Are Walkable, Bikeable Communities Effective at Carbon Reduction?

Policy summary
Planning authorities are considering multi-modal transport, with significant increases in walking and biking for short trips as part of a strategy for reducing greenhouse gas emissions from the Transport sector. Our findings indicate that mode switch to walking and biking for trips of less than 5 km can produce emissions reductions on the order of a few percent, but is unlikely to go beyond this level of reduction absent dramatic changes in the spatial design of communities and the separation of walking and biking paths from motorized vehicles. The findings on the co-benefits of carbon reduction through reduction in exposure to other air pollutants such as ozone or particulates, and through reduction in obesity, are mixed.

The Setting
Transport accounts for approximately a third of greenhouse gas emissions in most modern economies such as those of the UK and US. Strategies and policies to reduce these emissions can be seen usefully as a hierarchy such as that used in energy for buildings or waste recycling: (1) reduce the need for vehicular travel in the first place, (2) where vehicles still are needed, make those vehicles as fuel efficient as feasible, and (3) supply residual energy needs of the vehicles with low carbon sources.

To date, this policy hierarchy has been turned “upside down” in most cases, with an initial focus on use of renewables such as biofuel, then turning to fuel efficiency, and only later turning to policies that remove the need for vehicles. Careful spatial planning, and provision of safe and convenient alternatives to travel by vehicles, are the keys to reducing vehicular travel. And so planners and policy makers have begun to focus on masterplanning and the design of communities so they better accommodate walking and biking. This involves shortening distances between destinations, and designing walking and biking paths so they are out of the way of the dangers of mixing pedestrians, bikes and vehicles.

But how effective are these measures at reducing carbon emissions, improving air quality and improving health? In recent studies, we and colleagues in Spain and the US have addressed this question through modelling the effect of a mode shift to walking and biking on the environment and health in communities.
The Analysis

Our approach was to simulate mode choice behaviour and travel patterns of individuals in a community using Monte Carlo modelling. Once mode choice was selected at random from empirical information, and travel distance was determined from a spatial map of the community, the emissions of air pollutants and of greenhouse gases were estimated. These were converted into estimates of air quality (PM and ozone) and into benefits to health through exercise (if walking or biking was the selected mode). From the analysis, we were able to calculate the reduction in greenhouse gas emissions, improvements in air quality, effects of these air pollutants on human health, and effects of transport choices on calories burned and hence reduction in obesity and its associated health problems.

Conclusion

Our results only support in part the claims that a shift to walkable and bikable communities is effective at reducing greenhouse gas emissions and improving health. Walking and biking certainly reduce emissions of air toxics from vehicles and improve air quality in a community. And they are forms of exercise, which contributes to better health. However in most communities, sidewalks and bike lanes follow roadways where concentrations of air pollutants from transport are highest. Since walking and biking raise the rate of breathing, significantly higher exposure to pollutants can take place. This generally offsets the benefits of the decrease in pollutants in the air, and so health risks can be made worse by the switch in mode choice. In addition, walking or biking is 10 to 20 times more hazardous in regards to accidents than is travel in a vehicle. However, these trade-offs do not take place if walking and biking routes are separated from roadways.

As to greenhouse gas emissions reduction, the benefits are modest. Reduction in most communities due to a switch to walking and biking is on the order of a few percent, in large part because the willingness to use these modes of travel drops quickly with distance, and modern lives are characterized by increasing distances for trips. All is not lost, however, because these same studies show that if trip distances can be reduced to 1 mile or less, and pathways made safe and convenient, mode choices change appreciably and larger reductions in greenhouse gas emissions can take place. Again this is all down to community design.