Financial incentives for behavioral change in the ecological city

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Trends and issues

An Ecological City can be defined as "a city that provides an acceptable standard of living for its human occupants without depleting the ecosystems and bio-geochemical cycles on which it depends" (WHITE, 2002, pp. 3-4). Ideally, this means that an Ecological City discharges *no* unwanted residuals to the atmospheric, terrestrial and hydrological components of the surrounding biosphere. Specifically, this means that a city would emit *no* problematic gases, solids or liquids – no air pollution, no solid waste and no impure water. Clearly, the cities we inhabit are a very long way from this kind of ideal. Modern cities are *not* "ecological" in the sense defined above. In fairness to urban planners and urban managers, cities were never designed for zero ecological impact. Cities were designed to provide shelter and services, and to manufacture goods. Some had loftier aesthetic and spiritual purposes, but most were based on short-term, least-cost reasoning.

Not only are cities not physically designed to exist in harmony with the biosphere, but none of the key price signals have been set to encourage resource conservation or to minimize waste. Prices for services such as water and sewage treatment, transportation and solid waste management have evolved – at best – to meet some cost-recovery criteria. Even these criteria have not been pursued systematically.

This approach has produced cities that are extremely dysfunctional from an ecological standpoint. For example, traffic congestion is an almost universal feature of cities today. It is commonplace for "travellers" to spend more of their journey time immobile than mobile. Even 15 years ago, the engineers of the City of Toronto calculated that only 25 percent of the energy consumed by vehicles was used for motion – the rest is wasted (WHITE, 1994). The traffic situation in Toronto has greatly deteriorated since that time. For solid waste management, the situation has declined even further. The City's waste used to be taken to a landfill just north of the city boundary. When that landfill was closed in 1998, the "best solution" was identified as trucking the waste to a landfill in Michigan, some 450 km distant! Every day, between 120 and 140 trucks make the round trip, each carrying approximately 30 tonnes of solid waste. For air pollution, there have been some improvements for large particulates, carbon monoxide, lead and sulphates. However, for hydrocarbons and carbon dioxide, the situation has deteriorated further. Improvements in fuel and engine efficiency are far outweighed by increases in the number of vehicle-trips and the greater length of those trips. None of these trends is carrying us towards the goals of the Ecological City.

It might be assumed that a cleaner, healthier urban environment could be achieved only by restricting individual freedom, such as the freedom to pollute and to waste resources. That is not what is being proposed in this paper. On the contrary, the research question is: Are there changes that could be made to urban systems that would give the individual *more* choice, make the city less vulnerable, *and* provide the city with more revenue, from more diverse sources? More specifically, can we provide individuals and households with financial incentives to change their behavior?

This paper continues with a brief assessment of the implications of climate change for water availability and an introduction to the emerging field of urban environmental finance. It then assesses the potential for the application of the principles of urban environmental finance to the three main physical throughputs of water, energy and solid waste.

Water availability and climate change

Water quality is the single most important contributor to human health in both rural and urban areas. In urban areas, the greater density of settlement increases the risk of the spread of contagious diseases associated with poor water quality, as has been witnessed on a regular basis, especially with typhoid, cholera

and yellow fever. These diseases were largely checked in Western cities towards the close of the 19th century. They may still be a problem in poorer cities, along with other water-related diseases such as gastro-enteritis, hepatitis and malaria.

However, even in the richest cities we cannot afford to be complacent about water, either in quality or quantity. Cities like Los Angeles, located in a semi-arid region, are constantly looking for new sources of water. Even cities like Toronto and London face increasing costs for ensuring continuity of supply. For example, Thames Water in the UK has presented a proposal to build a desalination plant with a daily capacity to treat 150 million liters for the east London area, citing increasing demand per household, increasing population (800,000 people expected by 2016) and climate change (THAMES WATER, 2005). The proposal has been vetoed by the Mayor of London on the grounds that conservation is what is needed, rather than increasing supply, which is not a long-term solution.

Climate change will introduce a host of new challenges, including many related directly to water supply (WHITE, 2004). Although the global implications of climate change for average temperatures are quite well understood and quite predictable under the 'business as usual' scenario, little else is predictable (IPCC, 2001). Most fundamentally, business and government may not proceed "as usual" but may become very proactive toward the reduction of greenhouse gas emissions. Under the "business as usual" scenario, regional projections are subject to wide bands of uncertainty even for temperature, and more so for precipitation, wind and other atmospheric variables. What can be assumed is that the level of uncertainty for all these parameters will increase. It seems reasonable to further assume that, if we wish to maintain the same level of security under more uncertainty, then the costs of building and running urban infrastructure will increase.

The specific risks and uncertainties for the urban environment, under climate change, are:

- an increase in the probability of heavy precipitation events;
- these storms may affect water quality, through increased overland flow and disease transmission, such as *Giardia, E. Coli and Cryptosporidium;*
- these storms increase the probability of floods, including floods in urban areas;
- an increase in the probability of droughts;
- increased evapotranspiration, causing reservoir losses;
- a shift in disease vectors, especially malaria;
- more heat waves increasing the probability of deaths from heat stress, especially when added to the temperature increase due to the urban heat island effect; and,
- higher temperatures increasing the risk of wildfires in wooded areas adjacent to urban areas, as we have seen recently in southern France, south-east Australia, California and British Columbia.

Thus, climate change must be added to the main drivers that affect the future evolution of urban areas, along with population increase, an increasing percentage of the world's population living in urban areas, an increased level of material consumption and the disposal of residuals into the surrounding environment.

Urban environmental finance

Traditionally, urban services have been funded from revenue streams that might be completely unrelated to the use of the service or its impact on the environment (KITCHEN, 2000). Specifically, many urban governments rely heavily on residential and commercial property taxes. The tax is proportional to the value of the property and thus would be loosely correlated with the level of use of urban services. Transfers from senior levels of government are another important source of income. Urban governments also charge fees for a variety of services, such as parking fees and vending licences, as well as services such as the provision of water. Some urban governments have access to sales tax and some are able to tax company profits. None of these sources are linked closely enough to the environmental impacts of human behavior to act in a way that might modify that behavior (OPOKU-BOATENG, 2004).

Market-based instruments are now being applied to influence environmental outcomes directly in several countries and, internationally through the Kyoto Protocol, to the Framework Convention on Climate Change. The emerging field of environmental finance has been developed in order to address global environmental issues such as climate change and the extreme and unpredictable weather associated with it by using market-based instruments (LABATT and WHITE, 2002). Important products developed to date include trading credits for reducing emissions of pollutants (such as sulphur dioxide and carbon dioxide), weather derivatives (to hedge the risk of adverse weather), catastrophe bonds (to cover catastrophic risks such as hurricanes and earthquakes) and cost-cap-over-run insurance to cover unexpected costs for brownfield remediation. The field is expected to become an important force for improving environmental quality and reducing the financial impact of climate change.

With reference to principles for the successful trading of credits for emission reductions, Richard Sandor observed; "These core elements simultaneously assure environmental integrity, cost reduction, efficient trading and valid price discovery. They include: clear rules on emission monitoring and non-compliance penalties; unimpeded trading; fully fungible trading instruments; public-private partnerships to achieve transparent prices" (SANDOR, 2000, p. 11). Trading in emission reduction credits for sulphur dioxide and nitrogen oxides continues to evolve and now includes contracts for futures and derivatives (BIELLO, 2005). The European Union Emissions Trading Scheme (for carbon dioxide emission reduction credits) was launched on schedule in January 2005; finally we can identify "the price of carbon" (NICHOLLS, 2005).

In the urban context, local environmental issues are those associated with the basic elements of urban metabolism – inflows of water, energy and food, and outflows of solid waste, gaseous exhaust and wastewater (WHITE, 1994, Chapter Three). Can the market principles – identified by Sandor – be harnessed to provide more of what we need (goods and services) and less of what we do not need (wastes)? Finance is the key, *both to raise revenue, and to change behavior* (OPOKU-BOATENG, 2005). The reason we have so many avoidable problems in the urban environment is that we have sent the wrong price signals, and failed to internalize environmental externalities. The challenge is to understand the balance between these two facets – raising revenue and changing behavior – because a radical change in behavior may reduce the revenue stream, or fail to raise enough revenue to carry out the plan (OPOKU-BOATENG, 2005).

Given our lack of experience with this approach, it is difficult to predict accurately the impact on behavior. For example, the imposition of a traffic congestion charge in London in February 2003 has reduced peak congestion (by 30 percent) and increased bus ridership (by 14 percent) but "charge revenues have been lower and penalty revenues higher than anticipated" (LITMAN, 2005). The biggest surprise has been the rapid change in local opinion from (sometimes fierce) opposition to support for the scheme. The feared negative impacts on local businesses and the diversion of traffic to streets bordering the "charge zone" have proved to be insignificant (TRANSPORT FOR LONDON, 2005). The phrase "situated in the congestion charge zone" has even been used to advertise multi-million dollar townhouses, because being "in the zone" is an indicator of centrality and the residents of the zone are entitled to a 90 percent re-

bate on any charges that they pay. In the second year of operation of the congestion charge, net revenue amounted to US$ 175 million (£ 97 million), of which 80 percent will be spent on improving the bus network (TRANSPORT FOR LONDON, 2005).

Another recurrent concern is the welfare implication of user fees. For example, if water is to be priced for full cost recovery, how can the necessary minimum use be assured for low-income people? Similar examples can be found for solid waste management, energy for heating and cooling homes, transportation for the disabled, and so on. In addition to the welfare implications, there are direct health implications for all of these services, especially for water availability, air quality, climate change and waste management. All of these issues can be addressed on a case-by-case basis. A concern for the potential negative welfare implications of "true pricing" should not be used as an excuse for delaying reform forever. Indeed, in the water sector, under un-metered regimes, the poor (in apartments and smaller houses) subsidize those rich households which water large gardens.

Pricing that produces full-cost recovery may be implemented in either the public sector or the private sector. That is, pricing and ownership are separate issues. This fact is not always recognized in the arena of public debate where the issue often becomes emotionally charged to the detriment of analysis (BUDDS and McGRANAHAN, 2003). Because some privatization experiences have had very negative consequences (mostly in developing countries), there is widespread suspicion of privatization as a policy, especially in the water and sewage treatment sector. The fear is that companies will put profits and their shareholders before the public good.

A further objection to privatizing utilities and services is that the supposed competitive drive of the private sector does not come into play in these monopolistic situations. There is some validity to this observation, because it is true that the visible competition that is present between shopkeepers, people selling homes, or other recognized commodities does not exist for most urban infrastructure and related services. However, usually there are *elements* of competition. In the case of the English water supply, it is true that the consumers have only one supplier, but the economic regulator of the water industry – the Office of Water Services (OfWat) – has access to the pricing policies of several companies operating in similar markets. Thus – in the sense that prices must be approved by OfWat – these companies are in competition with one another to perform efficiently.

The other respect in which the competitive force can be brought into play is when the contract to design, build and operate a utility or service is put out to tender. Once awarded, the contract should be regularly reviewed for performance. This requires the regulatory bodies to operate in an effective and transparent manner, which cannot simply be assumed.

It is not easy to move from the traditional public sector supply system to one in which the private sector has an important role and in which prices are employed explicitly to move towards environmental targets, such as zero solid waste, zero harmful emissions to the air and 100 percent re-use of water. Pricing policy in a typical city today considers hardly any of these environmental quality issues, and none in a comprehensive manner. *Many pricing structures actually encourage wasteful behavior.* The situation is generally better in Europe than in North America but nowhere does it approach the goal of the Ecological City.

Water

Water is not only the most critical resource but is also the one that is most seriously mismanaged. The biggest waste of water occurs outside the city on the irrigated farm and is therefore outside the scope of this paper. However, some cities, such as Beijing and Los Angeles are now in direct competition with their rural hinterlands for water. In the worst urban cases, household water use is not even metered, but is simply made available in unlimited quantities for a fixed fee that is sometimes related to a property tax. This does *nothing* to encourage conservation. Indeed, it encourages a very inefficient peak use in the late afternoon in the summer as residents who have gardens water them profligately. In North America, this peak is several times larger than peak use in winter.

The overall environmental objective should be to approach 100 percent re-use of the water supply. Technically there is no reason why this could not be done. It would be much more efficient than the current systems in which cities (until recently) assumed that they could operate as a "free rider" on the natural hydrological cycle. As water becomes less freely available, we need to move towards a system based on 100 percent metered use with ascending block prices to encourage conservation. The price charged to users should be sufficient to cover both capital and recurrent costs of water use and treatment. The welfare and public health issues can be dealt with by making the lowest price block affordable to low-income people and sufficient to cover reasonable needs, such as 200 litres per person per day. Many cities are a very long way from this sort of target. In Toronto, even those households that are metered pay only US$1.12 (CAD1.37) per cubic meter for water, including sewage treatment.[1] Thus the daily charge for water use and sewage treatment, for a family of five people using 200 liters per person per day, is less than the price of a single cup of coffee.

Stormwater management is also being brought into the fee-for-service realm with the introduction of stormwater user fees based on the quantity and quality of runoff. Although more than 400 such schemes are operating in the United States, only three are operating in Canada (SMEH, 2003). The fees encourage the maintenance of porous surfaces and the control of contaminants discharged to the environment. Unfortunately, they do not curb the significant deposition of contaminants from motor vehicle exhaust.

Energy

Like water pricing policy, energy pricing policy has evolved without any regard for environmental consequences. The general objective within the framework of the Ecological City is to provide energy for a variety of purposes (the provision of manufacturing, administration and services; mobility, lighting, space heating and cooling, cooking, etc.) without damaging the environment or compromising human health. The transportation sector and its emissions to the air, which reduce air quality and change the climate, are major problems. Recently, attention has focused on the connection between the use of personal transportation and obesity. In North America, people in the suburbs, on average, weigh more than people living downtown who make more use of walking, cycling and public transport (FRANK et al., 2003). The final irony is that the automobile no longer delivers the service which people thought they had bought – an efficient means of personal mobility. As the suburbs sprawl and automobile use expands, more and more time on the road is spent in traffic jams.

There are various approaches to this conundrum. Many European cities have simply banned automobiles from the historic core, which was never designed for such traffic. Others have introduced congestion charges. The recent London example is not very sophisticated, being a set daily charge for entering the central part of the city. The price is fixed arbitrarily by the government. More ambitiously, Singapore has introduced a dynamic, market-based congestion charge that fluctuates with the degree of congestion. As congestion gets worse, the fee (which is deducted from an account) increases.

Electronic Road Pricing (ERP) ... uses a dedicated short-range radio communication system to deduct ERP charges from "smartcards" inserted in ... vehicles each time they pass a pricing point when the system is in operation. The pay-when-you-use principle helps make motorists more aware of the true cost of driving (GOVERNMENT OF SINGAPORE, 2004).

Some cities have tolls on ring roads and cross-town expressways. Others charge nothing for road use other than the vehicle tax and fuel tax. To improve the situation, we need to find financial instruments that will shift the transportation modal split from private automobiles to public transport, cycling and walking. This, in turn, will oblige energy-intensive travellers to pay for the environmental costs (as well as the congestion) which they generate.

Climate change has added a sense of urgency to the air quality and inefficiency implications of the transportation sector. Coupled with concerns about indoor air quality in the home and in the workplace, energy conservation has become a major focus for municipalities around the world, especially if they belong to the Cities for Climate Protection program established in 1993 by the International Council for Local Environmental Initiatives (BULLEID, 2005). As more data become available, it is easier to make the financial case for investing in environmental quality, for the household, the company, and the municipality.

Solid waste

As cities have become larger and more complex, their solid waste streams have become larger and more contaminated. In pre-industrial cities, most of the waste stream was organic and could be left to decompose, *in situ*. Today, the collection and disposal of solid waste – usually to a landfill outside the city – has become a significant municipal expenditure. Beyond the expense, a growing problem has evolved with resistance from local communities to accepting urban waste for various reasons, including odor, noise and dust, health fears, and impact on housing prices. As noted earlier, this problem has become so severe in the Toronto area that the city's waste is currently being shipped to Michigan.

It is not unreasonable to expect a city to take care of its own solid waste, rather than exporting it to an unwilling host community. Several means have been attempted to move in this direction. Much of household solid waste can be recycled, keeping the organics for compost (if a garden is available) and having reusable material – such as paper, plastic, glass, and metals – collected by the municipality or a private body. In most cities where these options exist, compliance is voluntary. These measures alone can reduce solid waste going to landfill by 80 percent per participating household.

It is more effective to tackle the problem of solid waste generation at source by making the manufacturers and retailers accept "producer responsibility." This was introduced in the European Union in 1994 with the Directive on Packaging and Packaging Waste (McCALLIN, 2003). Many municipalities have some form of take-back responsibility, if only for certain types of bottles, such as those for beer and soft drinks.

A more price-oriented approach can be developed in two ways – by paying the consumer for separating the recycled materials (as in the bottle-return programs), and by charging the consumer for any waste that has to go to landfill. There is some fear that the latter approach will encourage people to abandon their waste illegally but the evidence on this is inconclusive. Where consumers do have to pay per bag for waste removal, there is more obvious political support for obliging the producers to reduce waste materials at source by providing appropriate packaging which can be returned, re-used or recycled. In scientific terms, this is not a profound problem and it should be within our capacity to reduce solid waste close to zero.

The role of market forces and the role of privatization

Without succumbing to a naïve belief that if "we get the prices right" all our urban environmental problems will be solved, it should be evident that we can do much better than most cities currently do in attempting to get some of the prices moving in the right direction. It should be possible to agree that prices (or lack of them) should not encourage individuals to squander resources that are then paid for by the community at large. Whereas there is little support for insisting that everyone pay for the necessities of life, there should be a great deal of support for the view that people should pay for the damage they choose to cause, the resources they choose to squander and the waste they choose to generate. Those choices could certainly be made subject to realistic (i.e. full cost recovery) charges.

The potential benefits from using prices to encourage more environmentally friendly behavior are huge. For example, a city may not need a new sewage treatment plant if it can reduce both the contaminants entering the wastewater stream and the quantity of stormwater running into that stream.

The goal of using prices to encourage environmentally friendly behavior is quite separate from the potential of privatization for encouraging this change in behavior to take place. After several years of recent experience, the approach to this issue has become more pragmatic and less ideological. For those in favor of privatization, the advantages are that the private sector, driven by competition and the search for profits, is more efficient than the public sector. Prices may rise in the short term as investment deficiencies (in deferred maintenance and modernization) are made good but, in the longer run, prices would fall. For those opposed to privatization, the risks are seen as loss of employment as workforces are downsized and soaring prices as the consumers are sacrificed to the company's shareholders.

In practice, the quality of the outcome depends on the quality of the public regulation of private companies delivering services to the general public. In England, where the water supply and treatment sector was privatized in the early 1990s, there have been negative experiences, such as lack of water supply and public health impacts, but also much has been learned (BAKKER, 2000). The process by which the system is monitored is much more transparent than it was when run by dozens of separate municipalities and public water boards. The government will continue to regulate price changes and supervise quality standards.

Conclusion

There is little reason to fear that a coherent, environmentally oriented pricing policy for urban services will have negative welfare implications. On the contrary it is the lack of any coherent approach to pricing that is unjust. Why should the relatively poor pay for the relatively rich to water their lawns? Yet that is what happens if a water system is un-metered. Why should those who walk, cycle or take public transit absorb the environmental burden from automobiles? Why should the frugal pay for the disposal of the solid waste of the profligate? No one would argue in favor of these effects of this kind of approach to pricing – yet, in many cities, this is exactly the way the system works.

Given that cities are very inefficient from a metabolic point of view, why is more not being done? The will to change seems to be there as is evidenced by statements such as the Nagoya Declaration (1997) and the Charter of European Cities and Towns Towards Sustainability (the Aalborg Charter, 1994). The Council for Local Environmental Initiatives was established in 1990 and is associated with the International Union of Local Authorities (WHITE, 2002, Chapter 11, Appendices 1 and 2). From the Rio Earth Summit in 1992, a notable outcome was "Local

Agenda 21" which established environmental goals for local authorities throughout the world.

It could be argued that in most cities, the situation is getting worse, despite some evidence of innovation. As poorer countries become richer, most of them seem determined to follow the "development path" of the richer countries, despite the obvious dangers. (Daily, we read of streets in China's big cities being closed to bicycles so that automobiles may have a freer passage). The barriers to improvement are the usual barriers to innovation. Decision makers and the public are preoccupied with seemingly more pressing matters. There is limited awareness of those cases where innovation has been successful. And, finally, the cost of implementation is often seen as a barrier. Yet, the financing of the Ecological City should be cost-effective if it is approached in an experimental fashion or if we can devise effective behavior modification pricing mechanisms such as a dynamic congestion charge for road use.

Some lessons from the general field of environmental finance are encouraging. The first, large-scale environmental market was established for credits for emission reductions for sulphur dioxide and nitrogen oxides in the north-eastern United States in 1995 through the Environmental Protection Agency (SANDOR, 2000). Despite widespread opposition on grounds of the expected cost of compliance, the credits traded, for several years, at less than one quarter the price predicted by the opponents of the scheme, and the reduction targets were achieved ahead of schedule.

Similar savings should be possible within the urban context from using water more efficiently, reducing the amount of solid waste we produce, and shifting the transportation modal split to less destructive modes of travel than the automobile. There is no technological obstacle to building an Ecological City. Perhaps there is no financial obstacle either.

In the globalized economy, cities are said to be in economic competition with one another. In the 19th century, when cities used to compete regionally for investment, employment, and hence sources of tax revenue, there was an incentive for municipalities and regional governments to offer cheap infrastructure in order to attract employment. To a large extent, we are still living with this mindset, expecting to provide cheap energy, cheap water and cheap transportation, subsidized by the taxpayer via public sector investment. However, there is a growing awareness that resources are becoming scarcer and that low environmental standards carry a measurable health penalty in the form of water-related disease, respiratory illness and automobile accidents. International terrorism has added to this sense of vulnerability. Perhaps this means that municipal governments should focus on environmental quality, resilience and efficiency as incentives for potential corporate investors – rather than the old strategy of cheap energy, cheap water and subsidized infrastructure for automobiles.

Note

1. This is the price for the first 80 cu.m in a four-month billing period. The next block is US$ 1.16 (CAD1.41).

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