Regional commitment to reducing emissions

Local policy in the United States goes some way towards countering anthropogenic climate change.

The non-participation of the United States in the recently ratified Kyoto Protocol is a matter of global concern because it is estimated that the country produces 24% of all greenhouse-gas emissions worldwide. Here we analyse the commitment of individual states and municipalities addressing this problem and find that, despite the federal policy, between 24 and 35% of the US population are currently (or soon will be) engaged in policies directed towards significantly reducing anthropogenic climate change. The importance of this sub-national effort, which we estimate corresponds to 27–49% of the gross domestic product, will depend — like the targets adopted in Kyoto — on the real reductions achieved in greenhouse-gas emissions.

The current administration plans to adopt carbon-intensity targets that would allow the United States a 30% increase in emissions above those specified in Kyoto’s designated base year of 1990 (ref. 3). We have analysed the extent of the commitment at the sub-national level towards targets more like those of Kyoto. Because of the varying nature and maturity of any such regional policies, we divided the states and municipalities adopting them into three categories — current, probable and possible adopters. Current and probable adopters have climate-change policies that are similar in scope to Kyoto’s recommendations; possible adopters may have targets commensurate with the Kyoto recommendations, but to be included in this category only pledges to reduce emissions are needed. Our analysis, which includes contributions by different states, counties and cities (for details, see supplementary information), indicates that the current adopters represent about 24% of the US population and contribute about 27% of the gross domestic product (GDP) (Table 1).

There are several limitations to climate-change policies that operate at the sub-national level, including a lack of mechanisms for enforcing such small-scale initiatives. The Kyoto agreement is now legally binding, but it too could be undermined if targets are continually postponed and if the threat of exclusion from a trading system that is not yet proven turns out to be ineffective. Nonetheless, many Kyoto signatories are taking real steps towards compliance. In the United States, the Kyoto Protocol was not binding, but it too could have been undermined if too many Kyoto signatories had withdrawn or if Kyoto’s non-compliance were a challenge. In the Kyoto negotiations, which include contributions by different states, counties and cities (for details, see supplementary information), indicates that the current adopters represent about 24% of the US population and contribute about 27% of the gross domestic product (GDP) (Table 1).

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### Table 1: Sub-national contributors to greenhouse-gas reduction

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Current adopters</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>35.484</td>
<td>12.19</td>
<td>1,446</td>
<td>13.26</td>
</tr>
<tr>
<td>Connecticut‡</td>
<td>3.483</td>
<td>1.20</td>
<td>172</td>
<td>1.58</td>
</tr>
<tr>
<td>Maine‡</td>
<td>1.306</td>
<td>0.45</td>
<td>41</td>
<td>0.38</td>
</tr>
<tr>
<td>Massachusetts†</td>
<td>6.433</td>
<td>2.21</td>
<td>297</td>
<td>2.73</td>
</tr>
<tr>
<td>New Hampshire‡</td>
<td>1.288</td>
<td>0.44</td>
<td>49</td>
<td>0.45</td>
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<td>New Mexico‡</td>
<td>1.875</td>
<td>0.64</td>
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<td>New York†</td>
<td>19.190</td>
<td>6.59</td>
<td>822</td>
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</tr>
<tr>
<td>Rhode Island†</td>
<td>1.076</td>
<td>0.37</td>
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<td>0.36</td>
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<tr>
<td>Vermont†</td>
<td>0.619</td>
<td>0.21</td>
<td>21</td>
<td>0.19</td>
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<tr>
<td>Subtotal</td>
<td>70.755</td>
<td>24.31</td>
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<tr>
<td><strong>Probable adopters</strong></td>
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<td></td>
<td></td>
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<tr>
<td>New Jersey</td>
<td>8.638</td>
<td>2.97</td>
<td>397</td>
<td>3.64</td>
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<tr>
<td>Oregon</td>
<td>3.560</td>
<td>1.22</td>
<td>120</td>
<td>1.10</td>
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<td>Washington</td>
<td>6.131</td>
<td>2.11</td>
<td>245</td>
<td>2.24</td>
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<td>Subtotal</td>
<td>18.329</td>
<td>6.30</td>
<td>763</td>
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<td><strong>Possible adopters</strong></td>
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<tr>
<td>25 US municipalities</td>
<td>12.774</td>
<td>4.38</td>
<td>1,673</td>
<td>15.34</td>
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<td><strong>Total</strong></td>
<td>101.859</td>
<td>34.99</td>
<td>5,381</td>
<td>49.32</td>
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</table>

Percentage population figures are calculated for individual states with respect to the total US population of 291 million; the contribution of each state to the national economy is also shown, and is calculated from the 2003 value of the gross domestic product (GDP) of the United States ($10.9 trillion). For details, see supplementary information.

GDP being pledged towards significant reductions (27%; Table 1) represents 9% of the global economy; the upper bound represents 16.7%, which is slightly larger than the GDP of Japan, the world’s second largest economy.

Although there is no US federal cooperation with Kyoto, the implementation of climate-change policies by lower levels of government are widespread and governed by pledges that are not dissimilar from the targets adopted in Kyoto. These pooled efforts will ultimately be gauged by the real reductions in emissions that they achieve.

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### ANT NAVIGATION

**Priming of visual route memories**

Ants travelling to and fro between their nest and a foraging area may follow stereotyped foodward and homeward routes that are guided by different visual and directional memory sequences.

Honeybees are known to fly a feeder-to-hover or hive-to-feeder vector according to whether or not they have recently fed — their feeding state controls which compass direction they select. We show here that the feeding state of the wood ant *Formica rufa* also determines the choice between an outward or inward journey, but by priming the selective retrieval of visual landmark memories.

We trained the ants along a foraging route in which the appearance of a landmark differed on the ants’ foodward and homeward paths. The ants ran 1 m from a start-pot to a drop of sucrose, both of which lay 20 cm from a black wall that was 2 m long and 20 cm high. They were guided by the remembered appearance of the wall, which was to their left on the way to food and to their right on the way home. (For methods, see supplementary information.)

To investigate the role of feeding state in priming visual memories for the foodward or homeward route, trained ants that had either been fed or left unfed were placed individually in a start-pot midway along the wall (Fig. 1a). Unfed ants walked so that they viewed the wall on their right (56 of 61 paths), whereas fed ants viewed the wall on their left (55 of 61 paths). The wall was regularly rotated during training and the visual scene was identical for fed and unfed ants. We conclude that the ants’ feeding state, rather than the compass orientation or panoramic context, determines whether foodward or homeward memories are primed.

![Figure 1](https://www.nature.com/bca/fig/1a.png)

**Figure 1** Wood ants use feeding state to select visual memories for guiding routes towards food or the nest.

a. Individual trajectories of unfed and previously fed ants released from a start-pot (white circle). Thick line indicates the mean path, with 95% confidence interval (CI) plotted every 10 cm.

b. Trajectories of ants when the start-pot is placed midway between two walls. The exit from the start-pot is at the top of the figure. Fed ants left in the direction of the exit; unfed ants circled the pot before choosing a direction.

c. Y-shaped maze (dotted lines indicate front wall) with different patterns for foodward and homeward routes (see supplementary information). Distance from Y junction to pattern, 33 cm.

**Supplementary information** accompanies this communication on Nature’s website.

**BRIEF COMMUNICATIONS ARISING online**

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