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ECOLOGICAL ECONOMICS AND SUSTAINABLE DEVELOPMENT

Building a sustainable and desirable economy-in-society-in-nature

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Introduction

The current mainstream model of the global economy is based on a number of assumptions about the way the world works, what the economy is, and what the economy is for (Table 18.1). These assumptions arose in an earlier period, when the world was relatively empty of humans and their artifacts. In this context, built capital was the limiting factor, while natural capital was abundant. It made sense not to worry too much about environmental "externalities," since they could be assumed to be relatively small and ultimately solvable. It also made sense to focus on the growth of the market economy, as measured by gross domestic product (GDP), as the primary means to improve human welfare. And it made sense to think of the economy as only marketed goods and services and to think of the goal as increasing the amount of these goods and services produced and consumed.

Now, however, we live in a radically different world that is relatively full of humans and their built capital infrastructure. In this new context, we have to reconceptualize what the economy is and what it is for. We have to first remember that the goal of the economy should be to sustainably improve human well-being and quality of life, and that material consumption and GDP are merely means to that end, not ends in themselves. We have to recognize, as both ancient wisdom and new psychological research tell us, that too much of a focus on material consumption can actually reduce our well-being (Kasser 2002). We have to better understand what really does contribute to sustainable human well-being and recognize the substantial contributions of natural and social capital, which are now the limiting factors to improving that well-being in many countries. We have to be able to distinguish between real poverty, in terms of low quality of life, and merely low monetary income. Ultimately we have to create a new vision of what the economy is and what it is for, and a new model of the economy that acknowledges this new "full-world" context and vision.

Some argue that relatively minor adjustments to the current economic model will produce the desired results. For example, they argue that by adequately pricing the depletion of natural

Table 18.1 The basic characteristics of the current economic model, the green economy model, and the ecological economics model

	Current Economic Model	*Green Economy Model*	*Ecological Economics Model*
Primary policy goal	*More:* Economic growth in the conventional sense, as measured by GDP. The assumption is that growth will ultimately allow the solution of all other problems. More is always better.	*More but with lower environmental impact:* GDP growth decoupled from carbon and from other material and energy impacts.	*Better:* Focus must shift from merely growth to "development" in the real sense of improvement in sustainable human well-being, recognizing that growth has significant negative by-products.
Primary measure of progress	GDP	Still GDP, but recognizing impacts on natural capital.	Index of Sustainable Economic Welfare (ISEW), Genuine Progress Indicator (GPI), or other improved measures of real welfare.
Scale/carrying capacity/role of environment	Not an issue, since markets are assumed to be able to overcome any resource limits via new technology, and substitutes for resources are always available.	Recognized, but assumed to be solvable via decoupling.	A primary concern as a determinant of ecological sustainability. Natural capital and ecosystem services are not infinitely substitutable and real limits exist.
Distribution/ poverty	Given lip service, but relegated to "politics" and a "trickle-down" policy: a rising tide lifts all boats.	Recognized as important, assumes greening the economy will reduce poverty via enhanced agriculture and employment in green sectors.	A primary concern, since it directly affects quality of life and social capital and is often exacerbated by growth: a too rapidly rising tide only lifts yachts, while swamping small boats.
Economic efficiency/ allocation	The primary concern, but generally including only marketed goods and services (GDP) and market institutions.	Recognized to include natural capital and the need to incorporate the value of natural capital into market incentives.	A primary concern, but including both market and nonmarket goods and services, and effects. Emphasis on the need to incorporate the value of natural and social capital to achieve true allocative efficiency.
Property rights	Emphasis on private property and conventional markets.	Recognition of the need for instruments beyond the market.	Emphasis on a balance of property rights regimes appropriate to the nature and scale of the system, and a linking of rights with responsibilities. Includes larger role for common-property institutions.
Role of government	Government intervention to be minimized and replaced with private and market institutions.	Recognition of the need for government intervention to internalize natural capital.	Government plays a central role, including new functions as referee, facilitator, and broker in a new suite of common-asset institutions.
Principles of governance	*Laissez-faire* market capitalism.	Recognition of the need for government.	Lisbon principles of sustainable governance.

Source: Adapted from Costanza et al. (2014a).

capital (e.g. putting a price on carbon emissions) we can address many of the problems of the current economy while still allowing growth to continue. We call this approach the "green economy" (GE) model (see Table 18.1). Some of the areas of intervention promoted by GE advocates, such as investing in natural capital, are necessary and we should pursue them. However, we do not agree that they are sufficient to achieve sustainable human well-being. We need a more fundamental change, a change of our goals and paradigm.

Both the shortcomings and the critics of the current model are abundant. A coherent and viable alternative is sorely needed. *Our aim here is to sketch a framework for a new model of the economy based on the world-view and principles of ecological economics* (Costanza 1991; Costanza et al. 1997; Daly and Farley 2004). These include the following ideas:

1 Our material economy is embedded in society which is embedded in our ecological life-support system, and that we cannot understand or manage our economy without understanding the whole, interconnected system.
2 Growth and development are not always linked and that true development must be defined in terms of the improvement of sustainable human well-being, not merely improvement in material consumption.
3 A balance of four basic types of assets (capital) are necessary for sustainable human well-being: built, human, social, and natural capital (financial capital is merely a marker for real capital and must be managed as such).

We also accept that growth in material consumption ultimately is unsustainable because of fundamental planetary boundaries (Rockström et al. 2009) and, further, that such growth is or eventually becomes counterproductive (uneconomic) in that it has negative effects on well-being and on social and natural capital (Costanza et al. 2014b).

There is a substantial and growing body of new research on what actually contributes to human well-being and quality of life. While there is still much ongoing debate, this new science clearly demonstrates the limits of conventional economic income and consumption in contributing to well-being. For example, economist Richard Easterlin has shown that well-being tends to correlate well with health, level of education, and marital status and shows sharply diminishing returns to income beyond a fairly low threshold (Easterlin 2003). Economist Richard Layard argues that current economic policies are not improving well-being and happiness and that "happiness should become the goal of policy, and the progress of national happiness should be measured and analyzed as closely as the growth of GNP (gross national product)" (Layard 2005).

In fact, if we want to assess the "real" economy—all the things that contribute to real, sustainable, human well-being—as opposed to only the "market" economy, we have to measure and include the nonmarketed contributions to human well-being from nature; from family, friends, and other social relationships at many scales; and from health and education.

Doing so often yields a very different picture of the state of well-being than may be implied by growth in per capita GDP. Surveys of people's life satisfaction, for instance, have been relatively flat in the United States and many other developed countries since about 1975, in spite of a near doubling in per capita income.

A second approach is an aggregate measure of the real economy that has been developed as an alternative to GDP called the Index of Sustainable Economic Well-Being (ISEW) or a variation called the Genuine Progress Indicator (GPI). The GPI attempts to correct for the many shortcomings of GDP as a measure of true human well-being. For example, GDP is not only limited—measuring only marketed economic activity or gross income—it also counts all of this activity as positive. It does not separate desirable, well-being-enhancing activity from

undesirable, well-being-reducing activity. An oil spill increases GDP because someone has to clean it up, but it obviously detracts from society's well-being. From the perspective of GDP, more crime, sickness, war, pollution, fires, storms and pestilence are all potentially good things, because they can increase marketed activity in the economy.

GDP also leaves out many things that *do* enhance well-being but are outside the market, such as the unpaid work of parents caring for their own children at home, or the nonmarketed work of natural capital in providing clean air and water, food, natural resources, and other ecosystem services. And GDP takes no account of the distribution of income among individuals, even though it is well known that an additional dollar of income produces more well-being if one is poor rather than rich.

The GPI addresses these problems by separating the positive from the negative components of marketed economic activity, adding in estimates of the value of nonmarketed goods and services provided by natural, human, and social capital, and adjusting for income-distribution effects. Comparing GDP and GPI for the United States, shows that, while GDP has steadily increased since 1950, with the occasional dip or recession, GPI peaked in about 1975 and has been flat or gradually decreasing ever since (Talberth et al. 2007). The United States and several other developed countries are now in a period of what might be called uneconomic growth, in which further growth in marketed economic activity (GDP) is actually reducing well-being, on balance, rather than enhancing it.

A new model of the economy consistent with our new full-world context would be based clearly on the goal of sustainable human well-being. It would use measures of progress that openly acknowledge this goal (e.g. GPI instead of GDP). It would acknowledge the importance of ecological sustainability, social fairness, and real economic efficiency.

A framework for an ecological economy

Elsewhere (Costanza et al. 2014a; Costanza and Kubiszewski 2014) we have described in detail a vision of what a new economy-in-society-in-nature might look like. A number of other groups, for example, the Great Transition initiative (www.gtinitiative.org) and the Future We Want (www.futurewewant.org), have performed similar exercises. All are meant to reflect the essential broad features of a better, more sustainable world, but it is unlikely that any particular one of them will emerge wholly intact from efforts to make human civilization sustainable. For that reason and because of space limitations, we will not describe those visions here. Instead we want to lay out what we believe are the changes in policy, governance and institutional design that will be required to achieve any of these sustainable and desirable futures.

The key to achieving sustainable governance in the new, full-world context is an integrated approach—across disciplines, stakeholder groups, and generations—based on the paradigm of "adaptive management," whereby policy-making is an iterative experiment acknowledging uncertainty, rather than a static "answer." Within this paradigm, six core principles (the Lisbon principles) embody the essential criteria for sustainable governance (Costanza et al. 1998) and the use of common natural and social capital assets:

Principle 1: Responsibility. Access to common asset resources carries attendant responsibilities to use them in an ecologically sustainable, economically efficient, and socially fair manner. Individual and corporate responsibilities and incentives should be aligned with each other and with broad social and ecological goals.

Principle 2: Scale-matching. Problems of managing natural and social capital assets are rarely confined to a single scale. Decision-making should: (1) be assigned to institutional levels that

maximize ecological input; (2) ensure the flow of information between institutional levels; (3) take ownership and actors into account; and (4) internalize social costs and benefits. Appropriate scales of governance will be those that have the most relevant information, can respond quickly and efficiently, and are able to integrate across scale boundaries.

Principle 3: Precaution. In the face of uncertainty about potentially irreversible impacts to natural and social capital assets, decisions concerning their use should err on the side of caution. The burden of proof should shift to those whose activities potentially damage natural and social capital.

Principle 4: Adaptive management. Given that some level of uncertainty always exists in common asset management, decision-makers should continuously gather and integrate appropriate ecological, social, and economic information with the goal of adaptive improvement.

Principle 5: Full cost allocation. All of the internal and external costs and benefits, including social and ecological, of alternative decisions concerning the use of natural and social capital should be identified and allocated, to the extent possible. When appropriate, markets should be adjusted to reflect full cost.

Principle 6: Participation. All stakeholders should be engaged in the formulation and implementation of decisions concerning natural and social capital assets. Full stakeholder awareness and participation contribute to credible, accepted rules that identify and assign the corresponding responsibilities appropriately.

The following are examples of world-views, institutions and institutional instruments, and technologies that can help move us toward the new economic paradigm. The list is divided into three primary sections: (1) respecting ecological limits; (2) protecting capabilities for flourishing; and (3) building a sustainable macro-economy.

Respecting ecological limits

Once society has accepted the world-view that the economic system is sustained and contained by our finite global ecosystem, it becomes obvious that we must respect ecological limits. This requires that we understand precisely what these limits entail, and where economic activity currently stands in relation to them.

A key category of ecological limit is dangerous waste emissions, including nuclear waste, particulates, toxic chemicals, heavy metals, greenhouse gases, and excess nutrients. The poster child for dangerous wastes is greenhouse gases, as excessive stocks of greenhouse gases in the atmosphere are disrupting the climate. Since most of the energy currently used for economic production comes from fossil fuels, economic activity inevitably generates flows of greenhouse gases into the atmosphere. Ecosystem processes such as plant growth, soil formation, and dissolution of CO_2 in the ocean can sequester CO_2 from the atmosphere. However, if flows into the atmosphere exceed flows out of the atmosphere, then atmospheric stocks will accumulate. This represents a critical ecological threshold for flows, and exceeding it risks runaway climate change with disastrous consequences. At a minimum then, for any type of waste where accumulated stocks are the main problem, emissions must be reduced below absorption capacity.

Current CO_2 stocks are well over 400 parts per million (ppm), and there is already clear evidence of global climate change in current weather patterns. Moreover, the oceans are beginning to acidify as they sequester more CO_2. Acidification threatens the numerous forms of oceanic life that form carbon-based shells or skeletons, such as molluscs, corals, and diatoms. In short, the weight of evidence suggests that we have already exceeded the critical ecological threshold for atmospheric greenhouse gas stocks (Rockström et al. 2009). This means that we must reduce flows by more

than 80 percent or increase sequestration until atmospheric stocks are reduced to acceptable levels. If we accept that all individuals are entitled to an equal share of CO_2 absorption capacity, then the wealthy nations would need to reduce net emissions by 95 percent or more.

Another category of ecological limit entails renewable resource stocks, flows, funds and services. All economic production requires the transformation of raw materials provided by nature, including renewable resources (for example, trees). To a large extent, society can choose the rate at which it harvests these raw materials, i.e. cuts down the trees. Whenever extraction rates of renewable resources exceed their regeneration rates, stocks will decline. Eventually, the stock of trees (the forest) will reach a point at which it is no longer capable of regenerating. So the first rule for renewable resource stocks is that extraction rates must not exceed regeneration rates, thus maintaining the stocks to provide appropriate levels of raw materials at an acceptable cost.

However, a forest is not just a warehouse of trees, it is an ecosystem that generates critical services, including life support for its inhabitants. These services are diminished when the structure is depleted or its configuration changed. So another rule for guiding resource extraction and land use conversion is that they must not threaten the capacity of the ecosystem fund to provide essential services. Our limited understanding of ecosystem structure and function, and the dynamic nature of ecological and economic systems, mean that this precise point may be difficult to determine. However, it is increasingly obvious that the extraction of many resources to drive growth has already become uneconomic. Rates of resource extraction must therefore be reduced to below regeneration rates in order to restore ecosystem funds to desirable levels.

Protecting capabilities for flourishing

In a zero-growth or contracting economy, working-time policies that enable equitable sharing of the available work are essential to achieve economic stability and to protect people's jobs and livelihoods. Reduced working hours can also increase flourishing by improving the work/life balance, and there is evidence (Durning 1992; Schor 2005) that working fewer hours can reduce consumption-related environmental impacts. Specific policies should include greater choice for employees about working time; measures to combat discrimination against part-time work as regards grading, promotion, training, security of employment, rate of pay, health insurance, etc.; and better incentives to employees (and flexibility for employers) for family time, parental leave, and sabbatical breaks (Jackson 2009).

Systemic social inequality can likewise undermine the capacity to flourish. It expresses itself in many forms besides income inequality, such as life expectancy, poverty, malnourishment, and infant mortality (Acemoglu and Robinson 2009). Inequality can also drive other social problems (such as over-consumption), increase anxiety, undermine social capital, and expose lower income households to higher morbidity and lower life satisfaction (Jackson 2009).

The degree of inequality varies widely from one sector or country to another. In the civil service, military, and university sectors in the United States, income inequality ranges within a factor of 15 or 20. Corporate America has a range of 500 or more. Many industrial nations are below 25 (Daly 2010).

A sense of community, necessary for democracy, is hard to maintain across such vast income differences. The main justification for such differences has been that they stimulate growth, which will one day filter down, making everyone rich. In our full world, with its steady-state or contracting economy, this is unrealistic. And without aggregate growth, poverty reduction requires redistribution. Fair limits to the range of inequality need to be determined, i.e. a

minimum income and a maximum income (ibid.). Studies have also shown that the majority of adults would be willing to give up personal gain in return for reducing inequality they see as unfair (Fehr and Falk 2002; Almås et al. 2010). Redistributive mechanisms and policies could include revised income tax structures, improved access to high quality education, anti-discrimination legislation, implementing anti-crime measures and improving the local environment in deprived areas, and addressing the impact of immigration on urban and rural poverty (Jackson 2009). New forms of cooperative ownership (as in the Mondragón model) or public ownership, as is common in many European nations, can also help constrain internal pay ratios.

The dominance of markets and property rights in allocating resources also can impair communities' capacity to flourish. Private property rights are established when resources can be made "excludable," i.e. one person or group can use a resource while denying access to others. However, many resources essential to human welfare are "non-excludable," meaning that it is difficult or impossible to exclude others from access to them. Examples include oceanic fisheries, timber from unprotected forests, and numerous ecosystem services, including the waste absorption capacity for unregulated pollutants.

Absent property rights, resources are "open access"—anyone may use them, whether or not they pay. However, individual property rights owners are likely to over-exploit or under-provide the resource, imposing costs on others, which is unsustainable, unjust, and inefficient. Private property rights also favor the conversion of ecosystem structure into market product, regardless of the difference in contributions that ecosystems and market products have on human welfare. The incentives are to privatize benefits and socialize costs.

One solution to these problems, at least for some resources, is common ownership. A commons sector, separate from the public or private sector, can hold property rights to resources created by nature or society as a whole and manage them for the equal benefit of all citizens, present and future. Contrary to wide belief, the misleadingly labeled "tragedy of the commons" (Hardin 1968) results from no ownership or open access to resources, not common ownership. Abundant research shows that resources owned in common can be effectively managed through collective institutions that assure cooperative compliance with established rules (Pell 1989; Feeny et al. 1990; Ostrom 1990).

Finally, flourishing communities will be supported and maintained by the social capital built by strong democracy. A strong democracy is most easily understood at the level of community governance, where all citizens are free (and expected) to participate in all political decisions affecting the community. Broad participation requires the removal of distorting influences like special interest lobbying and funding of political campaigns (Farley and Costanza 2002). The process itself helps to satisfy myriad human needs, such as enhancing the citizenry's understanding of relevant issues, affirming their sense of belonging and commitment to the community, offering opportunity for expression and cooperation and strengthening the sense of rights and responsibilities. Historical examples (though participation was restricted to elites) include the town meetings of New England or the system of the ancient Athenians (Prugh et al. 2000; Farley and Costanza 2002).

Building a sustainable macro-economy

The central focus of macro-economic policies is typically to maximize economic growth; lesser goals include price stabilization and ensuring full employment. If society instead adopts the central economic goal of sustainable human well-being, macro-economic policy will change radically. The goal will be to create an economy that offers meaningful employment

to all, that balances investments across the four types of capital to maximize well-being. Such an approach would lead to fundamentally different macro-economic policies and rules.

A key leverage point is the current monetary system, which is inherently unsustainable. Most of the money supply is a result of fractional reserve banking. Banks are required by law to retain a percentage of every deposit they receive; the rest they loan at interest. However, loans are then deposited in other banks, which in turn can lend out all but the reserve requirement. The net result is that the new money issued by banks, plus the initial deposit, will be equal to the initial deposit divided by the fractional reserve. For example, if a government credits $1 million to a bank and the fractional reserve requirement is 10 percent, banks can create $9 million in new money, for a total money supply of $10 million. In this way, most money is today created as interest-bearing debt. Total debt in the United States, adding together consumers, businesses, and the government, is about $50 trillion dollars. This is the source of the national money supply.

There are several serious problems with this system. First, it is highly destabilizing. When the economy is booming, banks will be eager to loan money and investors will be eager to borrow, which leads to a rapid increase in money supply. This stimulates further growth, encouraging more lending and borrowing, in a positive feedback loop. A booming economy stimulates firms and households to take on more debt relative to the income flows they use to repay the loans. This means that any slowdown in the economy will make it very difficult for borrowers to meet their debt obligations. Eventually some borrowers will be forced to default. Widespread default eventually creates a self-reinforcing downward economic spiral, leading to recession or worse.

Second, the current system systematically transfers resources to the financial sector. Borrowers must always pay back more than they borrowed. At 5.5 percent interest, homeowners will be forced to pay back twice what they borrowed on a 30-year mortgage. Conservatively speaking, interest on the $50 trillion total debt of the United States must be at least $2.5 trillion a year, one-sixth of our national output.

Third, the banking system will only create money to finance market activities that can generate the revenue required to repay the debt plus interest. Since the banking system currently creates far more money than the government, this system prioritizes investments in market goods over public goods, regardless of the relative rates of return to human well-being.

Fourth, and most important, the system is ecologically unsustainable. Debt, which is a claim on future production, grows exponentially, obeying the abstract laws of mathematics. Future production, in contrast, confronts ecological limits and cannot possibly keep pace. Interest rates exceed economic growth rates even in good times. Eventually, the exponentially increasing debt must exceed the value of current real wealth and potential future wealth, and the system collapses.

To address this problem, the public sector must reclaim the power to create money, a constitutional right in the United States and most other countries, and take away from the banks the right to do so by gradually moving towards 100-percent fractional reserve requirements.

A second key lever for macro-economic reform is tax policy. Conventional economists generally look at taxes, although necessary, as a significant drag on economic growth. However, taxes are an effective tool for internalizing negative externalities into market prices and for improving income distribution.

A shift in the burden of taxation from value added (economic goods, such as income earned by labor and capital) to throughput flow (ecological bads, such as resource extraction and pollution), is critical for shifting towards sustainability (Daly 2010). Such a reform would internalize external costs, thus increasing efficiency (Daly 2008). Taxing the origin and narrowest point in the throughput flow, for example, oil wells rather than sources of CO_2 emissions, induces more efficient resource use in production as well as consumption, and facilitates monitoring and

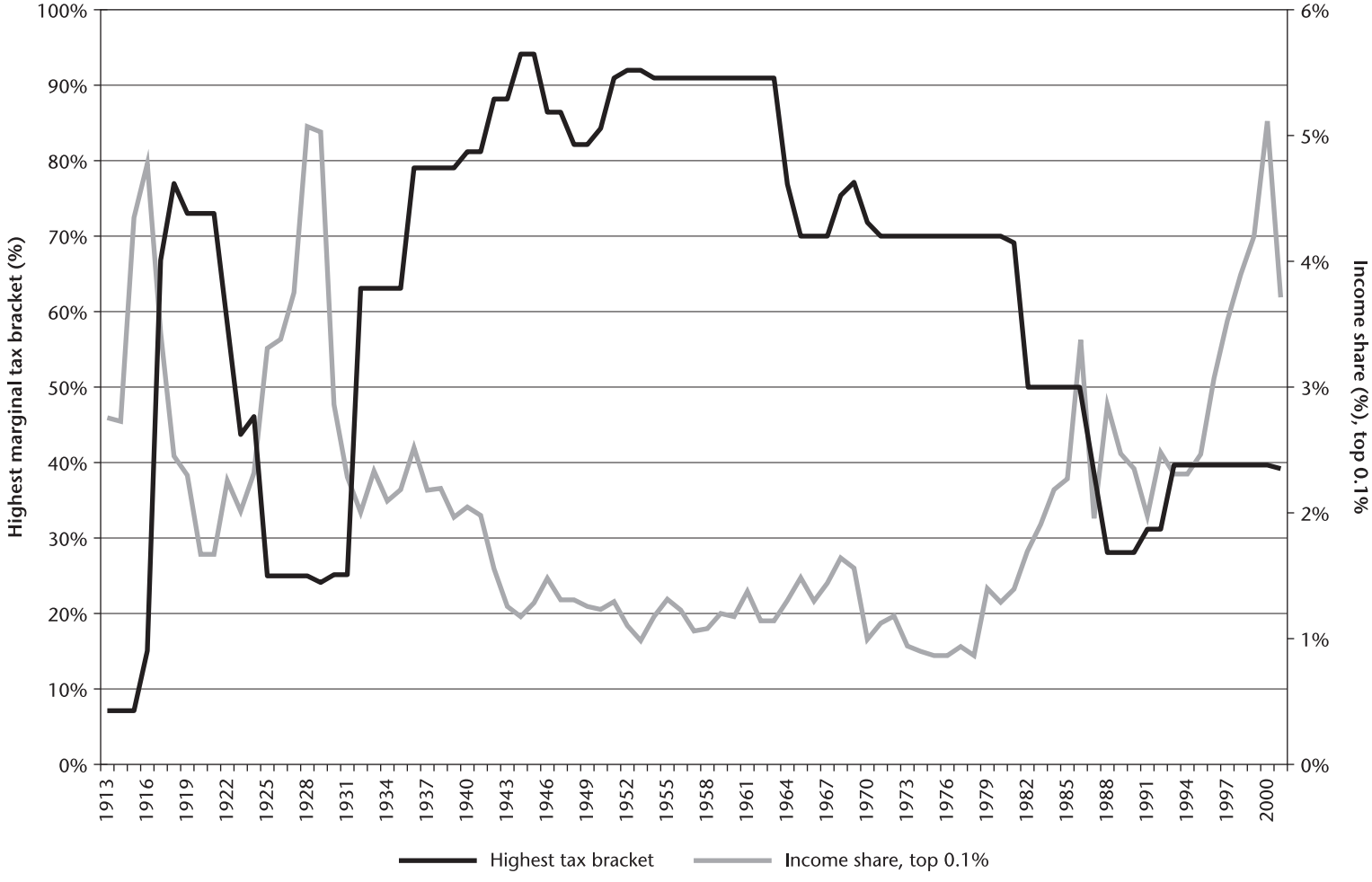

Figure 18.1 Time series of income in the highest tax bracket in the U.S. (black) and income share in the top 0.1% of households (grey) from 1913 to 2002

Source: Daly and Farley (2004).

(Diamond 2005; Costanza et al. 2007), and many of them were not what we would call "desirable," there have been a few successful historical cases in which decline did not occur, including the following (Weiss and Bradley 2001; Diamond 2005):

- Tikopia Islanders have maintained a sustainable food supply and non-increasing population with a bottom-up social organization.
- New Guinea features a silviculture system more than 7,000 years old with an extremely democratic, bottom-up decision-making structure.
- Japan's top-down forest and population policies in the Tokugawa-era arose as a response to an environmental and population crisis, bringing an era of stable population, peace, and prosperity.

A second line of evidence comes from the many groups and communities around the world that are involved in building a new economic vision and testing solutions. Here are a few examples:

- Transition town movement (www.transitionnetwork.org)
- Global EcoVillage Network (www.gen.ecovillage.org)
- Co-Housing Network (www.cohousing.org)
- Wiser Earth (www.wiserearth.org)
- Sustainable Cities International (www.sustainablecities.net)
- Center for a New American Dream (www.newdream.org)
- Democracy Collaborative (www.community-wealth.org)
- Portland, Oregon, Bureau of Planning and Sustainability (www.portlandonline.com/bps/)

All of these examples embody the vision, world-view, and policies we have elaborated to some extent. Their experiments collectively provide evidence that the policies are feasible at a smaller scale. The challenge is to scale up some of these models to society as a whole, and several cities, states, regions, and countries have made significant progress along that path, including Portland, Oregon; Stockholm and Malmö, Sweden; London, UK; the states of Vermont, Washington, and Oregon in the United States; Germany, Sweden, Iceland, Denmark, Costa Rica and Bhutan.

A third line of evidence for the feasibility of our vision is based on integrated modeling studies suggesting that a sustainable, non-growing economy is both feasible and desirable. These include studies using such well-established models as World3, the subject of *The Limits to Growth* (Meadows et al. 1972) and other more recent books, and the Global Unified Metamodel of the BiOsphere (GUMBO) (Boumans et al. 2002).

A recent addition to this suite of modeling tools is LowGrow, a model of the Canadian economy that has been used to assess the possibility of constructing an economy that is not growing in GDP terms but that is stable, with high employment, low carbon emissions, and high quality of life (Victor and Rosenbluth 2007; Victor 2008). LowGrow was explicitly constructed as a fairly conventional macro-economic model calibrated for the Canadian economy, with added features to simulate the effects on natural and social capital.

LowGrow includes features that are particularly relevant for exploring a low/no-growth economy, such as emissions of carbon dioxide and other greenhouse gases, a carbon tax, a forestry sub-model, and provision for redistributing incomes. It measures poverty using the UN's Human Poverty Index. LowGrow allows additional funds to be spent on health care and on programs for reducing adult illiteracy and estimates their impacts on longevity and adult literacy.

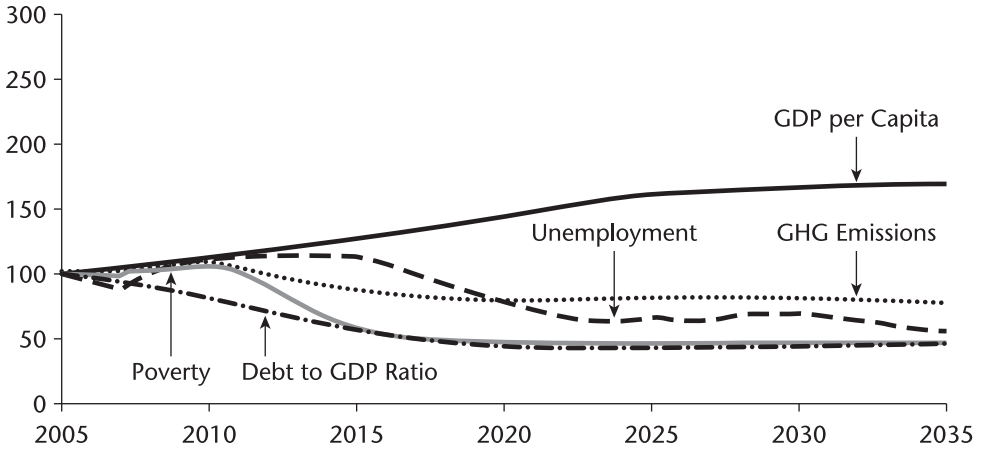

Figure 18.2 A low-/no-growth scenario

Source: Victor (2008).

A wide range of low- and no-growth scenarios can be examined with LowGrow, and some (including that shown in Figure 18.2) offer considerable promise.

Compared with the business-as-usual scenario, in this scenario, GDP per capita grows more slowly, leveling off around 2028, at which time the rate of unemployment is 5.7 percent. The unemployment rate continues to decline to 4.0 percent by 2035. By 2020 the poverty index declines from 10.7 to an internationally unprecedented level of 4.9, where it remains, and the debt-to-GDP ratio declines to about 30 percent and is maintained at that level to 2035. Greenhouse gas emissions are 31 percent lower at the start of 2035 than 2005 and 41 percent lower than their high point in 2010. These results are obtained by slower growth in government expenditures, net investment, and productivity; a positive net trade balance; cessation of growth in population; a reduced workweek; a revenue-neutral carbon tax; and increased government expenditure on anti-poverty programs, adult literacy programs, and health care. In addition, there are more public goods and fewer positional (status) goods, through changes in taxation and marketing; limits on throughput and use of space through better land use planning and habitat protection and ecological fiscal reform; and fiscal and trade policies to strengthen local economies.

These are precisely the policies that we have elaborated in the previous sections of this chapter. No model results can be taken as definitive, since models are only as good as the assumptions that go into them. But what World3, GUMBO, and LowGrow have provided is some evidence for the *consistency* and *feasibility* of these policies, taken together, to produce an economy that is not growing in GDP terms, but that is sustainable and desirable.

This chapter offers a vision of the structure of an "ecological economics" option and how to achieve it—an economy that can provide nearly full employment and a high quality of life for everyone into the indefinite future while staying within the safe environmental operating space for humanity on Earth. The policies laid out here are mutually supportive and the resulting system is feasible. Due to their privileged position, industrial countries have a special responsibility for achieving these goals. Yet this is not a utopian fantasy; to the contrary, it is business as usual that is the utopian fantasy. Humanity will have to create something different and better—or risk collapse into something far worse.

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