NRDC Legislative Facts

Cutting Global Warming Pollution at Low Cost with the Lieberman-Warner Climate Security Act

An analysis of the proposed Lieberman-Warner legislation prepared for the Natural Resources Defense Council (NRDC) shows that the global warming pollution reduction targets established by the bill can be achieved without a significant increase in the country's total energy costs. The overall economic impact is small because increased investment in new, more efficient appliances and equipment and low-carbon technologies is offset by savings from decreased expenditures on fuel and electricity. The analysis also shows that there are opportunities in the major transition to new technologies needed to achieve these reductions.

The analysis was performed using an improved and extended version of the US national MARKAL[1] model (US-NM50) originally developed by the Environmental Protection Agency's Office of Research and Development.[2] The reference point for the analysis is a business-as-usual (BAU) scenario calibrated to the Department of Energy's 2008 Annual Energy Outlook (AEO2008).

The effect of the Lieberman-Warner bill on energy investments and total energy system costs is illustrated with two different cases. Case A illustrates a future where substantial reductions in renewable energy costs occur as experience with these technologies accumulates, causing those resources to achieve a large market share after 2030. Case B illustrates a future with major continued investments in coal generation, with more substantial reliance on carbon capture and geologic sequestration (CCS). The main findings of this analysis, presented by topic, include:

Emission reductions in both cases come mostly from the electric sector through a combination of efficiency improvements reducing electricity and direct fuel consumption, renewable energy use, CCS, and reduced energy service demands. Direct emissions from major consuming sectors are roughly flat in both scenarios – with efficiency improvements offsetting economic growth. CCS grows to about 440 million tons per year in Case A and to more than 1.2 billion tons per year in Case B. Global warming pollution offsets account for about 30 percent of the cumulative reductions through 2050, in line with the legislation (Figure 1).

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www.nrdc.org/policy

1 www.estap.org
2 http://www.epa.gov/appcdwww/apb/globalchange/

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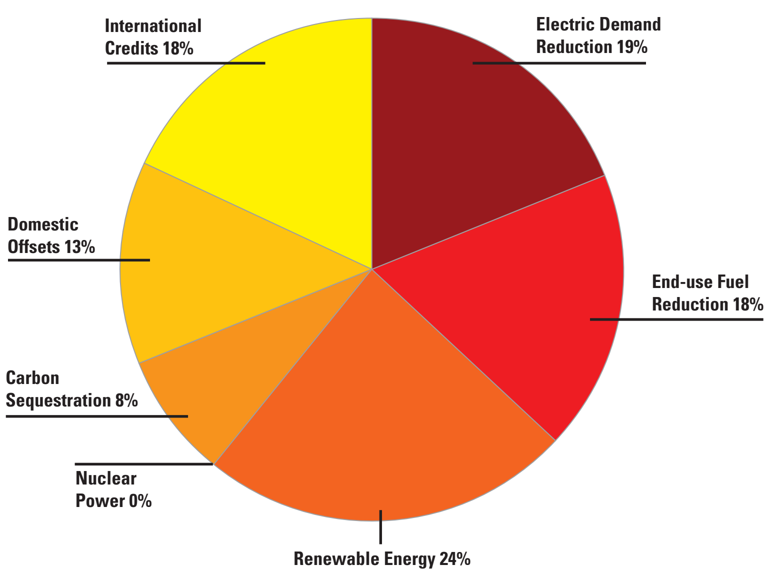
More Detail on the US-NM50 MARKAL Model

The US-NM50 MARKAL model is an integrated representation of the full U.S. energy economy which covers all demand sectors (commercial, residential, industrial and transportation) as well as the complete range of fuel supplies and electricity generation and fuel processing technologies needed to serve these demands. The model covers the period from 2000 to 2050 and is calibrated to 2000 and 2005 historical data. The starting point for the analysis is a business-as-usual (BAU) scenario that tracks closely to the Department of Energy's Annual Energy Outlook 2008 for the 2010 to 2030 period. This analysis focuses on emissions of carbon dioxide, the primary global warming pollutant that would be controlled by the Lieberman-Warner bill. In this analysis, a cumulative CO_2 emission limit is specified in proportion to the cap on total emissions under the bill.

The model includes a large array of new technology options, including renewables, coal with carbon capture and sequestration (CCS), advanced nuclear and hydrogen production technologies. These new technologies are subject to the documented effects of learning, so that their costs decline as enterprises gain experience with building and operating them (based on cumulative installed capacity). The model also includes a wide variety of new, high efficiency end-use devices and energy conservation measures. In addition, energy service demands respond to prices, decreasing or increasing as costs rise or fall. The model finds the lowest cost evolution of the energy system utilizing available resources and technologies to meet the energy service demands, subject to physical limitations, policies and market constraints imposed on the system. The model enables a robust comparison between the BAU and Lieberman-Warner scenarios of energy use patterns and prices, technology choices, system costs, security of supply, CO_2 allowance prices, and other energy system elements.

Figure 1: Contribution to CO_2 Reductions

Lieberman-Warner Case A—
158 Gt total reduction



Achieving the Lieberman-Warner CO_2 emission reductions targets results in about a 0.45 percent increase in the total discounted energy system cost in Case A relative to the BAU case over the 2000 to 2050 period. The impact is modest because increased investments in energy efficient end-use devices and renewable energy technologies are offset over the long-term by reduced expenditures on fuel and electricity (Figure 2). The model calculates CO_2 allowance prices that rise steadily over time from $12 per ton of CO_2 in 2020 to $20 per ton in 2030 and almost $50 per ton in 2050 (Figure 3).

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Figure 2: Energy System Expenditures

Change in Discounted System Cost (2010 to 2050), Case A Relative to BAU

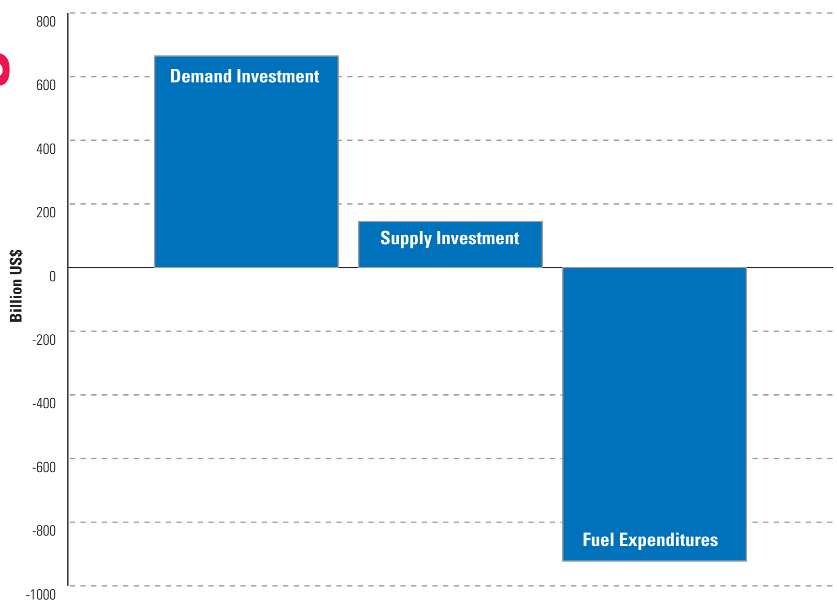
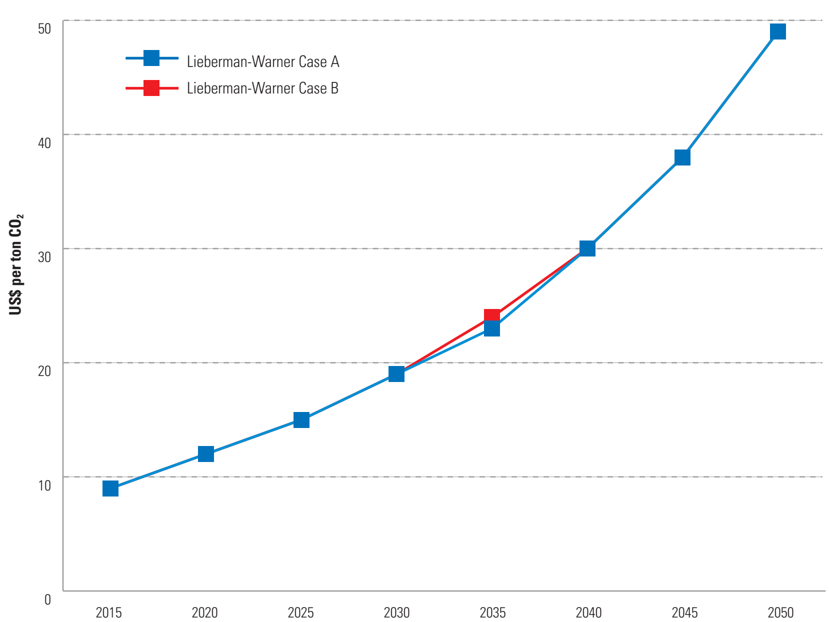


Figure 3. CO_2 Allowance Prices



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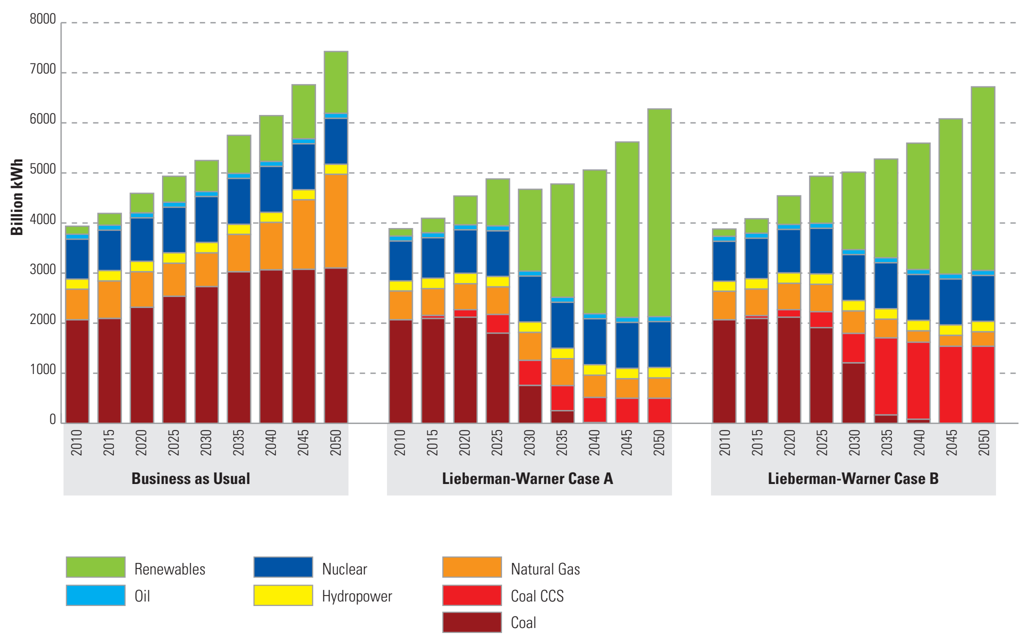
Primary fuel use shows coal increasing gradually from 23 quads today to about 28 quads in 2025 and then decreasing to between 7 and 16 quads by 2050 for Case A and Case B, respectively. Oil and natural gas use are reduced from the BAU case. Nuclear power generation remains essentially constant, and renewable energy use increases to 26 quads in 2030 and to between 50 and 56 quads by 2050.

New investment in more efficient end-use devices results in significant reductions in electricity consumption for the commercial and residential sectors compared to BAU. Industrial electricity use increases as savings in machine drive and electrochemical use are offset by fuel switching for other industrial energy needs. Transport electricity consumption increases dramatically to supply plug-in hybrid vehicles.

Electricity generation increases over time, but demand under Lieberman-Warner is between 16 percent and 9 percent below the BAU case—with more consumption in the CCS-intensive Case B to supply plug-in hybrids that achieve additional reductions from the transportation sector. CCS in power generation starts to deploy after 2015 with early adoption stimulated by incentives included in the legislation. Natural gas generation decreases substantially, except for peaking applications, as renewable electricity generation increases. Nuclear power grows slightly due to upgrades at existing plants only. Renewables, which grow to between 50 percent and 60 percent of total electricity supply, are a mix of biomass, geothermal, concentrating solar power, solar photovoltaics and wind technologies (Figure 4). The largest contributors to renewable electric output are large, remote wind farms with dedicated transmission to load centers, and concentrating solar power with integrated energy storage.

Figure 4: Electricity Supply by Plant Type



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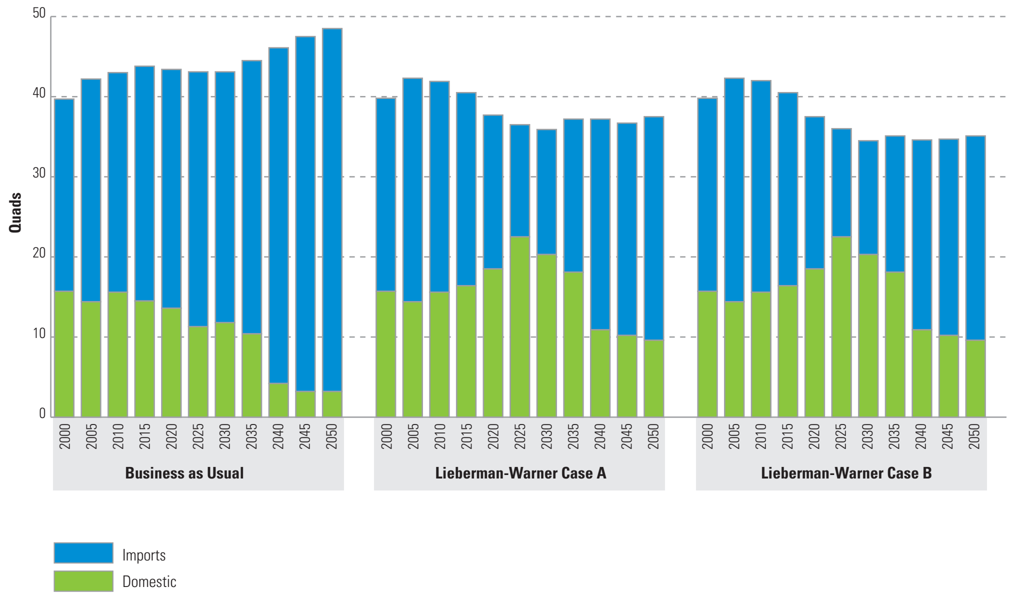
Oil imports drop to 35 percent of total oil supply in the middle years of the period under study due to both lower demand and the use of CCS for Enhanced Oil Recovery (EOR) that greatly expands domestic production from existing fields. Oil imports rise again between 2035 and 2050 as the EOR resource (estimated at 50 billion barrels) begins to deplete, although they remain under 60 percent of total oil supply, as compared to more than 80 percent by 2050 in the BAU case (Figure 5).

Figure 5: Domestic vs. Imported Oil



Fleet efficiency for new Light Duty Vehicles (LDV) increases to 52 and 60 mpg in the two Lieberman-Warner cases compared to about 35 mpg in the BAU case. The LDV fleet moves to hybrids and plug-ins running flexibly on ethanol and gasoline. Gasoline use decreases to about 40 percent of all LDV fuel in Case A and 25 percent in Case B. The ethanol fuel share (primarily from cellulosic feedstocks) is 25 percent to 30 percent, and the electricity share is between 20 percent and 30 percent.

CO_2 offsets significantly lower compliance costs at the levels allowed by the Lieberman-Warner bill (regulated sources are allowed to meet up to 15 percent of their compliance obligations through domestic offsets and an additional 15 percent through international credits). Allowing additional use of offsets would reduce costs only modestly while decreasing the allowed use of offsets to below 10 percent each for domestic offsets and international credits increases compliance costs substantially due to the steeper CO_2 reductions required in the electric sector. The model indicates that these reductions would be met through earlier retirement of existing power plants and increased demand for energy efficiency, renewable energy and CCS.

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Complementary policies to remove barriers to adoption of energy-efficient technologies and deployment of renewable energy systems significantly reduce the total cost of the energy system. Incentives to install energy efficient appliances, increase vehicle fuel economy, promote renewable electricity generation and develop CCS technology and infrastructure reduce CO_2 allowance prices.

Energy prices for coal and natural gas (not including allowance costs) are between 15 and 30 percent lower relative to the BAU case because of decreased demand. The marginal cost of generating electricity for summer days decreases relative to the BAU case due to the lower demand, while summer night costs increase as the use of plug-in hybrids grows.

In conclusion, this analysis shows that the Lieberman-Warner CO_2 reduction targets are achievable with a minimal (0.45 percent) increase in the overall cost of the energy system. The analysis finds that:

- Emission reduction strategies focus on early and steady reductions in the electric sector through rapid promotion of energy efficiency, early development of renewable energy and strong deployment of CCS technology after 2015;
- The nation's LDV fleet transitions to hybrid and plug-in vehicles running flexibly on ethanol, gasoline and electricity;
- Use of domestic offsets and international credits within the limits in the legislation significantly reduce compliance costs, while expanded access to offsets would be of little additional benefit, and
- The implementation of CCS-based enhanced oil recovery substantially reduces dependence on foreign oil.

This study was performed by Pat DeLaquil, Gary Goldstein and Evelyn Wright of International Resources Group, and guided by the close involvement of Dan Lashof, Elizabeth Martin and Richard Duke of NRDC.

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