Energy Savings from the Use of Chemistry Products in the US

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HIGHLIGHTS

The use of chemistry products in various energy-saving applications saves between **8.0 and 10.9 quadrillion British thermal units (Btus)** of energy annually. This represents 8.1% to 11.1% of total US energy consumption. To put these energy savings into perspective, the annual savings of 8.0 to 10.9 quadrillion Btus would be the equivalent amount of energy used to heat, cool, light, and power **41 to 56 million households**. This is about one-third to one-half of all US households. Alternatively, the energy savings could be used to power **98 to 135 million vehicles** for a year, or between 40-55% of the cars on the road today. Looking at it another way, the energy savings from chemistry products is equivalent to the amount of energy generated by **177,000 to 243,000 windmills** operating under typical conditions. This is two to three times more than the wind capacity in place at the end of 2011.

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ANALYSIS

The chemical industry produces many products used to conserve energy, including insulation, compact fluorescent lighting, lightweight plastics to reduce automobile and packaging weight, etc. In 2009, on behalf of the International Council of Chemical Associations (ICCA), McKinsey & Company developed estimates of the global greenhouse gas savings attributable to use of chemistry products. To derive an estimate of the gross *energy* savings from chemistry products in the US only, ACC economists made two estimates using different approaches. One uses a top-down approach and the other uses a bottom-up approach. Both estimates are based on results from the McKinsey life-cycle analysis (LCA) study[1]. Because the estimates are somewhat uncertain based on the lack of specific data for the US, an average of the two estimates is presented. Thus, because of the products of chemistry, US energy consumption was between 8.0 and 10.9 quadrillion Btus lower than it would have otherwise been.

Table 1 - Net Savings from Chemistry Products

	Minimum	Maximum
Top-Down Approach	7.9	11.4
Bottom-Up Approach	8.1	10.5
Average	**8.0**	**10.9**
% of Total US Energy Consumption	8.1%	11.1%

ENERGY SAVINGS IN PERSPECTIVE

The amount of energy saved from the use of chemistry products is substantial, representing between 8.1% and 11.1% of total US energy consumed. Table 2 shows the energy saved expressed in households, wind turbines, and motor vehicles.

Table 2 – Energy Savings Comparisons

	Energy Savings		Actual
	Minimum	Maximum	(for comparison)
Households (million)	41	56	113
Wind Turbines* (thousands)	177	243	n/a
Wind Capacity (thousand MW)	93	127	43
Motor Vehicles (millions)	98	135	245

*assuming 1.5-MW turbines operating at 35%

To put these energy savings into perspective, the annual savings of 8.0 to 10.9 quadrillion Btus would be the equivalent amount of energy used to heat, cool, light, and power 41 to 56 million households. This is about one-third to one-half of all US households. Alternatively, the energy savings could be used to power 98 to 135 million vehicles for a year, or between 40-55% of the cars on the road today. Looking at it another way, the energy savings from chemistry products is equivalent to the amount of energy generated by 177,000 to 243,000 windmills operating under typical conditions. This is two to three times more than the wind capacity in place at the end of 2011.

[1] "Innovations for Greenhouse Gas Reductions: A Life Cycle Quantification of Carbon Abatement Solutions Enabled by the Chemical Industry", July 2009.

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DESCRIPTION OF THE DIFFERENT APPROACHES TO THE CALCULATIONS

Top – Down

According to the McKinsey study, use of the products of the chemical industry saves 3.6 to 5.2 gigatons of carbon dioxide equivalent ($GtCO_2e$) emissions globally. Of that, however, about 27% is related to avoiding land-use changes from increased yields due to fertilizers and crop protection chemicals. Excluding that, between 2.6 and 3.8 $GtCO_2e$ of emissions are saved due to chemical products that curb energy consumption. To arrive at the *energy* savings from chemistry products in the US, we converted emissions to the amount of energy that would be consumed to generate those emissions. Assuming the emissions were related to the combustion of fossil fuels and assuming that the fuel mix in the US is roughly comparable to global fuel use, we used data on fossil fuel based CO_2 emissions and fossil fuel energy consumption to calculate a conversion coefficient. We then allocated a portion of the global energy consumption to the US using data from the Energy Information Administration (EIA). Finally, the energy savings were adjusted to reflect the change in energy consumption between 2005 and 2010. As a result, it is estimated that between 7.9 and 11.4 quadrillion BTUs of energy were saved in the US in 2010 using the top-down approach.

Table 3 - Net Savings from Chemistry Products Calculated Using a Top-Down Approach

	Minimum	Maximum
Global Emissions (mmCO2e)	3,600	5,200
Global Emissions, excluding fertilizers and crop protection (mmCO2e)	2,642	3,816
Global Energy Savings (quad Btus)	37.8	54.6
US Energy Savings (quad Btus)	**7.9**	**11.4**

Bottom - Up

The Bottom-Up approach was also based on the McKinsey LCA Study. To arrive at the *energy* savings from chemistry products in the US, we examined the various cases evaluated to assess savings from using products of the chemical industry. Since the data in the LCA study reflected global coverage, we used US values where available or made adjustments to reflect US conditions in each of the various cases, or end-uses. For example, houses in the United States are larger than those in Europe and Japan and feature higher cooling demands and in most cases higher heating demands. The larger size of a typical American household also plays a role in lighting and other household operations. In a similar manner, light vehicles are larger (and feature a larger plastics and chemistry component) in the United States than in Europe and Japan. As a result, light vehicles will figure more prominently among end-use markets for chemistry in the United States. On the other hand, existing relative weight- (and energy-) savings in Europe and Japan may be more extensive in this end-use, somewhat offsetting the greater prominence in the United States. Savings were then adjusted to reflect the differences among cases and end-uses and then aggregated, resulting in a different savings ratio per unit of energy consumed. Finally, the energy savings were adjusted to reflect the change in chemical industry energy consumption and chemical industry end-use markets between 2005 and 2010. As a result, it is estimated that between 8.1 and 10.5 quadrillion BTUs of energy were saved in the US in 2010 using the bottom-up approach.

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