The Economics of Energy Efficiency in Buildings

Trevor Houser | September 23, 2009
US Energy Demand by Sector
1950-2008

INDUSTRY

BUILDINGS*

TRANSPORTATION

Source: EIA's Annual Energy Review 2009. * Buildings includes all residential and commercial energy demand but excludes energy demand from industrial buildings.
How Buildings Fit into the Big Picture
IEA Estimates of Emissions Abatement by Source/Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>2050 BAU</th>
<th>2050 Blue MAP</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power generation</td>
<td>--</td>
<td>--</td>
<td>18.2</td>
</tr>
<tr>
<td>Industry</td>
<td>23.2</td>
<td>5.2</td>
<td>9.1</td>
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<tr>
<td>Buildings</td>
<td>20.1</td>
<td>3.1</td>
<td>8.2</td>
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<tr>
<td>Transport</td>
<td>18</td>
<td>5.5</td>
<td>12.5</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>62</strong></td>
<td><strong>14</strong></td>
<td><strong>48</strong></td>
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</tbody>
</table>

Source: IEA Energy Technology Perspective 2008
Buildings – The Low-Hanging Fruit?
McKinsey GHG Abatement Cost Curve v2

Building Sector CO2 Emissions
Gigatons

Source: IEA estimates from Energy Technology Perspective 2008. PIIE estimates from “The Economics of Energy Efficiency in Buildings”.

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## Building Transformation Cost Estimates
Based on WBCSD EEB Model

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Additional investment Billion USD per year 2005–2050</th>
<th>Net-present value* Billion USD per year 2005–2050</th>
<th>Emission reduction Million tons in 2050 relative to BAU</th>
<th>Average abatement cost USD per metric ton, 2005–2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD North America</td>
<td>244</td>
<td>-46</td>
<td>1,699</td>
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<tr>
<td>United States</td>
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<td>OECD Europe</td>
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<td>EU 27</td>
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<td>OECD Pacific</td>
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<td>Japan</td>
<td>37</td>
<td>-9</td>
<td>168</td>
<td>52</td>
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<td>Transition Economies</td>
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<td>-12</td>
<td>548</td>
<td>24</td>
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<td>Russia</td>
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<td>-10</td>
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<td>Developing Asia</td>
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<td>-26</td>
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<td>China</td>
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<td>Africa</td>
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<td>298</td>
<td>10</td>
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<td>World</td>
<td>1,042</td>
<td>-180</td>
<td>8,200</td>
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</tr>
</tbody>
</table>

BAU = Business as usual

* Net-Present Value is calculated over 20 years using constant energy prices and a 6 percent discount rate.

Relative Abatement Costs
IEA Abatement Cost Curve

Marginal cost (USD/t CO₂)

0  5  10  15  20  25  30  35  40  45  50
2050 CO₂ emissions reduction relative to Baseline (Gt CO₂/yr)

End-use efficiency

Power sector

Industry fuel switching and CCS

Transport alternative fuels

Technology pessimism

BLUE Map
Technology a

ACT Map

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The Cost of Failing on Buildings
And making up those reductions in the power sector

IEA Utility Sector Reductions (18.2Gt)
Equivalent Reductions from Building Sector (8.2Gt)

Source: International Energy Agency and Peterson Institute for International Economics
Building Sector Abatement by Policy
Million metric tons of CO2, by region

North America

OECD Europe

OECD Pacific

Transition Economies

Developing Asia

Latin America

Middle East

Africa

$30 CO2 TAX  10-YEAR PAYBACK  STANDARDS AND SUBSIDIES  FEED-IN TARIFF

Source: Peterson Institute for International Economics
US Residential Energy Expenditures
Billions of dollars (2007 real)

Source: Business-as-usual projections are EIA Annual Energy Outlook 2009. The climate policy scenario is EIA’s assessment of the impact of the Waxman-Markey bill (HR.2454). The building transformation scenarios is Waxman-Markey plus per-square foot efficiency improvement achieved in the WBCSD model (WBCSD 2009).
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