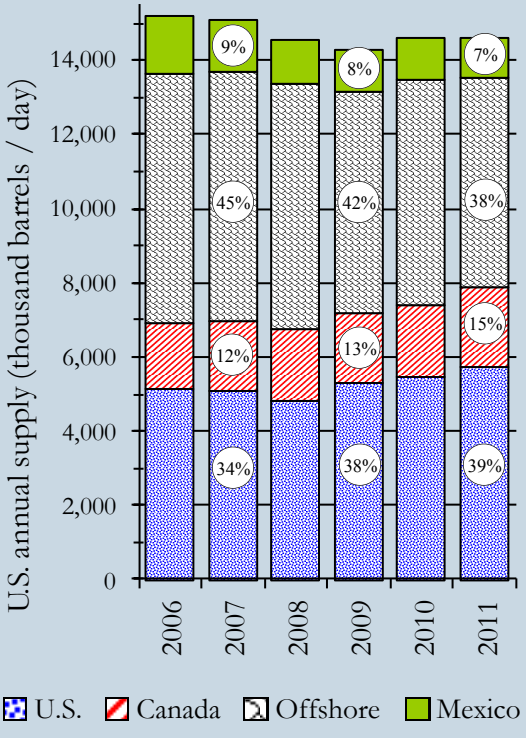

Figure 2 reveals that in recent years the U.S. has become less dependent upon foreign sources of natural gas, even as gas consumption has increased. The use of new drilling technologies (in particular, horizontal drilling accompanied by hydraulic fracturing—"fracking") has dramatically boosted domestic production.

Crude Oil & Petroleum Products. Figure 3 shows sources and uses in both Canada and the U.S. of liquid petroleum substances. *Net* flow over the course of the year 2011 is again depicted, but the figure is more complicated because of the distinction between *crude oil* and the *final products* that result from the blending and refining process. The blue dashed lines identify sources of crude oil, and the disposition of stocks of crude is shown with the set of solid red arrows in the right half of the diagram. The U.S. relies upon foreign sources for the majority of its crude supply, with Canada and Mexico each serving as a major supplier. The 2,161 tbd (thousand barrels per day) imported from Canada represents 14.8 percent of U.S. supply. In the middle of the diagram are boxes representative of the blending and refining process, with dotted green lines indicating sources of other liquids. One such source is renewable liquids (ethanol, biofuels) that

have received policy emphasis in the U.S. for over a decade. The second source is "natural gas processing liquids." When natural gas is first extracted, there are associated liquids that are then separated in order to produce the "dry" natural gas that is delivered to end users. (*Note: Figure 1 shows volumes of dry gas*). The resulting liquids are then delivered as a feedstock to the oil refining and blending process. Interestingly, the oil refining process results in a significant net increase in the volume of final products, above and beyond the sum of the several petroleum feedstocks (e.g., see 1,489 tbd noted in the text box for the U.S.). While Figure 3 omits the details associated with the refining process in Canada, a processing-related augmentation of volume occurs there as well, as evidenced by the fact that the stock of final products exceeds the volume of the crude oil input. The leftmost text boxes show the volumes of final products supplied in the U.S. and Canada. There is substantial international trade associated with such products: in 2011 the U.S. was a net exporter with respect to both Mexico and the offshore market, but a net importer with respect to Canada. Green dots are again arrayed along the Canada – U.S. border to identify the locations of the 12 cross-border oil pipelines.

Figure 4 shows changes in the source of U.S. crude oil supply over time. The overall supply has trended downward, partly because of the economic recession that began in 2008, and partly due to the low price of natural gas, which has prompted some consumers to use natural gas instead of oil, where readily feasible. The advances in drilling technology mentioned earlier have also led to an increase in U.S. and Canadian oil extraction, as evident in the figure. There has been slightly less reliance upon Mexico over time, and substantially less reliance upon offshore sources.

Conclusion. In recent years, technological advances have altered the extent of U.S. dependence upon Canadian crude oil and natural gas, leading to opposing trends for the two commodities. With respect to natural gas, the U.S. has become less dependent over time. Other things being equal, surging domestic production might tempt U.S. policy-makers to pay less heed to Canadian concerns. However, dependence upon Canadian crude oil has grown, and that heightened dependence has led to a *lessening* of dependence upon offshore suppliers that are less firmly allied to the U.S. This vital corollary benefit underscores the continued need for the U.S. to nurture the energy relationship.

Endnotes

1. Author calculations based upon "Annual" data in EIA tables "U.S. Imports by Country" and "U.S. Exports by Country," retrieved May 2012 at: http://www.eia.gov/naturalgas/data.cfm#imports
2. Author calculations based upon "Annual-Thousand Barrels Per Day" data for "Crude Oil" in EIA tables "U.S. Imports by Country of Origin" and "Exports by Destination," retrieved May 2012 at: http://www.eia.gov/petroleum/data.cfm#imports
3. **U.S. data:** import/export from sources cited in note (1); other Uses/Sources from Table 4.1 in April 2012 edition of EIA's *Monthly Energy Review*, retrieved at: http://www.eia.gov/totalenergy/data/monthly/archive/00351204.pdf; cross-border pipeline data as cited in note (4).
   Canadian data: LNG imports from query of "Gas & LNG-Month & YTD Summary by Port" database accessible at: http://www.neb-one.gc.ca/CommodityStatistics/GasStatistics.aspx?language=english; LNG origins from query of "LNG -Shipment Details" at same URL; production/consumption ***estimated*** by reconciling NEB data retrieved at http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/sttstc/mrktblntrlgsprdctn/mrktblntrlgsprdctn-eng.html with EIA data retrieved at http://www.eia.gov/countries/country-data.cfm?fips=CA&trk=m
4. Based upon EIA's "Locations of U.S. Natural Gas Import & Export Points" retrieved at: http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/impex_list.html and upon EIA's map "Major U.S. Natural Gas Transportation Corridors" retrieved at: http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/transcorr_map.html
5. Import data as cited in note (1); U.S. production data as cited in note (3).
6. **U.S. data:** import/export from sources cited in note (2); data re: domestic production, stock changes, processing gain, NGPL, biofuels, and consumption from Table 3.1 in April 2012 edition of EIA's *Monthly Energy Review*, retrieved at: http://www.eia.gov/totalenergy/data/monthly/archive/00351204.pdf
   Canadian data: data re: import/export, crude stock, and final products from author calculations based upon U.S. data cited in note (6), reconciled with Statistics Canada Table 126-001, retrievable at: http://www5.statcan.gc.ca/cansim/a05?lang=eng&id=1260001&pattern=1260001&searchTypeByValue=1&p2=35 Cross-border pipeline data from Canadian Association of Petroleum Producers' "Crude Oil Pipeline & Refinery Map" retrieved at: http://www.capp.ca/getdoc.aspx?DocID=191097
7. Import/export data as cited in note (2); U.S. production data as cited in note (6).