Pathways to Deep Decarbonization in New England’s Transportation Sector

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• Three pillars of deep decarbonization
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Definitions

Deep Decarbonization:
Transformation of the energy economy consistent with keeping global warming less than 2°C
Definitions

Pathway:
Plan or blueprint to achieve deep decarbonization of the energy system
Deep decarbonization pathways

Charting a course for climate mitigation

• Is deep decarbonization of the economy possible?
  • What parts of the economy can be decarbonized?
  • What are the potential pathways to do this?
  • What are the best practices in navigating the path forward?
Regional carbon emissions trajectories

- Pathways are based on analysis from a recent report on achieving 2050 greenhouse gas goals in the U.S. Northeast conducted jointly with the Sustainable Development Solutions Network.

Roadmap: three pillars of deep decarbonization

New York & New England

2050 Benchmarks

- 3x increase in the share of energy from electricity
- 87% decrease in the emissions intensity of electricity generation
- 40% drop in final energy use per capita (no drop in energy services)

Three pillars

New England Transportation

**Pillar: Electrification**
Transition vehicles on the road from gasoline-powered internal combustion engine to battery electric and plug-in hybrid electric vehicles where possible.

**Pillar: Energy Efficiency**
50 percent decrease in energy consumption due to efficient electric powertrains and high efficiency internal combustion engines.

**Pillar: Electricity Decarbonization**
Charging electric vehicles on a low carbon electricity grid decreases overall transportation emissions by 80 percent.

Light duty vehicle benchmarks

New England

Sales
Number of vehicles

Light Duty Vehicles
Number of vehicles

BEV Sales
Benchmark
Year: 2030
Value: 568K

Rest
Gasoline ICE
BEV
PHEV

Transportation stock across vehicle weights

New England

Light Duty Vehicles
Number of vehicles

- Gasoline ICE
- PHEV
- BEV

Medium Duty Vehicles
Number of vehicles

- Gasoline ICE
- Rest
- Diesel ICE
- BEV

Heavy Duty Vehicles
Number of vehicles

- Rest
- Diesel ICE
- BEV

Vehicle electrification can also be accomplished by fewer electric vehicles driving more

- Autonomous vehicles, especially those that are used for shared mobility, have higher utilization. Operational savings from an electric vehicle lead to more favorable economics than ICEs.
- Accelerates turnover and achievement of the electrification pillar.
- Achieving electricity decarbonization means any concurrent increase in VMTs has little impact on overall carbon emissions.
- AEVs reduce overall costs of transportation.

Because of the savings in transport, total deep decarbonization net costs can be negative.
Final thoughts: Three Pillars Questions

New England Transportation

**Electrification**

How do we accelerate consumer adoption of electric technology? How will autonomous vehicles change the picture?

What strategies can we pursue in areas where electrification isn’t possible?

**Energy Efficiency**

What is the right level of efficiency as we transition to zero-carbon energy supplies?

How does demand reduction fit into this pillar?

**Electricity Decarbonization**

How can electrified transportation address electricity balancing challenges inherent in low-carbon electricity systems?

Will load growth from electrifying transportation mean the region exceeds available renewable resources?
Three Pillars in Practice

United States

2050 U.S. Benchmarks

• 2x increase in the share of energy from electricity or electrically derived fuels
• ~99% decrease in the emissions intensity of electricity generation
• 3x drop in energy use per unit GDP
# Three Pillars in Practice

## China, India and United Kingdom

### Energy Efficiency

<table>
<thead>
<tr>
<th>Country</th>
<th>2010</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>16.83</td>
<td>4.61</td>
</tr>
<tr>
<td>India</td>
<td>12.96</td>
<td>3.08</td>
</tr>
<tr>
<td>UK</td>
<td>2.87</td>
<td>0.91</td>
</tr>
</tbody>
</table>

Energy intensity of GDP, MJ/$

### Decarbonization of Electricity

<table>
<thead>
<tr>
<th>Country</th>
<th>2010</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>741</td>
<td>68</td>
</tr>
<tr>
<td>India</td>
<td>771</td>
<td>66</td>
</tr>
<tr>
<td>UK</td>
<td>441</td>
<td>28</td>
</tr>
</tbody>
</table>

Electricity emissions intensity, gCO₂/kWh

### Electrification of End-Uses

<table>
<thead>
<tr>
<th>Country</th>
<th>2010</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>18%</td>
<td>34%</td>
</tr>
<tr>
<td>India</td>
<td>14%</td>
<td>27%</td>
</tr>
<tr>
<td>UK</td>
<td>19%</td>
<td>40%</td>
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</tbody>
</table>

Share of electricity in total final energy, %

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Source: figures from Deep Decarbonization Pathways Project country reports (2015)
Three Pillars of Deep Decarbonization

• Breadth of analyses conducted has given us a good basis to draw some high-level conclusions about what a deeply decarbonized energy system must include
• We call these the **Three Pillars** and they are:
  1. **Electrification**: Switching to electricity as final energy product for some end-uses (i.e. electric vehicles).
  2. **Energy Efficiency**: Using less energy to perform the same energy service (i.e. LED lightbulbs provide the same lighting service with less electricity)
  3. **Electricity Decarbonization**: Generating more energy from clean and renewable sources and less from fossil fuels