

Urban Ecology: Building Green

For many the phrase “urban ecology” is an oxymoron, as urban development disrupts and destroys ecosystems. Yet with more than half the world’s population living in cities,¹ we must learn to live more ecologically in urban environments. Solving urban problems begins with seeing each city, with its suburbs and surrounding countryside, as an evolving landscape within nature:

The city is a granite garden, composed of many smaller gardens, set in a garden world. Parts of the granite garden are cultivated intensively, but the greater part is unrecognized and neglected. To the idle eye, trees and parks are the sole remnants of nature in the city. But nature in the city is far more than trees and gardens, and weeds in sidewalk cracks and vacant lots. It is the air we breathe, the earth we stand on, the water we drink and excrete, and the organisms with which we share our habitat. Nature in the city . . . is rain and the rushing sound of underground rivers buried in storm sewers. It is water from a faucet, delivered by pipes from some outlying river or reservoir, then used and washed away into the sewer, returned to the waters of river and sea. Nature in the city is an evening breeze, a cork-screw eddy swirling down the face of a building, the sun and the sky. Nature in the city is dogs and cats, rats in the basement, pigeons on the sidewalks, raccoons in culverts, and falcons crouched on skyscrapers. It is the consequence of a complex interaction between the multiple purposes and activities of human beings and other living creatures and of the natural processes that govern the transfer of energy, the movement of air, the erosion of the earth, and the hydrologic cycle.²

A more ecological view of cities requires a new approach to urban planning. Nature’s ecosystems have a *circular* metabolism. Every output discharged by an organism also becomes an input. The web of life hangs together in a “chain of mutual benefit” through the flow of nutrients passing from one organism to another.³

Unfortunately the “metabolism” of most cities now is largely *linear*, with resources being moved through the urban system with little concern for their origin or what is done with the waste. Food is imported into cities, consumed, and then exported from cities as sewage in rivers and coastal waters. Raw materials are extracted from nature and processed into consumer goods that end up as waste in landfills, where organic materials are mixed with glass, metals, plastics, and toxic residues.

Therefore our goal for sustainable urban life is to create “an adaptive, resilient, evolving, self-organizing” system that provides “a sustainable livelihood, whose ecological footprint is minimal, and which interfaces with natural systems in a way that promotes ecological integrity.”⁴

The Built Environment

In 1993 the International Union of Architects and the American Institute of Architects at its joint World Congress issued the “Declaration of Interdependence for a Sustainable Future.” This declaration begins by recognizing that: “A sustainable society restores, preserves, and enhances nature and culture for the benefit of all life, present and future,” and that “today’s society is seriously degrading the environment and is not sustainable.”⁵

Recognizing that buildings have a major impact on the natural environment and our quality of life, the World Congress of Architects pledged to promote sustainable design that

1 | Text from Chapter 14 of *Doing Environmental Ethics* by Robert Traer (Westview Press, 2013).

integrates resource and energy efficiency, healthy buildings and materials, ecologically and socially sensitive land use, and “an aesthetic sensitivity that inspires, affirms, and ennobles.”⁶ The declaration also affirms that building with a sustainable design will provide construction jobs as well as improve the quality of life and protect the natural environment.⁷

Standards

In 1990 in the United Kingdom, the Building Research Establishment published a set of guidelines known as the Building Research Establishment Environmental Assessment Method (BREEAM). In 1996 the US Green Building Council created the Leadership in Energy and Environmental Design (LEED) standards, and two years later countries supporting the Green Building Challenge began to promote the Green Building Assessment Tool (GBTool).⁸

These standards are important because buildings consume about 40 percent of all the raw materials and energy used by human communities. In the United States, buildings use about 65 percent of the electricity consumed, produce around 30 percent of the greenhouse gas (GHG) emissions, consume almost 12 percent of the potable water used, and generate approximately 135 million tons of construction and demolition waste per year.⁹

LEED takes a whole-building approach to sustainability: sustainable site development, materials, water savings, energy efficiency, and the quality of the indoor environment.¹⁰ The US Green Building Council promotes the LEED standards, and seven federal agencies (including the army, navy, and air force) have adopted these standards for new building projects, as have many states and cities.¹¹

Green standards are also being incorporated into municipal building codes. Santa Monica now requires building design features that are 20 to 25 percent more efficient than California’s regulations. In Boulder, Colorado, residential construction has to earn twenty-five “green points” for approval. “Green points are earned according to the amount of insulation (for example, R-24 wall insulation would earn 3 points), the type of windows (high performance glazing would earn between 2 and 8 points), the kind of heating system (radiant floor heating, for example, would earn 5 points), and by positioning new construction so that it has enhanced access to solar heat (2 points).”¹²

San Francisco has stringent building codes that require new large commercial and residential buildings to have environmentally friendly features such as solar power, nontoxic paints, and plumbing fixtures that minimize water use. This plan has the support of the San Francisco Building Owners and Managers Association, because it makes sense and has been phased in gradually over four years.¹³

Industrial Ecology

In a sustainable world, not only agriculture but also industry should be shaped by biomimicry. Industrial systems should be modeled on ecosystems so that excess energy and waste from some manufacturing activities are used as inputs for other activities. After their “birth, life, and death” at one scale, industrial products would ultimately be utilized at another scale, copying the waste-free cycles of natural systems.¹⁴

This ethical presumption represents a new way of looking at economic development. “Industrial ecology is taken to be the activity of designing and managing human

production-consumption systems, so that they interact with natural systems, to form an integrated (eco)system which has ecological integrity and provides humans with a sustainable livelihood.”¹⁵ Every ton of metal that is reused or recycled replaces a ton that would otherwise have been mined and smelted.¹⁶

Green buildings are rich in ecological benefits. First, a green building *uses less fossil fuel* than a standard building. Increased insulation, windows that prevent energy loss, lighting and heating with daylight, and natural cooling yield significant energy savings. Additional reductions in the use of carbon-based energy can be realized with solar heating, wind power, geothermal heat exchange systems, or fuel cells.¹⁷ One goal of ecological design is to eliminate the use of fossil fuels to adjust temperatures. This can be done by designing buildings that rely on temperature differences occurring naturally in the air and the earth, and even in water.¹⁸

Second, a green building *conserves water*. Strategies include installing low-flow toilets and showerheads, using water from washing machines and showers for irrigation, treating black water (from the sewer) for irrigation, using waterless urinals or composting toilets, and capturing rainwater. Planting a landscape that is native also reduces water use.

These strategies do not require new technology, although technological innovation will improve their efficiency. In 2000 the American Institute of Architects recognized a building constructed at the University of British Columbia (UBC) for its significant reduction in water use. The building has nine composting toilets and three urinals that require no water, and it uses gray water and rainwater for irrigation, for a net savings of about fifteen hundred gallons of potable water every day.¹⁹ Construction costs were comparable to a similar building; moreover, the operating and maintenance costs of the UBC building are lower.

Third, a green building *creates less waste*. This involves filtering polluted water before it leaves the site, recharging groundwater, preserving and encouraging biodiversity in the landscape, and using integrated pest management. The materials used in the building should be salvaged and recycled, as well as durable. Occupants of the building should easily be able to recycle, compost, and reuse waste.

Fourth, a green building is not only efficient, but *maximizes the effective use of energy*. “This distinction emphasizes the amount of energy required to perform a particular service, rather than the efficiency with which energy is converted from one form to another.”²⁰

For example, if the waste heat from turbines generating electricity is used to help heat a building or, “through the absorption cycle, to cool the building in the summer, the gain from using the waste heat will not show up in the efficiency calculation but will show up in an effectiveness calculation.”²¹ Similarly, a building that captures heat generated during the day by machines and people within it, then uses this stored heat at night to maintain room temperature, is more effective in its heating even though the main heating system is not operating more efficiently.

Sustainable Construction

Summing up, the objectives of “building green” standards, industrial ecology, and sustainable construction are to:

- Reduce resource consumption.
- Reuse resources to the maximum extent possible.
- Recycle built environment end-of-life resources and use recyclable resources.

- Protect natural systems and their function in all activities.
- Eliminate toxic materials and by-products in all phases of the built environment.
- Incorporate full-cost accounting in all economic decisions.
- Emphasize quality in all phases of the life cycle of the built environment.²²

These principles embrace the three Rs, internalize the real costs of the environmental and social consequences of construction, and protect as well as mimic natural systems.²³

European governments have strongly supported green construction. In the United States the federal government has yet to establish standards for buildings that require greater energy efficiency, but local building codes are changing. Americans should support more stringent standards, because the average building in the United States now consumes about a third more energy than a similar building in Germany.²⁴

Transportation

Economic interests that have persuaded Congress to keep gasoline taxes low and to support federal subsidies for highway development are largely responsible for the urban-suburban sprawl of most US cities. Few of these cities have energy-efficient mass transportation systems, and most have substantial traffic congestion that increases travel time, causes a greater consumption of gasoline, and adds to urban air pollution.

Mass Transit

There are, however, more sensible cities. Curitiba, Brazil, a city of 2 million in a metropolitan area of 3.5 million, has a bus system used by 85 percent of its people. Moreover, a quarter of the city's drivers ride the bus to work. Why is Curitiba's bus system so effective?

- Buses travel on a dedicated track, like a train, so they are not held up by traffic.
- Passengers board through a raised bus stop, which allows rapid wheelchair access.
- Passengers pay at the bus stop, reducing the time required for loading a bus.
- Buses can carry 270 passengers, more than three times the ordinary bus.²⁵

These innovations have enabled the city to realize most of the benefits of subways at less than 5 percent of the cost of building an underground train system.

There is only one low price for a bus ticket, no matter how far a passenger travels. Also, the city has contracts with ten private companies for bus service, pays according to the length of a route rather than the number of passengers carried, and buys old buses from the companies to ensure that new buses are regularly brought into service. Finally, the city has not widened highways to facilitate travel by motorized vehicles and has set aside streets for pedestrians.

There are many other efforts worldwide to reduce the use of cars. In Freiburg, Germany, residents in a new ecological district pay a hefty fee for a space in a nearby parking garage, and "car-free" estates are being created in the Netherlands. London has a traffic-congestion zone and charges motorists driving in the city center between 7:00 a.m. and 6:00 p.m.²⁶ Stockholm imposes a congestion tax for vehicles entering the city center,²⁷ and Singapore has an electronic road-pricing system that charges motorists using the roads during peak hours.²⁸

Bicycles and Pedestrians

To promote the use of bicycles, European cities have increased bike lanes and made other changes. Separated bike lanes have their own signals, signs, and priority at intersections. Many cities have also installed extensive bicycle parking facilities at train stations and public buildings.²⁹ Almost 40 percent of those working in Copenhagen bike to work, and the city offers “public bikes” that can be used by depositing a coin.³⁰ Paris has twenty thousand bikes available for rental by credit card at eighteen hundred sites around the city.³¹

The United States lags far behind. To encourage cycling, laws are needed that support the ethical presumption that motor vehicles should give way to cyclists where neither has a clear right of way.³² As bicycling in the United States for the foreseeable future will require using city streets, municipalities should widen curbside lanes and shoulders, replace drain grates, patch potholes, mark lanes, and install bike-activated traffic signals.³³

The suburbs, too, need to be redesigned, with pedestrians rather than automobiles in mind. Neighborhoods with housing, parks, and schools need to be within walking distance of shops, government offices, workplaces, and public transportation.³⁴ Realizing this new form of community life will require a significant change in attitudes among Americans.

Water and Waste

Cities consume enormous amounts of water. Greater London, with a population of about seven million, uses over one billion tons of water per year, which is about 100 gallons per person each day. In the United States it is estimated that cities use about 150 gallons of water per person each day.³⁵ Much of this water is used to carry waste away from the city, and only a small fraction of the water treated for city use is consumed as drinking water.

Water Use

A more cost-effective and sustainable way of using water in cities involves “dual-use systems” that deliver drinking water separately to homes and businesses and utilize an alternative system to provide lesser-quality water for manufacturing, urban farming, landscaping, firefighting, and carrying away wastes. This approach can be combined with water quality treatment at the neighborhood level, which minimizes the length of the dual-use delivery system.³⁶

Also, recycled water that is not suitable for drinking can be used for watering lawns and gardens and flushing toilets. A building can be plumbed to collect and use its gray water for these purposes. At least one water district in California now delivers recycled water as well as drinking water to commercial users that have installed dual-use systems.³⁷

As the water pipes in our cities deteriorate, the water pumped from central water treatment systems will decline in quality. Installing a dual system with satellite treatment facilities located in neighborhoods would be more cost effective, if done as deteriorating pipes are replaced. Cleaner drinking water can be provided immediately, however, by installing in-home and workplace water treatment systems. Governments could provide financial incentives for this investment by offering low-interest loans, tax credits, and rebates, as is being done for building renovations that save energy.

Our ethical presumptions for conserving water in the city include (1) installing dual-use delivery systems with satellite water treatment facilities, (2) providing recycled water for uses that do not require drinking water, and (3) offering financial incentives for in-home and workplace water treatment systems. These changes increase short-term costs, but are

probably cost effective in the long term. Moreover, using less drinking water and recycling gray water not only lowers the demand for water, which reduces the rate at which we are consuming nonrenewable groundwater, but also reduces the need for water treatment facilities.

Natural Wastewater Treatment

Natural wastewater treatment systems should be a priority. In these systems, sewer water seeps into the roots and stems of aquatic plants, which take up nutrients from the water. Bacteria and other microorganisms living on the plants also remove polluting materials. A natural treatment system can remove from water almost any material, including heavy metals and pathogens.³⁸

The system in Arcata, California, “begins with primary settling[,] after which 2 to 3 million gallons of sewage move into three oxidation ponds each day and an equal amount moves out. After that, a 5.3 acre intermediate marsh, planted mostly with the hardstem bulrush (*Scirpus acutus*), reduces suspended solids. Mosquito fish control mosquito populations. Chlorination and dechlorination follow the intermediate marsh; then the water moves into the 154-acre Arcata Marsh and Wildlife Sanctuary and from there” into the Pacific Ocean.³⁹

An aquatic natural treatment system occupies more land than mechanized systems, but in an urban plan, natural wastewater treatment facilities can be developed with satellite and dual-use water delivery systems. Also, these concepts can be applied at any scale to produce clean water and an enriched aquatic environment. These natural systems do not use fossil fuels or pollute the air and cost far less than mechanized alternatives. Such a system can be combined with techniques to separate sewage before purifying and converting it to fertilizer. The city of Bristol in the United Kingdom, with a population of 600,000, has invested in this process and produces 10,000 tons of fertilizer from its annual sewage output.⁴⁰

Solid Waste

Burial and burning have been the most common ways of disposing of solid waste, but burial results in contaminants seeping into the soil and groundwater, and incineration releases dioxins and poisonous gases into the atmosphere. Burning waste produces energy, but recycling paper, plastics, rubber, and textiles is three to six times more energy efficient than incineration.⁴¹ Therefore, solid urban waste should be largely recycled, reused, or tapped for methane gas as a source of energy. In 2007 the Environmental Protection Agency reported that more than four hundred landfills tap gas for power and an additional five hundred dumps contain usable supplies of methane.⁴²

In Curitiba, the Garbage Purchase program in low-income areas helps to clean up sites that are difficult for conventional waste-management service. Thousands of families gather and exchange tons of garbage for bus tokens and surplus food, and students collect and exchange garbage for notebooks.⁴³

Generally, *effective recycling requires financial incentives*. Arguments that may help to persuade businesses to recycle include:

- Separating wastes, once institutionalized, can *save money*.
- Recycling removes *liability* for storing toxic wastes.
- Greater competition for usable waste makes recycling *convenient*.

- Businesses can receive *publicity* for their recycling efforts.
- Employees and customers support *corporate responsibility*.⁴⁴

In construction, contracts should ensure that a subcontractor is responsible for disposing of any waste that is the result of his work. Research has shown that waste reduction on the job site may reach 80 percent with such a “supply-install-dispose” contract.

Sustainable Cities

A 1993 report of the US National Commission on the Environment (NCE) asserts that sustainable development requires “living within the earth’s means.”⁴⁵ This requires that the present generation protect natural resources so future generations will have the option of living, with hard work and innovation, as well as we do today.⁴⁶

Many cities take this duty to future generations seriously. The citizens of Seattle understand sustainability as involving *quality of life* concerns as well as conservation. Some communities express this understanding of sustainability as three Es: *environment*, *economy*, and *equity*.⁴⁷

Cities committed to sustainability promote recycling and the reuse of solid wastes. Household recycling is measured by the proportion of households that put recycle bins out for collection, and many city governments set targets to reduce the amount of waste going to landfills and incinerators.⁴⁸

A sustainable city plan will need support from business and civic organizations as well as government agencies, and also decision-making procedures, like adaptive management, that are responsive to local concerns. Business leaders or a civic organization may initiate a planning process, but to be effective it must be institutionalized in the municipal government.

Portland, Oregon, has incorporated its sustainability goals into the city’s comprehensive plan and charged a single municipal agency (the Office of Sustainable Development) with implementation.⁴⁹ Austin, Texas, owns its electrical generating company and is offering residents the option of receiving energy generated by renewable resources.⁵⁰

Chicago, which hopes to be the most environmentally friendly city in the nation, has planted more than half a million trees in the past twenty years and has stringent energy conservation standards for buildings.⁵¹ With business and civic leaders, the city has created the Chicago Climate Action Plan, which contains detailed suggestions for energy conservation, use of renewable fuels, and cutting waste from the city’s transportation systems.⁵² The city also manages a “Sustainable Backyard Program” that provides financial incentives and guidance for planting native plants and trees, building compost bins, and installing rain barrels or a cistern.⁵³

In addition, Chicago maintains a garden on the roof of its city hall with twenty thousand plants in more than 150 species. Like every green roof, the city hall garden improves air quality, conserves energy, and reduces storm water runoff. The plants reflect heat, providing shade and helping to cool the surrounding air by releasing water through pores in their leaves. As the water evaporates, the air is cooled. Plants also improve air quality by transforming carbon dioxide into oxygen.⁵⁴

These cities understand that sustainable urban development requires learning from the circular metabolism of nature. The overriding ethical and economic presumption of urban ecology is biomimicry.

Environmental Justice

In 1987 the Commission on Racial Justice of the United Church of Christ (UCC) released a report entitled “Toxic Wastes and Race in the United States” that verified the correlation between hazardous waste sites and race. The study confirmed that three out of five African American and Hispanic American residents were living in communities with uncontrolled hazardous waste sites. The response in 1991 by the federal government was the creation of an Office on Environmental Equity within the EPA.

In 1994 President Clinton’s Executive Order 12898 required each federal agency to make achieving environmental justice part of its mission, by addressing the disproportionately adverse human health or environmental impacts of its activities on minority and low-income populations.⁵⁵ In 2011 the EPA began pursuing Plan EJ 2014, which it identifies as a strategy to integrate environmental justice into its ongoing activities. The goals of Plan EJ 2014 are to:

- Protect health in communities overburdened by pollution.
- Empower communities to take action to improve their health and environment.
- Establish partnerships with local, state, tribal, and federal organizations to achieve healthy and sustainable communities.⁵⁶

For the EPA, air and water pollution—from factories, power plants, and landfills—is the greatest threat to environmental justice.

In contrast, the Federal Highway Administration (FHA) of the Department of Transportation considers the cost of transportation a major issue of environmental injustice. In a publication entitled “Environmental Justice Emerging Trends and Best Practices Guidebook,” the FHA reports that low-income families may pay more than half of their income for housing and transportation. Nonetheless, “The cost of transportation is typically overlooked in everyday decisions and public policies related to housing, despite the fact that transportation expenses can cost as much as housing for some American households.”⁵⁷

States have also created environmental justice policies. California’s legislation is administered by the Office of Planning and Research. To secure environmental justice, this state agency requires open hearings before implementing a policy that will likely have adverse environmental impacts.

Thus, the power plant review process in California requires opportunities for residents who might be affected to express their opposition. The state energy commission claims that environmental justice is served by public “participation, including open and effective dialogue with stakeholders,” because this “fosters relationships, provides a forum to address concerns, and helps to promote actions that minimize impacts on the surrounding community and the environment as a whole.”⁵⁸ Note the relationship and consequential arguments in this statement.

The rights “to participate” in public decisions and “to know” what decision-makers are planning, which are clearly stated in the Sierra Club principles on environmental justice, are necessary for justice but not sufficient. Due process requirements ensuring procedural justice must be accompanied by substantive justice—by actually reducing pollution as well protecting the right “of equity” for those with less affluence and political power.

“Environmentally degrading land uses should be avoided,” the Sierra Club policy asserts, “but when such uses occur, they should be equitably sited[,] taking into account all environmental and community impacts including the cumulative and synergistic ecological and health effects of multiple facilities. All people have the right to a safe and healthful work and home environment.”⁵⁹ Governments, and all of us, have a duty to help protect the rights that are necessary for both procedural and substantive justice.

Community groups are more active in pursuing environmental justice than are environmental NGOs, and community groups that collaborate with unions, health advocates, and university researchers have had success. Government agencies often do not have adequate information to assess the health hazards of pollution levels in a community, and research done by university faculty and students can fill this gap. Unions and other groups defending their rights help to provide higher turnout for protests.

Following the model of the civil rights movement, environmental justice advocates argue that every person has the right to clean air, water, food, and housing. Environmental justice requires that public officials act on their duty to protect these rights for everyone, but especially for the poor and vulnerable. This ethical argument is consistent with the theory of distributive justice developed by John Rawls, which measures social justice by the protection that society provides for the least advantaged among its members. As in the civil rights movement, the ethical argument is completely anthropocentric.⁶⁰

When environmental advocates focus only on damage to ecosystems and the biosphere, they are criticized by community leaders protesting environmental injustice. Robert Bullard, a leading voice arguing against environmental injustice and racism, says the environmental justice movement “is trying to address all of the inequities that result from human settlement, industrial facility siting and industrial development.”⁶¹ The focus is not simply the natural world, but also our social and cultural environment.

A follow-up study, *Toxic Wastes and Race at Twenty*, concludes that little has changed:

- Racial and socioeconomic disparities in the location of the nation’s hazardous waste facilities are geographically widespread throughout the country.
- People of color are concentrated in neighborhoods and communities with the greatest number of facilities, and people of color in 2007 are *more* concentrated in areas with commercial hazardous sites than in 1987.
- Race continues to be a significant independent predictor of commercial hazardous waste facility locations when socioeconomic and other nonracial factors are taken into account.⁶²

The report also documents efforts by the George W. Bush administration to undermine the EPA’s regulatory authority as well as its mandate to address environmental injustice.

Under the Obama administration, the EPA has made environmental justice a priority, issuing millions of dollars to local communities and tribal organizations to address health hazards. In 2010 the EPA distributed \$1.9 million for this purpose, more than in any other year in the past decade.⁶³ Through its Environmental Justice Awards program, the EPA recognizes partnerships that produce positive environmental and human health benefits for communities.⁶⁴ In addition, the EPA funds student internships through its Environmental Justice Eco-Ambassador Program.⁶⁵

Phoenix, however, is a stark reminder of the continuing environmental injustice in many US cities. Prosperous neighborhoods have LEED-certified houses with solar roofs and

yards with drought-tolerant plants. In contrast, “South Phoenix is home to 40 percent of the city’s hazardous industrial emissions and America’s dirtiest ZIP code, while the inner-ring Phoenix suburbs, as a legacy of cold-war era industries, suffer from some of the worst groundwater contamination in the nation.”⁶⁶ For areas like South Phoenix, public funding is needed to create green jobs in the city, reduce pollution, and provide mass transit to low-income neighborhoods.

The present inequities in our cities are largely the result of injustice from decades of economic development that has subsidized the urban areas used by the affluent at the expense of the neighborhoods where lower-income families live with polluting factories and landfills that benefit everyone, but impose the greatest health burden on people of color. Therefore, our ethical presumption should be to redress this inequity by providing public benefits for those who have previously been disadvantaged.

Consequences

What would be the likely consequences of acting on these presumptions to make our communities more sustainable? In the short term, the costs might outweigh the benefits. Furthermore, if future benefits were discounted, as is often done in cost-benefit analysis, the high front-end costs of investing in long-term economic and environmental sustainability might seem unjustified.

Yet the 1993 report by the US National Commission on the Environment (NCE) requires that we *consider long-term consequences without discounting them*. The report says we have an ethical duty to pass on to future generations an environment and an accumulation of resources that will allow them to live at least as well as we have. The NCE report also requires that the loss of *natural capital* be included in any cost-benefit analysis.⁶⁷

The costs of losing natural capital are immense, including the resources from the environment that we depend on, such as minerals, clean air and water, and healthy habitats.⁶⁸ The 1993 NCE report asserts that we should be living off the “interest” of natural capital, instead of consuming it. Natural capital does not literally have interest, but preserving the environment (natural capital) allows us to benefit from its ecosystem functions (benefits analogous to interest) even as we sustain natural capital so it will also provide these benefits for future generations.

Long Term

The major principles of the Netherlands National Environmental Policy Plan (NEPP) offer a summary of the ethical presumptions required for sustainable urban life:

- *Intergenerational equity*: The current generation is responsible for providing a sustainable environment for the next generation.
- *The precautionary principle*: In light of uncertainties, it is best not to make decisions that may involve serious environmental risks.
- *The standstill principle*: As an absolute minimum, environmental conditions shall not further deteriorate.
- *Abatement at source*: Harmful environmental actions should be prevented at their source.
- *The polluter pays principle*: Environmental costs should be internalized through such means as licensing fees and environmental taxes.
- *Use of the best applicable technology* to control pollution and other environmental harms.

- *Prevention* of all unnecessary waste.
- *Isolation, management, and control* of wastes that cannot be processed.
- *Internalization*: Environmental considerations are to be integrated into the actions of all responsible groups.
- *Integrated lifecycle management*: Manufacturers are responsible for all environmental impacts of their products, from manufacture to use to disposal. Waste flows and pollution should be reduced at all stages.
- *Environmental space (footprint)*: A limit to the level of resources each person can consume if society is to be environmentally sustainable is recognized.⁶⁹

Do the likely consequences of acting on these presumptions call them into question? The *standstill* and *polluter pays* principles, as well as the presumptions that it is best to *abate pollution at its source* and to *prevent unnecessary waste* (rather than having to clean it up), are easily justified by cost-benefit analysis, even if the focus is only short term.

The ethical principle of *intergenerational equity*, which means accepting a duty to preserve natural capital for future generations, may be criticized as being “too expensive.” From an ecological perspective, however, this objection seems largely self-serving. Certainly using a utilitarian standard and considering the greatest good for the greatest number over more than one generation would require limiting our consumption of natural capital, so it can continue to provide its life-sustaining benefits.

What about requiring use of the *best applicable technology*? Saving money in the short term, by using less expensive but less effective technology to clean water, will likely not be cost effective in the long run. Internalizing environmental and social costs, rather than ignoring these as externalities, will increase the cost of doing business and the price of goods. Yet ignoring these real costs simply passes them on to the next generation.

Isolation, management, and control of wastes that cannot be processed and reused would seem, on its face, to yield better consequences than dumping these wastes into the environment. Moreover, assigning this responsibility to manufacturers, along with responsibility for all the likely environmental impacts of their products, gives them a financial incentive to reduce, recycle, or reuse waste in every possible way. Those who argue that governments should be responsible for all these costs, rather than manufacturers, bear the burden of demonstrating that this would be more effective.

The Precautionary Principle

German law adopted this ethical principle in the 1970s, in a provision known as the “foresight” principle, which states that natural resources should be protected and that demands on them should be made with care. This duty extends beyond the responsibility to act (with “hindsight”) after environmental damage has taken place, in order to prevent future occurrences, and even beyond acting to prevent an imminent hazard. The ethical presumption is that “the proponent of an activity, rather than the public, should bear the burden of proof.”⁷⁰

The precautionary principle involves three elements. First, there must be some factual basis creating a legitimate reason for concern. Second, there must also be uncertainty about whether the concern is justified or the suggested remedy will be effective. Third, the remedy must involve a significant economic or social cost.⁷¹

The Sierra Club explicitly endorses this ethical presumption. “When an activity potentially threatens human health or the environment, the proponent of the activity, rather than the

public, should bear the burden of proof as to the harmlessness of the activity. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation.”⁷²

Perhaps the strongest argument against the precautionary principle is not that it raises costs, but that it may curtail innovation.⁷³ Yet all the precautionary principle does is shift the responsibility for assessing risks and costs from government regulators to the manufacturer of a product, which must verify that a product is safe before it is used or sold. Imposing this principle on all industrial innovation does not disadvantage any particular business.

Corporations are beginning to adopt the precautionary principle, at least for activities that directly affect environmental integrity or human health. The Body Shop International, a cosmetics company, has included the precautionary principle in its chemicals policy.⁷⁴ P&G affirms: “nothing is more important to us than ensuring the safety of our products for our consumers and the environment.”⁷⁵

In 2003 San Francisco passed an ordinance that reads: “The Board of Supervisors encourages all City employees and officials to take the precautionary principle into consideration and evaluate alternatives when taking actions that could impact health and the environment, especially where those actions could pose threats of serious harm or irreversible damage.”⁷⁶ Two years later the city began to consider the environmental and health costs of every item purchased in its \$600 million annual budget.

Economic Benefits

Despite the lack of federal legislation supporting urban ecology, thirty-three states and a dozen federal agencies have adopted laws and regulations that support the construction of more energy efficient buildings. Revenue for design firms from green projects rose 17 percent to \$3.3 billion in 2009, even though the recession meant that their overall revenue fell 12 percent. For construction contractors, revenue from green projects rose by 11 percent, while total revenue for the industry decreased by 14 percent.⁷⁷

In 2011 President Obama launched the Better Buildings Initiative with a goal of achieving a 20 percent improvement in energy efficiency by 2020. The president has asked Congress to change the present tax deduction for upgrading commercial buildings to a credit that is more generous, as an incentive to building owners to retrofit their properties.⁷⁸ Architecture 2030, an NGO dedicated to reducing GHG emissions, argues that this initiative would create 300,000 new jobs. Each \$1 billion in tax credits would generate \$16.4 billion in new private spending and \$3.6 billion in new federal tax revenues.⁷⁹

There will be continuing debate in the United States over whether federal subsidies and regulations will create more jobs than the market would without these governmental interventions. Nonetheless, according to the Bureau of Labor Standards, in 2010 government regulations or other interventions in the economy accounted for only 0.3 percent of the job losses, whereas declining business demand led to 25 percent of the layoffs. Regulations raise the cost of doing business, but when jobs are lost they are usually made up in the same industry.⁸⁰

Nature as Our Model

These ecological policies for urban living embody the ethical principle of internalizing the environmental costs of our consumption. Implementing these policies requires research

that reveals the loss of natural capital involved in making a product, the environmental impact of using it, and the disposal costs of each item. Combining this with the integrated lifecycle management of products by manufacturers and with supply-install-dispose construction contracts would help cities be more environmentally sustainable.

How are we to prevent all unnecessary waste? We should produce more *consumables* that, “when eaten, used, or thrown away, literally turn back into dirt, and therefore are food for other living organisms. This means that shampoos should be in bottles made of beets that are biodegradable in your compost pile. It means carpets that break down into carbon dioxide and water. It means furniture made of lignin, potato peels and technical enzymes that look just like your manufactured furniture of today except it can be safely returned to the earth.”⁸¹

To eliminate waste in using products that are not consumables, but instead provide a service (cars, computers, etc.), these *durables* should be licensed rather than sold, and the producer should have a legal duty to disassemble, recycle, and reuse the components of the product.⁸² “Customers may use them as long as they wish, even sell the license to someone else, but when the end-user is finished with, say, a television, it goes back to Sony, Zenith, or Philips.”⁸³

Toxins and other hazardous products should not be made at all, and *unmarketables* that have already been made should be stored safely until we figure out a safe and nontoxic means of disposing of them.⁸⁴

Keeping these principles in mind, McDonough and Braungart modeled a new building for Oberlin College in Ohio on the way a tree works. “We imagined ways that it could purify the air, create shade and habitat, enrich soil, and change with the seasons, eventually accruing more energy than it needs to operate.”⁸⁵ In its first summer the building began generating more energy capital than it was using.

Features include solar panels on the roof; a grove of trees on the building’s north side for wind protection and diversity; an interior designed to change and adapt to people’s aesthetic and functional preferences with raised floors and leased carpeting; a pond that stores water for irrigation; a living machine inside and beside the building that uses a pond full of specially selected organisms and plants to clean the effluent; classrooms and large public rooms that face west and south to take advantage of solar gain, special windowpanes that control the amount of UV light entering the building, a restored forest on the east side of the building, and an approach to landscaping and grounds maintenance that obviates the need for pesticides or irrigation.⁸⁶

Cities can adopt the circular metabolism of nature. Our built environment can become a “granite and green garden.” Urban ecology is possible and necessary for sustainable living.

NOTES

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