ISSUE

Public transportation is often heralded as a way to reduce greenhouse gas (GHG) emissions. To date, most efforts have focused on deploying low-emission buses and policies, like discounted fares, that draw drivers out of private cars. Far less attention has been given to designing and operating low-carbon transit networks.

By setting a GHG-reduction target based on the market price of carbon, and designing a system to meet that target, significant emissions cuts are possible—without having to shift drivers out of their vehicles. Furthermore, by designing the transit network to reduce operators’ costs and riders’ travel-times, targets can be achieved without losing ridership.

RESEARCH FINDINGS

To test this idea, we designed an idealized transit network that would take into account a host of factors. It counted emissions from a transit system’s entire life-cycle, including construction (e.g., tracks and stations), manufacturing vehicles, operations and maintenance. Tradeoffs between total costs and emissions were identified across a range of carbon prices. We also tested idealized networks for different transit modes (e.g., heavy-rail metros, light-rail, bus rapid transit and bus) and different system designs for cities of varying sizes, levels of transit demand and wages (which affect riders’ perceived costs of travel times).
Our study showed it is important to tailor strategies to specific types of city. For example, we found that a bus rapid transit (BRT) system can be a low-cost and low-emissions option for small cities where both wage rates and transit demand are high. BRT outperforms regular buses because it provides faster service. In most instances, heavy-rail transit has life-cycle emissions that are roughly four times greater than those of other modes, even though it is cost-competitive in large cities.

In the figure at left, each point has a corresponding carbon price value, representing the cost of further reductions. As the price of carbon increases, the GHG emissions (the dotted line curves) tend to decrease faster than travel time (solid lines) increases. Light-rail transit averages the smallest reductions in emissions, while it and bus experience the smallest increases in travel times across the range of carbon prices. At a carbon price of $100 per metric ton, the potential emissions reductions are at most six percent. Such emission reductions would occur without any perceptible changes to the system. This suggests that significant GHG reductions could be achieved without travelers having to shift modes.

**RECOMMENDATION**

Our research findings can be used to design transit systems that are cost-effective and help shrink carbon footprints. For many cities, BRT is shown to be a low-cost as well as low-emissions mobility option.

Our findings are particularly relevant to states like California that are considering carbon credit programs. Well-designed transit systems, we show, can provide appreciable carbon offsets. Local and regional agencies can also use our findings in the quest to design low-carbon transit systems that thrive in smart-growth communities, thus helping to achieve GHG-reduction targets set in California’s pioneering legislation, Senate Bill 375 (Sustainable Communities and Climate Protection Act of 2008).