

## Sustainable Cities of the Future: The Behavior Change Driver

Peter Newman

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# SUSTAINABLE CITIES OF THE FUTURE:

## THE BEHAVIOR CHANGE DRIVER\*

by Peter Newman\*\*

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### INTRODUCTION

Imagine a city that uses 100 percent renewable energy... where most transport is by electric light rail, biking, or walking . . . where the solar office block is filled with green businesses, where the local farmers' market sells fresh, bioregional produce . . . where parents meet in the parks and gardens while their children play without fear in streets that are car-free. This is a reality in Vauban, a new eco-city of 5,000 households within Frieburg, Germany.<sup>1</sup> And in nearby Hanover, a city of 500,000 people has reduced its greenhouse gas emissions by fifty percent.<sup>2</sup>

How did these communities transform their cultures to make the transition that every city now faces? Vauban and Hanover took the opportunity to use every policy lever possible at every step of the way—from planning to delivery—to ensure that the goal of sustainability drove each decision. These policy levers will be outlined and new data will be provided regarding the education lever, which involves behavior change and cultural adaptation.

### WHY SUSTAINABILITY IN CITIES?

Cities have always been places of economic and social opportunity. They emerged when hunter-gatherer societies were transformed into settled societies based on agriculture. Today's cities have grown large during the industrial era and still provide the main economic and social opportunities for the world's growing population.<sup>3</sup> But cities are now having a significant environmental impact, as they are based around the consumption of fossil fuels and materials at increasing rates. They must continue to provide opportunities, but they must also become more like Vauban and Hanover—sitting lighter on the planet. Indeed, the key question now is whether cities can not only reduce their impact on Earth but also contribute to its regeneration.<sup>4</sup>

Around the world, cities are becoming more sustainable through resilient buildings, alternative transportation systems, distributed and renewable energy systems, water-sensitive design, and zero-waste systems—with all the cleverness of a new industrial green revolution. From new cities like Masdar in Abu Dhabi, United Arab Emirates<sup>5</sup> to redeveloped areas like Treasure Island, California in the United States,<sup>6</sup> Vauban and Hanover in Germany, and BedZED and the new Olympic village in London, these pioneers are dramatically reducing their ecological footprints.<sup>7</sup>

### HELPING URBAN RESIDENTS LIVE SUSTAINABLY

BedZED is a carbon-neutral development and social housing experiment in inner London.<sup>8</sup> It has many ecological innovations: it uses local and recycled materials; its energy-efficient design is combined with photovoltaics (“PV”) and biomass-fueled combined heat and power; it recycles gray water and harvests rainwater; it has local facilities to reduce the need for travel and is near a train station; and it has on-site permaculture gardens.<sup>9</sup> When a detailed assessment of residents' ecological footprints was made, however, a huge variation was found in how people made use of the area's ecological features. The average footprint for some residents was around 4.4 hectares per person (still less than the average for London of 6.6 hectares), yet some residents were able to get their impact down to 1.9 hectares per person.<sup>10</sup>

Experiences in many early European experiments in urban ecology may hold the explanation for the variation in residents' footprints. Buildings and neighborhoods that are not developed within a community can fail to achieve their design outcomes. If innovations are imposed on people who do not know how to use the new buildings as designed or do not know why they should use less power, water, or fuel, residents can simply transfer their old consumptive lifestyles to the new “eco” situations. The growth of sustainable cities will only be mainstreamed when the green transformation involves all elements of the policy process—especially the processes that help people want to change.<sup>11</sup>

Several key government policies can help cities move toward sustainability:

- Infrastructure to enable energy, water, transport, and waste to be managed with minimal ecological impact;
- A design to ensure that the infrastructure is efficiently available to all;
- Innovation through research and development and demonstrations to continually ensure the latest ecotechnology becomes mainstream;

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\* Based on an article originally published in *Worldwatch Institute's 2010 State of the World report*. [www.worldwatch.org](http://www.worldwatch.org).

\*\* Peter Newman is the Professor of Sustainability at Curtin University in Perth, Australia. He has been a post doc at Stanford University, and a Visiting Professor at the University of Pennsylvania and University of Virginia where he was a Fulbright Senior Scholar in 2006/2007. He is a Lead Author on Transport for the next round of Intergovernmental Panel on Climate Change (“IPCC”) Reports.

- Tax incentives to direct investment into these new technologies and provide people with a price signal motivation to change their behavior;
- Regulations to set the standards high enough for sustainability technologies to cover their externalities; and
- Education and behavior change programs to ensure households and communities want to make the changes needed.

Nowhere is this more evident than in policies about getting people out of cars.

### KICKING THE CAR HABIT

Car use is easily adopted as a way of life in cities, especially those that were developed in the past fifty years. U.S. cities use twice as much transport fuel per person as Australian cities, and those cities in turn use twice as much as European cities and five times as much as Singapore, Tokyo, and Hong Kong.<sup>12</sup> Policymakers often claim that cities with a high dependence on cars are impossible to change. But with cars now being the largest single technology contributing to climate change and the one growing the fastest, it is time for decision-makers everywhere to see how the policy changes just described can bring about a cultural transformation and get their cities to kick the car habit.<sup>13</sup>

A first priority is infrastructure. Cars are chosen for most destinations because they are quicker than other more sustainable modes, and people do not like to commute more than an hour a day on average.<sup>14</sup> Thus if a modern electric rail system or bus rapid transit can be installed down an urban corridor that is faster than the traffic, people move quickly to use it.<sup>15</sup> Perth's new Southern Rail meets this goal and now has 55,000 riders a day, compared with 14,000 who used to take the bus; the equivalent of eight lanes of traffic.<sup>16</sup> Similarly, a good bicycle system and walkable urban environment means that in Copenhagen cars were used for only twenty-seven percent of all work trips in 2003 compared with bicycles on thirty-six percent of such trips.<sup>17</sup>

The design of the city is totally enmeshed in its infrastructure priorities. When cities favor sustainable modes of transportation, land use tends to cluster around it.<sup>18</sup> But if a city only builds highways, it generally scatters in highly car-dependent patterns. Density and transport fuel use are closely linked.<sup>19</sup> Planning cities to be much less car-dependent will be a key part of any plan to reduce a city's carbon footprint. For example, "transit-oriented developments" have been shown to cut residential car use in half, and residents save twenty percent on their household income by having one less car per household.<sup>20</sup>

New technology to make cities smarter and more sustainable is appearing and needs government assistance in order to be facilitated and tested. The new plug-in electric vehicles (for cars and for transit) need testing, along with the associated smart grids and renewable energy use that can allow cities to become 100 percent renewable.<sup>21</sup> Green transit-oriented developments that can demonstrate the new technology would seem to be ideal sites for trials of such technology so that renewable transport can also lead to reductions in car use.<sup>22</sup>

Every nation and city has its own way of making the adoption of more planetary lifestyles convenient and easy compared with lifestyles that are more consumptive. When it comes to cars, however, the more that a city is car-dependent, the harder it is to use tax incentives to change people's lifestyles. European cities have much higher gasoline taxes than American and Australian cities, and accordingly they use cars less.<sup>23</sup>

In the car-dominated cities of North America and Australia, the major public policy to reduce the global and local impacts has been through regulations on vehicles that have forced them to become cleaner. Following the introduction of these, most urban atmospheres have also become cleaner, although fuel use has continued to increase as vehicles have become bigger and their use has continued to grow.<sup>24</sup> Regulations have also been applied to safety and congestion management, but this will continue to worsen if increased car use is facilitated.<sup>25</sup> Regulations alone do not change behavior. Neither will a price increase on gasoline dramatically change behavior as has been proven by the 2008 price rise that just led to people being unable to pay their mortgages in highly car dependent areas.<sup>26</sup>

Without an education on climate change and the changing role for cars, these necessary policy approaches will be wasted. For example, something known as the Jevons Paradox—increasing efficiency means increasing consumption—has been found to apply to car use.<sup>27</sup> If people buy cars that use less fuel, they just drive them more—undermining most gains made possible through the new technology. Thus cultural change to help people want to drive less needs to be a part of any city's policy arsenal if it is to face up to the challenge of growing a sustainable city. One such program shows that this is indeed possible.<sup>28</sup>

German sociologist Werner Brög has developed an approach to travel demand management based on the belief that cultural change toward less car dependence can happen in any city as long as it is community-based and household-oriented. After some trials in Europe, Brög's approach was adopted in large-scale projects in Perth, Western Australia.<sup>29</sup> It has since spread across most Australian cities and to other European cities, especially in the United Kingdom, and has now been piloted in six American cities.<sup>30</sup>

Known as TravelSmart, the approach targets individual households directly (rather than through mass media) in the form of a letter from the Mayor or State Minister (funds for the program are usually a partnership of the two), asking them to participate in the program. Follow-up phone calls elicit the residents' interest in receiving further information and, for the few who need extra support, a potential visit from a TravelSmart officer.<sup>31</sup> People select information materials to suit their individual needs, which are then delivered by staff using bikes and trailers.<sup>32</sup> The information is packaged in specially designed TravelSmart bags and includes walking and transit information as well as pamphlets on why it is good for health and the planet for people to get out of their cars more often.<sup>33</sup> The information materials encourage people to start with local trips, especially the school trip for children, which is now seen as an essential part of the healthy development of young people's sense

of place and belonging in any community as well as a way to reduce obesity.<sup>34</sup>

In communities where TravelSmart has been conducted, people have reduced the kilometers traveled by vehicle by between twelve to fourteen percent—a result that seems to last for at least five years after the program ends.<sup>35</sup> Although where transit is not good and destinations are more spread out, the program may only reduce car use by eight percent, where these are good it can rise to fifteen percent.<sup>36</sup> This is not a revolution, but it has many synergistic positive outcomes.<sup>37</sup>

People involved in TravelSmart become real advocates of sustainable transport—telling their friends how much better they feel after bicycling, walking, or taking the bus or train instead of driving. They show friends how much money it saves them as well as how it makes them feel to be doing their bit for climate change and oil vulnerability. There is evidence in Brisbane, Australia, that at least fifty percent more people than those involved in the initial household interviews were actually following the program when the surveys were done; in other words, people were spreading the message to their friends and colleagues.<sup>38</sup>

When people start to change their lifestyles and see the benefits, they become advocates of sustainable transport policies in general. Governments find it easier to manage the politics of transformation to reduced car use and lower oil use when the communities they serve have begun to change themselves.

The city of Perth has been rebuilding its rail system over the past twenty years following a strong social movement that demanded a better system.<sup>39</sup> The extension of the rail system to far outer suburbs has been more positive and politically achievable than expected, with a massive ninety percent support for its last stage, the Southern Suburbs Railway. In conjunction with this political process, Perth had some 200,000 households undergoing the TravelSmart program, which seems to have helped. Indeed, the Southern Suburbs Railway increased public transport patronage by fifty-nine percent in areas without TravelSmart and by eight-three percent in areas where TravelSmart was deployed to promote the new rail services.<sup>40</sup> Patronage on the rail system has gone from seven million a year to sixty million in seventeen years, moving public transport from five to ten percent of the work journey trips taken in the city. Perth has become a model across Australia for other cities that are now determined to upgrade their rail systems funds to provide the needed infrastructure.<sup>41</sup>

The TravelSmart program recognizes a fundamental principle about cultural change: it works best when a community supports the change, when it is part of the development of social networks that support the changes in lifestyle. TravelSmart develops this social capital around sustainable transport modes rather than the dominant culture of the car. It does this through relationships established with the TravelSmart officer and with others in the local community who are making the same first steps to get out of their cars.

In the workplace, TravelSmart is found to work well when a TravelSmart Club (“TS Club”) is formed that enables people to

share experiences, bring in local speakers, and lobby for facilities like showers for bike riders and transit passes instead of parking spaces.<sup>42</sup> For example, the natural gas company Woodside in Perth involved their employees in planning their new building and a strong representation from the TS Club led to good bicycle facilities being provided. The firm now has more employees biking than driving to work and the subsequent saving in car parking spaces is considerable.<sup>43</sup>

## PLANETARY LIFESTYLES

The same approach to cultural change that TravelSmart uses to positively affect dependency on cars can be applied to other aspects of sustainability at the household level—reducing energy, water, and waste. The program needs to provide infrastructure for the new technologies, an urban design that ensures the technologies are efficiently available for all residents, research and development on the best options available, regulations to set the energy and water use efficiency in buildings and appliances at the highest possible level, tax incentives to push people toward more “planetary lifestyles,” and education to motivate people.

As with TravelSmart, the possibility of using educational programs to underpin these policy areas is critical to achieving the necessary planetary cultural change. In many cities, approaches to community-based planetary education are emerging as the politics of climate change becomes a major political force.<sup>44</sup>

Perth has built on its TravelSmart program to create a successful household education-based approach, known as LivingSmart, which brings sound and locally relevant material into people’s homes.<sup>45</sup> The eco-coaches who have worked with the first 15,000 households in a trial run have found enormous enthusiasm from people who have been looking for this targeted assistance. Using unsolicited phone calls to residents, the program is finding that seventy-four percent of households telephoned are interested in making changes to improve energy, water, waste, and travel sustainability. Half of the households contacted sign up for ongoing coaching for special meters, advice on gardens, workshops, and home audits.<sup>46</sup>

Unlike TravelSmart, where change tends to occur slowly and incrementally, the LivingSmart program is receiving reports from households of instant and radical changes—replacing inefficient lights, for example, or ordering PV, solar hot water, and gray water recycling systems.<sup>47</sup> The program is aiming to reduce carbon dioxide emissions by 1.5 tons per household a year.<sup>48</sup> Australians on average are responsible for fourteen tons per household.<sup>49</sup> This reduction in carbon dioxide emissions will save participants up to ten percent in their gas, electric, water, and petroleum bills.<sup>50</sup>

The social capital being built up around these new technologies and lifestyles is also proving highly infectious and is poised to become the basis of a major social movement if governments are prepared to adopt the approach more broadly.

## CONCLUSIONS

The end result of household programs like the ones outlined above, combined with the necessary policy initiatives, may be the beginning of a transformative sustainability

process—not just in the actual savings in fossil fuels and other valuable materials, but also in the growing sense that households and communities can achieve a transition to a more sustainable city.



# Endnotes: Sustainable Cities of the Future: The Behavior Change Driver

<sup>1</sup> Jan Scheurer & Peter Newman, *Vauban: A European Model Bridging the Brown and Green Agendas*, in UN HABITAT GLOBAL REPORT ON HUMAN SETTLEMENTS 2009 4 (2009), available at <http://www.unhabitat.org/downloads/docs/GRHS2009CaseStudyChapter06Vauban.pdf>.

<sup>2</sup> *Id.*; CITY OF HANOVER, HANNOVER-KRONSBURG: MODEL OF A SUSTAINABLE COMMUNITY (1998), available at [http://www.hannover.de/data/download/lhh/umw\\_bau/energie/download\\_sustainable\\_hannover/Kronsborg\\_a\\_model\\_for\\_sustainable\\_urban\\_development.pdf](http://www.hannover.de/data/download/lhh/umw_bau/energie/download_sustainable_hannover/Kronsborg_a_model_for_sustainable_urban_development.pdf); CITY OF HANOVER, CO<sub>2</sub>AUDIT 1991–2001 (2003).

<sup>3</sup> PETER NEWMAN & ISABELLA JENNINGS, CITIES AS SUSTAINABLE ECOSYSTEMS (2008); Peter Newman, *The Environmental Impact of Cities*, 18 ENV'T AND URBANIZATION 275, 278 (2007).

<sup>4</sup> *Id.* at 275.

<sup>5</sup> Masdar City is a planned community being developed just outside Abu Dhabi, United Arab Emirates (“UAE”). Funded primarily by the UAE government, the goals of the project include creating a sustainable urban environment designed to use as few resources as possible and to create a center for research and academic work. See ABU DHABI FUTURE ENERGY CO., MASDAR CITY, <http://www.masdarcity.ae/en/index.aspx> (last visited Oct. 13, 2010).

<sup>6</sup> The Redevelopment Plan for Treasure Island, between San Francisco and Oakland, California, calls for high density residential and commercial districts, convenient public transit systems, sustainable urban design, and remediation of existing environmental problems. See TREASURE ISLAND/YERBA BUENA ISLAND REDEVELOPMENT PLAN, ENVIRONMENTAL IMPACT REPORT, at II.4-5 (2010), available at [http://www.sf-planning.org/ftp/files/MEA/2007.0903E\\_TL\\_DEIR\\_05\\_ChapterII.pdf](http://www.sf-planning.org/ftp/files/MEA/2007.0903E_TL_DEIR_05_ChapterII.pdf).

<sup>7</sup> PETER NEWMAN, TIMOTHY BEATLEY & HEATHER BOYER, RESILIENT CITIES: RESPONDING TO PEAK OIL AND CLIMATE CHANGE 14 (2009).

<sup>8</sup> Chris Twinn, *BedZED*, THE ARUP JOURNAL, Jan. 2003, at 10, 11, available at [http://www.arup.com/\\_assets/\\_download/download68.pdf](http://www.arup.com/_assets/_download/download68.pdf).

<sup>9</sup> *Id.* at 10.

<sup>10</sup> WWF ET AL., LIVING PLANET REPORT 2008 32 (2008), available at [http://assets.panda.org/downloads/living\\_planet\\_report\\_2008.pdf](http://assets.panda.org/downloads/living_planet_report_2008.pdf).

<sup>11</sup> Jan Scheurer, Urban Ecology, PhD Thesis, INSTITUTE FOR SUSTAINABILITY AND TECHNOLOGY POLICY, MURDOCH UNIVERSITY, 2002, available at <http://www.istp.murdoch.edu.au/ISTP/publications/jscheurer/carfree/carfree.html>; David Beyer, Sustainable Building and Construction, PhD Thesis, INSTITUTE FOR SUSTAINABILITY AND TECHNOLOGY POLICY, MURDOCH UNIVERSITY, 2002, 38-40, available at <http://www.istp.murdoch.edu.au/ISTP/students/theses/honours/dbeyer/Sustainable%20Building%20and%20Construction.pdf>.

<sup>12</sup> PETER NEWMAN & JEFFERY KENWORTHY, SUSTAINABILITY AND CITIES: OVERCOMING AUTOMOBILE DEPENDENCE 70-71 (1999).

<sup>13</sup> *Id.* at 51-52.

<sup>14</sup> Peter Newman & Jeffery Kenworthy, *Greening Urban Transportation*, in WORLDWATCH INSTITUTE, STATE OF THE WORLD 2007 77 (2007).

<sup>15</sup> NEWMAN & KENWORTHY, *supra* note 12, at 90.

<sup>16</sup> TRANSPERTH PTA ANNUAL REPORT 2009/09, PUBLIC TRANSPORT AUTHORITY OF WESTERN AUSTRALIAN GOVERNMENT, <http://www.pta.wa.gov.au/Portals/0/annual-reports/2009/transperth/index.html> (last visited October 13, 2010).

<sup>17</sup> Newman & Kenworthy, *supra* note 14, at 68.

<sup>18</sup> *Id.* at 78.

<sup>19</sup> *Id.* at 74.

<sup>20</sup> THE CENTER FOR TRANSIT-ORIENTED DEVELOPMENT, HIDDEN IN PLAIN SIGHT: CAPTURING THE DEMAND FOR HOUSING NEAR TRANSIT 21 (2004), available at <http://www.reconnectingamerica.org/public/show/hipsi>.

<sup>21</sup> Andrew Went, Peter Newman & Wal James, *100% Renewable Transport*, in 100% RENEWABLE: ENERGY AUTONOMY IN ACTION 205-24 (Peter Droege ed., 2009).

<sup>22</sup> *Id.* at 219-20.

<sup>23</sup> GERHARD P. METSCHIES, FUEL PRICES AND VEHICLE TAXATION (2nd ed., 2001), available at <http://www.international-fuel-prices.com/downloads/FuelPrices2001.pdf>; RICHARD PORTER, ECONOMICS AT THE WHEEL: THE COSTS OF CARS AND DRIVERS (1999). See also CURTIN UNIVERSITY SUSTAINABILITY POLICY INSTITUTE, <http://sustainability.curtin.edu.au> (last visited Oct. 13, 2010).

<sup>24</sup> See NEWMAN, BEATLEY & BOYER, *supra* note 7, at 107.

<sup>25</sup> *Id.* at 158-59.

<sup>26</sup> *Id.* at 86.

<sup>27</sup> NEWMAN & KENWORTHY, *supra*, note 12, at 142.

<sup>28</sup> See Randy Salzman, *TravelSmart: A Marketing Program Empowers Citizens to be a Part of the Solution in Improving the Environment*, MASS TRANSIT: SUSTAINABILITY CONCEPTS, Apr. 2008, at 8, available at <http://masstransitmag.epubxpress.com/link/mass/2008/substain/1?s=0>; Randy Salzman, *Now That's What I Call Intelligent Transport...SmartTravel*, THINKING HIGHWAYS, Mar. 2008, at 26.

<sup>29</sup> Colin Ashton-Graham, GARNAUT CLIMATE CHANGE REVIEW, TRAVELSMART AND LIVINGSMART CASE STUDY—WESTERN AUSTRALIA (forthcoming), available at <http://www.garnautreview.org.au> (following the link: Home page > All reports & resources > Case studies > TravelSmart and LivingSmart—Western Australia)

<sup>30</sup> *Publication and Maps*, DEPARTMENT OF TRANSPORT, GOVERNMENT OF WESTERN AUSTRALIA, <http://www.transport.wa.gov.au/14897.asp> (last visited Oct. 9, 2010); SALZMAN *supra* note 28.

<sup>31</sup> *About TravelSmart*, DEPARTMENT OF TRANSPORT, GOVERNMENT OF WESTERN AUSTRALIA, <http://www.transport.wa.gov.au/15002.asp> (last visited Oct. 13, 2010); Ashton-Graham, *supra* note 29.

<sup>32</sup> *How Does TravelSmart Household Work?*, DEPARTMENT OF TRANSPORT, GOVERNMENT OF WESTERN AUSTRALIA, <http://www.transport.wa.gov.au/14958.asp> (last visited Oct. 13, 2010).

<sup>33</sup> Colin Ashton-Graham & Gary John, *TravelSmart + TOD = Synergy and Sustainability*, TRANSIT-ORIENTED DEVELOPMENT CONFERENCE FREMANTLE 3 (2005).

<sup>34</sup> *TravelSmart to School*, DEPARTMENT OF TRANSPORT, GOVERNMENT OF WESTERN AUSTRALIA, <http://www.transport.wa.gov.au/14909.asp> (last visited Oct. 13, 2010).

<sup>35</sup> Ashton-Graham & John, *supra* note 33.

<sup>36</sup> *Id.*

<sup>37</sup> *Id.*

<sup>38</sup> IAN KER, NORTH BRISBANE HOUSEHOLD TRAVELSMART: PEER REVIEW AND EVALUATION, FOR BRISBANE CITY COUNCIL, QUEENSLAND TRANSPORT, AND AUSTRALIAN GREENHOUSE OFFICE (2008).

<sup>39</sup> Newman & Kenworthy, *supra* note 14, at 66.

<sup>40</sup> SOCIALDATA AUSTRALIA, DEPARTMENT OF TRANSPORT, TRAVELSMART HOUSEHOLD FINAL EVALUATION REPORT MURDOCH STATION CATCHMENT (CITY OF MELVILLE 2007) 28 (2009), available at [http://www.dpi.wa.gov.au/ts\\_finalreport\\_melville\\_east.pdf](http://www.dpi.wa.gov.au/ts_finalreport_melville_east.pdf).

<sup>41</sup> *Id.*; PUBLIC TRANSPORT AUTHORITY, WESTERN AUSTRALIAN GOVERNMENT, <http://www.pta.wa.gov.au/> (last visited Oct. 9, 2010).

<sup>42</sup> DAVID WAKE, REDUCING CAR COMMUTING THROUGH EMPLOYER-BASED TRAVEL PLANNING IN PERTH, AUSTRALIA, 3 (2007), available at <http://www.dpi.wa.gov.au/ReducingCarCommutingPerth.pdf>.

<sup>43</sup> *Id.*

<sup>44</sup> *Living Smart Home*, DEPARTMENT OF TRANSPORT, GOVERNMENT OF WESTERN AUSTRALIA, [www.dpi.wa.gov.au/livingsmart](http://www.dpi.wa.gov.au/livingsmart) (last visited Oct. 9, 2010).

<sup>45</sup> Ashton-Graham, *supra* note 29, at 5.

<sup>46</sup> Ashton-Graham, *supra* note 29; SOCIALDATA AUSTRALIA, DEPARTMENT OF TRANSPORT, IMPLEMENTATION REPORT LIVING SMART JOONDALUP AND MANDURAH (2009), available at [http://www.transport.wa.gov.au/ls\\_Implementation\\_Report\\_2009.pdf](http://www.transport.wa.gov.au/ls_Implementation_Report_2009.pdf).

<sup>47</sup> SYNOVATE LTD., LIVINGSMART QUALITY SURVEY—HOUSEHOLD RESPONSES TO ENERGY, WATER, WASTE AND TRAVEL DEMAND MANAGEMENT SERVICES 43 (2009), available at [http://www.transport.wa.gov.au/ls\\_Quality\\_Survey\\_Report\\_2009.pdf](http://www.transport.wa.gov.au/ls_Quality_Survey_Report_2009.pdf).

<sup>48</sup> Ashton-Graham, *supra* note 29.

<sup>49</sup> *Living Smart Home*, *supra* note 44. See, e.g. *Environmental Indicators: Greenhouse Gas Emissions*, U.N. STAT. DIVISION, [http://unstats.un.org/unsd/environment/air\\_co2\\_emissions.htm](http://unstats.un.org/unsd/environment/air_co2_emissions.htm) (last updated Aug. 2009) (indicating as of 2006, per capita emissions were 19.7 tonnes in the United States, 9.2 tonnes in the United Kingdom, and 19 tonnes in Australia).

<sup>50</sup> SYNOVATE LTD., *supra* note 47.