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Mobile phones have been become one of the major symbols of mass consumption in today's society.

3. Toward a New Production/ Consumption Model

Modern economies mobilize enormous quantities of fuels, metals, minerals, construction materials, and forestry and agricultural raw materials. The changes that are in place or in the works today have made the global economy more resource-efficient and have the potential to substantially reduce its reliance on fossil fuels. However, the limits of these changes are also evident. Gains in efficiency may simply be overwhelmed by continued economic growth. More far-reaching concepts—such as dematerialization, remanufacturing, “zero-waste,” closed-loop systems, making products more durable and repairable, and replacing products with efficient services—have been discussed for some time, but need to be translated into reality on a more urgent basis.

A range of studies and assessments has affirmed the potential of a “dematerialization” strategy—which aims to reduce the amount of raw materials needed to create a product by, for example, making paper thinner and vehicles lighter, and to cut the amount of energy needed to operate products—from light bulbs to washing machines and automobiles. Specifically, the advocates of dematerialization have pushed for “Factor 10”—policies that aim at providing a given volume of goods and services with one-tenth as much material input.¹⁰⁶

Advocates of “clean production” say that there are plenty of opportunities to reduce and perhaps eliminate the reliance on toxic materials in manufacturing, to prevent air and water pollution, and to avoid hazardous waste generation.¹⁰⁷

There is also a need to question whether a system of unbridled consumption—well entrenched in Western industrialized countries, but spreading rapidly to the growing middle classes of countries like China and India—can ultimately be sustainable even with “leaner” ways of producing. This calls into question basic precepts of the economic system. It also requires more thought with regard to the future of employment and how best to share available work. Economic systems that are able to churn out huge volumes of products but require less and less labor to do so pose the dual challenge of environmental impact and unemployment. In the future, not only do jobs need to be more green, but their very essence may need to be redefined. A number of countries and companies have wrestled with proposals to reduce individuals’ work time in order to share available work better among all those who desire work.

These are questions that mostly pertain to the richer countries. For countries at the other end of the spectrum, where poverty and deprivation, even food insecurity and hunger, dominate daily existence, these seem to be idle questions. In order to achieve a decent life, hundreds of millions of people will need to produce and consume more, not less. However, it is precisely because the global poor—close to 3 billion people—need to consume more that the need for the global consumer class of about 1.7 billion people to dramatically reduce theirs is so important. Stepping

back from the environmental precipice and achieving greater equity in humanity's draw on Earth's resources requires nothing less. Rough calculations suggest that in order to accommodate these twin imperatives, the rich nations may need to cut their use of materials by as much as 90 percent over the next few decades. There are many ideas and proposals for accomplishing this task. Combining this quest with job creation and retention is the ultimate green jobs challenge.

The standard industrial "cradle-to-grave" approach means that raw materials are extracted and processed, and the substances not directly useful to a factory become unwanted waste. An alternative "cradle-to-cradle" system seeks to build integrated, closed-loop systems, in which the byproducts of one factory become the feedstock of another, instead of becoming environmental time bombs. ¹⁰⁸

Environmentalists widely regard the community of Kalundborg in Denmark as a trailblazer of industrial ecology. An increasingly dense web of symbiotic relationships among a number of local companies there has slowly been woven over the past three decades, yielding both economic and environmental gains. For instance, natural gas previously flared off by a refinery is being used as feedstock in a plasterboard factory, desulfurized fly-ash from a coal-fired power plant goes to a cement manufacturer, and nitrogen- and phosphorus-containing sludge from a pharmaceutical plant is used as fertilizer by nearby farms. This experience presents a real-life alternative to industrial orthodoxy. But replicating this model may not be all that easy. Setting up a zero-waste industrial symbiosis takes considerable time. And it may be more workable to construct such reciprocal webs piece by piece (as actually happened in Kalundborg) rather than drawing up overly ambitious plans from the outset. ¹⁰⁹

Finding new ways to reduce waste and pollution by closing the production loop requires close attention to production methods and workplace habits. Close inspection of existing arrangements in each factory implies a greater need for labor. The cost of adding employees for such purposes could be offset by the savings achieved from reduced waste and waste disposal costs. But in order to turn such a general observation into a more specific sense of what it might mean for added employment, it is necessary to implement and analyze specific cases.

Durability and Repairability

Resource productivity can be boosted not only through greater energy and materials efficiency, but also by moving the economy away from the idea that churning out products designed to fall apart easily is good for the economy and good for the consumer. Durability, repairability, and "upgradability" of products are essential to achieving sustainability. By working to extend and deepen useful product life, companies can squeeze vastly better performance out of the resources embodied in products—improving the productivity of these resources—rather than selling the largest possible quantity of products. Such a move will have implications for employment across the economy, in extractive industries, manufacturing, transportation, and services.

In today's industrial economies, many products, even some that are nominally durable, have become "commodified": large quantities can be manufactured with such ease and at such relatively little monetary cost that there is considerable incentive to regard them as throwaways

rather than to produce them for durability. Consumer electronics such as mobile phones now have particularly short life cycles. If planned obsolescence rules, then not only is the use of energy and materials far higher than need be, but human dexterity, skill, and workmanship are also likely to be given low priority by management. Not just the product, but the labor that generates it, too, becomes a cheapened, undervalued commodity.

Many of today's consumer products are made in such a way as to discourage repair and replacement of parts, and sometimes even to render it impossible. And even when repair is possible, the cost is often too high relative to a new item. If repair and maintenance are not "worth the trouble," then most jobs in such occupations are condemned to vanish, as many have done in past decades. Although consumers have an obvious interest in cheap products, the price must be sufficiently high to justify ongoing maintenance, repair, or upgrading, and hence to make jobs in these occupations viable, satisfying, and well paying.

Over time, a durable product, such as a watch or a pair of shoes, with higher upfront cost of purchase will be economically more advantageous to consumers than cheaper, flimsier items that must be replaced frequently. Still, for certain items, the upfront cost could be steep, and this calls for the development of innovative financing plans. Where consumer credit is now geared to maintaining the hyper-throughput economy, allowing people to carry high personal debts and to rebound from insolvency in order to keep consuming, finance in a durable product economy will need to devise ways to make possible—and to reward—the purchase of long-life products.

Principles for Durability

Products can be designed and produced in such a way as to permit three characteristics crucial for durability: first, the ability to maintain, refurbish, repair, and upgrade them so that their useful life can be extended; second, the ease with which they can be taken apart so that components can be replaced or reconditioned as needed and materials salvaged for recycling or reuse; and third, the potential for remanufacture of products so that the value-added—the labor, energy, and materials embodied in the product when it was first made—can be recaptured. Studies at the Massachusetts Institute of Technology (MIT) and in Germany found that 85 percent or more of the original energy and materials typically are preserved in remanufacturing. Remanufacturing is more labor-intensive than the original manufacturing process and could therefore serve as a particularly appropriate approach in developing countries.¹¹⁰

For easy refurbishing and upgrading (so durability does not translate into technological obsolescence), a "modular" approach that permits easy access to individual parts and components is important. Computers serve as an obvious example here: standardized slots will accept components such as modems, sound cards, or memory chips virtually irrespective of which company made them. But the automobile industry, too, offers an illustration: DaimlerChrysler's "Smart" car has been designed with interchangeable body panels and other parts that allow for quick replacement.¹¹¹

Companies like Xerox (in its copiers and printers) and Nortel (in telecommunications) have adopted this philosophy. By working to extend and deepen useful product life, companies can squeeze

vastly better performance out of the resources embodied in products rather than selling the largest possible quantity. Although extended producer responsibility (EPR) laws do not as such address the issue of product longevity, they can be an incentive for companies to move in this direction.¹¹²

Job Implications

What are the job implications of these strategies? When goods do not wear out rapidly, they need not be replaced as frequently. An obvious implication is that fewer goods will be produced. While common sense might suggest that this would mean fewer employees are needed, this is not necessarily the case. To be sure, extractive industry jobs would again clearly be among the losers, but a shift to durability would also open up new opportunities. Using more robust materials, and processing and assembling them into longer-lasting, higher-quality products, implies a more craft-oriented, smaller-batch production process than the current mass-manufacturing practices—it takes more labor, and particularly more skilled labor. (This does not have to signal a return to the past, as modern techniques can help make materials more resistant to breakage and identify spots of structural weakness in products.)

More importantly, though, there will be greater opportunity and incentive to maintain, repair, upgrade, recycle, reuse, and remanufacture products, and thus there will be more job potential throughout the life of a product. These activities are all more labor-intensive and far less energy-intensive than producing new goods from virgin materials. Table I.3-1 offers a rough conceptual exploration of the likely employment implications.¹¹³ A fuller evaluation would require detailed assessments of the specific changes and how they translate into job losses and opportunities for new employment.

Table I.3-1. Employment Implications of Durable, Repairable, and Upgradable Products

Product Life-Cycle Phase	Observation	Possible Job Effects
Design and Engineering	Intense redesign of products (and production processes) required	Positive
Energy and Materials Inputs	Fewer products; therefore, fewer raw material inputs needed but more robust materials required	Negative
Manufacturing/ Assembly	Fewer products; but production more attentive to durability and quality, and likely performed in smaller-batch mode	Mixed
Distribution/ Transport	Fewer products shipped to end consumer, but increased (local) circulation from users to repair shops, remanufacturers, materials salvagers, etc., and back to consumers	Mixed
Maintenance	Revitalizing almost-abandoned functions; labor-intensive	Positive
Re-Manufacturing	Currently limited; more labor-intensive than initial manufacturing	Positive
Upgrading	Currently limited; labor-intensive	Positive
Consulting/ Performance Contracting	Advice on maximizing product utility and extending product-life; guidance on substituting services for goods	Positive
Disposal at End of Life-Cycle/ Reuse and Recycling	Fewer products to be disposed of, but more recycling and disassembly of parts and components for reuse; more labor-intensive than landfilling and incineration	Positive

Source: See Endnote 113 for this section.

Transportation Shifts

An economy that embraces durability will require a transportation system different in its structure and mix of modes, and this, too, would mean changes in employment. The current system handles and delivers raw materials and components and final consumer goods through a dizzyingly complex global network. The resource consumption and environmental impact of this worldwide network are substantial and growing. Instead of today's "making-disposing" system, with its mostly one-way flow of raw materials, products, and waste, a "making-unmaking-remaking" system would emerge—able to collect and take back products that need to be repaired or upgraded and then redistributed to consumers, as well as those disassembled for remanufacturing or for salvaging of parts and materials.

Such a system would probably be focused less on long-distance supplies and deliveries and more on interchanges within local and regional economies. Accordingly, there would likely be fewer long-distance truckers and more local delivery and pick-up van drivers, fewer freight pilots and handlers and more people employed in facilities where old products are sorted and returned to the original manufacturer or to other firms that can make use of components and materials.

A New Service Economy

Most service establishments are directly responsible for very little pollution and environmental degradation. But although nobody in the service sector wields chainsaws to cut down old-growth forests or operates the machinery that turns mountainsides into piles of ores and toxic tailings, this segment of the economy is currently still very much a part of the resource-intensive economy—the grease that lubricates the industrial system. By coordinating, facilitating, and financing resource extraction and processing; by providing distribution channels (wholesale and retail) for unsustainably produced goods; and by shaping real estate development that usually translates into sprawling, resource-inefficient settlement patterns, many service jobs are inextricably linked to oil drilling, strip-mining, forest clear-cutting, paper pulping, and metals smelting.¹¹⁴

Today's retail jobs depend on large-scale purchases of "stuff"—in principle, anything that sells, no matter what the quality and durability. Discount retailers in particular have led the trend toward a part-time, low-paid sales force. In such a quantity-focused environment, fewer consumer purchases translate into fewer retail jobs. The challenge is to generate service jobs that facilitate a shift away from our current resource-intensive forms of production and consumption, rather than to reinforce these patterns.

A sustainable economy implies an emphasis on "quality retail," in which the salesperson knows how to sell intelligent use rather than simple ownership. This means advising consumers on the quality and upkeep of products; counseling them on how to extend usefulness with the least amount of energy and materials use; and diagnosing whether upgrades or other changes may maximize the usefulness of a product. Because such a system is not geared to increasing materials use—focusing merely on getting products out of the showroom or off the store shelf—but

instead to ensuring consumer utility and satisfaction, it entails jobs with higher skills, and pay. It also implies expanded education and training.¹¹⁵

Such changes in the way products are retailed build on an argument that has been put forward by Amory Lovins, co-founder of the Rocky Mountain Institute, since the 1970s: “People do not want electricity or oil...but rather comfortable rooms, light, vehicular motion, food, tables, and other real things.” Nor do workers’ jobs—outside the extractive and primary-processing industries, at any rate—have to depend on maintaining such a huge quantity of materials flow. Both consumers’ and workers’ interests can be safeguarded at much lower levels of resource use and with far less environmental impact.¹¹⁶ In *Natural Capitalism*, Amory Lovins and co-authors Hunter Lovins and Paul Hawken make the case for “a new perception of value, a shift from the acquisition of goods as a measure of affluence to an economy where the continuous receipt of quality, utility, and performance promotes wellbeing.” In such a new kind of service economy (quite unlike what we now mean by the term “service sector”), manufacturers no longer sell products with an “out-of-sight, out-of-mind” approach. Instead, consumers obtain desired services by leasing or renting goods rather than buying them outright. Manufacturers retain ownership of the product, are responsible for proper upkeep and repair, take the necessary steps to extend product life, and ultimately recover the item’s components and materials for recycling, reuse, or remanufacturing.¹¹⁷

Selling Performance

Because corporate revenues and profits would no longer be derived from selling a maximum quantity of stuff, but rather from squeezing the most service and best performance out of a product, companies would have a vested interest in ensuring product quality, durability, upgradability, and reusability. They would have a strong interest in minimizing energy and materials consumption and maximizing the utility of the product. Such a shift would be good for employment because it changes the focus from the input of energy and materials into the production process—which does not generate a significant number of jobs—to making intelligent, and sparing, use of resources. And that would require more skilled people.¹¹⁸

There are several examples of companies that have begun to translate the concept of product performance into reality. Agfa-Gevaert, for instance, pioneered the leasing of copier services, in place of selling copy machines. Instead of selling air-conditioning equipment, Carrier Corp. is creating a program to sell “coolth”—the opposite of warmth. The company is also increasingly looking into lighting retrofits, the installation of energy-efficient windows, and other measures at customers’ facilities that will help reduce air-conditioning needs and make the provision of coolth easier (and more profitable).¹¹⁹

In a similar vein, we see the emergence of “performance contracting.” Companies dedicated to this principle measure their success by the degree to which they help their customers—private sector firms, government agencies, hospitals, and others—cut their use of energy, raw materials, and water, and therefore the bills for these inputs. They are paid with a share of the achieved savings. In marked contrast to traditional business interests, it is avoided resource consumption

and prevented waste and pollution that makes such companies thrive.¹²⁰ In the United States, energy services companies that earn most of their money by delivering efficiency services to utilities, state and local governments, and other customers, are estimated to have had revenues of \$3.6 billion in 2006. With the exception of the period 2001–04, they have experienced annual growth of about 20 percent in their business since 1990.¹²¹

The concept of focusing on performance rather than increasing inputs is catching on even in one of the most pollution-intensive industries: cleaning. Dow Chemical and Safety-Kleen have begun to lease organic solvents to industrial and commercial customers, advising them on their proper use, and recovering these chemicals instead of leaving the customer responsible for disposing of them. A German subsidiary of Dow Chemical, SafeChem, is planning to take this a step further, charging customers by the square meter degreased rather than by the liter of solvents used. Selling a service instead of the chemicals gives SafeChem a strong incentive to use fewer solvents.¹²²

Perhaps the most often-cited example of companies reinventing themselves as new types of service providers is Interface, the world's largest commercial carpet manufacturer.¹²³ (See Box I.3-1.) Although Interface's strategy suggests less carpet manufacturing than in the past, it has not resulted in fewer jobs because volume production has been replaced with a far greater emphasis on quality inspections, upkeep, and remanufacturing operations. While revenues doubled and profits tripled, Interface boosted its employment by 73 percent between 1993 and 1998, to more than 7,700 employees worldwide.¹²⁴

Box I.3-1. The Interface Experience

In the 1990s, Interface launched a transition from selling to leasing office carpets. It remains responsible for keeping the carpet clean, in return for a monthly fee. Regular inspections permit the company to focus on replacing just the 10–20 percent of carpet tiles that show most of the wear and tear, instead of the entire carpet, as in past practice. This more targeted replacement helps reduce the amount of material required by some 80 percent.

Interface has also made strides toward making the carpet material more durable. It developed a new material called solenium that lasts four times as long as traditional carpets, but uses up to 40 percent less raw material and embodied energy. In addition, used carpets can be completely remanufactured into new carpets, instead of being thrown away or “down-cycled” into less valuable products.

The company's accomplishments over the past decade are impressive. Between 1996 and 2007, the amount of waste sent to landfills from its manufacturing facilities decreased by 66 percent. During that time, the company's “ReEntry” program reclaimed a total of 60 million pounds (about 30,000 metric tons) of carpet material that otherwise would have been sent to landfills. Meanwhile, the percentage of recycled and bio-based materials used to manufacture products has increased from 0.5 percent to 25 percent. Energy use per square yard of carpet produced has been cut by 45 percent, and the share of renewable energy has risen from zero to 27 percent. Total greenhouse gas emissions are down 33 percent.

Source: See Endnote 123 for this section.

What is true for Interface and other pioneering firms is likely to hold up more generally. Moving toward a new service economy that radically reduces material inputs does not have to be bad news for jobs. Clearly, there will be less demand for energy and materials than in the past, and this will reinforce the already obvious downward trend of employment in extractive industries and in primary materials processing. But these losses will be more than counterbalanced by manufacturing operations that are focused on producing high-quality products (and therefore more interesting jobs), by job opportunities in repairing and upgrading products, and by new service occupations that help customers get the best possible performance out of the lowest possible quantity of resources. Resource productivity, not additional labor productivity gains, will be key.

Rethinking Consumption

More-efficient and cleaner technologies are essential instruments in the sustainability toolbox—promising to moderate modern economies’ draw on resources. And the emergence of a new type of service economy will provide additional maneuvering space in the quest for a more sustainable economy. Sooner rather than later, however, we need to confront the specter of insatiable consumerism itself. There is a danger that the consumer juggernaut will overwhelm even the most sophisticated methods and technologies that can be devised to make consumption lean and super-efficient. Consuming better does not obviate the need to consider moderation in overall consumption levels. It is worth recalling ecological economist Herman Daly’s warning that “to do more efficiently that which should not be done in the first place is no cause for rejoicing.”¹²⁵ And Wolfgang Sachs of the Wuppertal Institute in Germany has cautioned that we need to think as much about sufficiency as efficiency.

How societies go about the task of discouraging “excessive” consumption (at least in the wealthy countries; the world’s poor, by contrast, indisputably need to increase their consumption if they are to leave behind conditions of misery) is not part of the remit of this report. But what needs scrutiny is the predominance of highly individualized consumption patterns that inevitably lead to the multiplication of many goods and services on a grand scale—a redundancy that implies far greater material requirements than necessary. The balance of public and private consumption needs as much attention as the development of less-polluting technologies.

Government action is indispensable in overcoming the immense structural impediments to lowering consumption levels and to more public forms of consumption. Nowhere is this more pronounced than in transportation: low-density, sprawling settlement patterns translate into large distances separating homes, workplaces, schools, and stores—rendering public transit, biking, and walking difficult or impossible. While the decision as to what kind of automobile to buy is up to consumers, the more basic decision whether to buy one at all is frequently out of their control. Likewise in housing, homeowners have a range of choices for heating and air-conditioning. But it is in developers’ and builders’ hands whether a house incorporates adequate insulation and energy-efficient windows; these fundamental decisions dictate heating and cooling needs over the life of the house.

In recognition of these realities, the Organisation for Economic Co-operation and Development (OECD) has referred to an “infrastructure of consumption” that compels people to engage in involuntary patterns of consumption.¹²⁶ As important as it is for consumers to choose more-efficient products, this alone cannot overcome these structural constraints. Forward-looking government policies—improved land-use planning, environment-oriented norms and standards, and the creation of a reinvigorated public infrastructure that allows for greater social provision of certain goods and services—will help ensure that consumers are not overly compelled to make consumption-intensive choices.

Another key area where government action is needed is consumer credit. Whereas consumer credit is now geared to maintaining the hyper-throughput economy, which encourages people to carry high personal debts, finance in a sustainable consumption economy will need to devise ways to allow—and to reward—the purchase of efficient, high-quality, durable, and environment-friendly products. These undoubtedly have a higher upfront cost of purchase, but over time such items will be economically more advantageous to consumers than cheaper, flimsier items that must be replaced frequently. Governments could help consumers by offering advantageous credit terms for “green” purchases (and this could be linked to green labeling programs). The Japanese and German governments do this to support the installation of solar roofs on private homes, but many other eco-friendly purchases could be encouraged in the same way. Or, governments can offer targeted rebates for green purchases or energy efficiency upgrades and retrofits.

To further encourage the manufacture and purchase of environmentally benign products, governments could design policies that offer tax rebates for the best-performing products while taxing those that fall short of standards. A graduated system could be constructed in which rates of both rebates and fees are scaled according to how efficient, longlasting, or otherwise environment friendly an item is. Such a blend, known as a “feebate,” has been used to some extent vis-à-vis energy producers, but the concept has not yet been implemented in a consumer setting.¹²⁷ A feebate system might even be more effective if hitched up with other policies, such as eco-labeling and EPR laws.

A New Approach to Work Hours

Industrial economies are extraordinarily productive—meaning that the same quantity of output can be produced with less and less human work. In principle, this can translate into either of two objectives: raising wages (in line with productivity) while holding working hours constant, or providing greater leisure time while holding income from wages constant. In practice, it has mostly been the former. Most people have been locked into a “work-and-spend” pattern.

Since the rise of mass industrialization in the late 19th century, there has been an ongoing tug-of-war between employers and unions over working hours. Employees have struggled for less work time—in the form of shortened workdays or weeks, extended vacation time, earlier retirement, or paid leave. These efforts were primarily motivated by a desire to improve the quality of life and to create more jobs. While environmental issues have not played a central role, channeling

productivity gains toward more leisure time instead of higher wages that can translate into ever-rising consumption also increasingly makes sense from an ecological perspective.

It took close to a century to arrive at the 40-hour workweek in most industrial countries. Most employers have been very reluctant to agree to more reductions, and a shift in the employer-union balance of power, with waning union strength and rising pressure from globalization, has made further change difficult. By and large, a full-time job at something like 40 hours per week is still considered the norm for anyone wanting to be considered eligible for employment with career advancement opportunities.

But the discussion has shifted from fixed weekly hours to introducing greater flexibility, with employers and employees promoting competing notions and interests. Employers are seeking the ability to turn the spigot of labor supply on and off according to fluctuations in the demand for their products. Employee demands center on more individual options to accommodate personal and family needs and to achieve greater “time sovereignty.” Americans are increasingly working longer hours than Europeans. Japanese, Koreans, and Chinese work some of the longest hours anywhere in the industrialized world. And of course, many people in the world feel compelled to work long hours simply to make ends meet. But several promising approaches to work time have emerged in Europe.¹²⁸ (See Table I.3–2.) These may form the basis for new concepts of how to better share available work.

Table I.3-2. New Approaches to Work Time in Europe

Country	Status
Belgium	Established a “time credit” system that allows individuals to work a four-day week for up to five years and to take a one-year leave of absence during a career while receiving a paid allowance from the state.
Denmark	Pioneered a system of paid educational, childcare, and sabbatical leaves that allows job rotation between the employed and unemployed. (Variants were later put in place by Belgium, Finland, and Sweden.)
Netherlands	In 1982, government, business, and labor agreed on work-time reductions in return for wage moderation. Length of workweek was cut from 40 to 38 hours in the mid-1980s and to 36 hours in early 1990s. Voluntary part-time work expanded dramatically, with part-time workers legally entitled to the same hourly pay, benefits, and promotional opportunities as full-timers. Legislation in 2000 extended the right to reduce hours to all workers, while part-timers can request longer hours.

Source: See Endnote 128 for this section.

The discussion about work-time reductions has progressed in starts and fits and remains controversial. Proponents have principally been interested in the potential benefits that such initiatives would bring with regard to reduced unemployment and gains in quality of life. But this is also an issue that relates to environmental challenges. If the work-and-spend pattern can be broken, and if reduced work hours still allow people to make ends meet—admittedly big “ifs”—then the environmentally destructive impacts of consumerism could be reduced. At the same time, these are issues that will remain applicable only to a portion of humanity. For the majority that struggles to escape poverty, long work hours are, at least for the time being, an inescapable reality.

Certainly, a large and sudden decline in consumer spending would likely send the world economy—premised on endless growth—into a tailspin and cause major unemployment. But moving toward a less consumptive economy more gradually and deliberately would allow time to reorient how the economy functions, giving companies and employees an opportunity to adjust. Smoothing a transition will be a series of investments and technological innovations to accomplish the shift toward sustainability. Promoting renewable energy sources; expanding public transit systems; replacing inefficient machinery, equipment, buildings, and vehicles with far more efficient models; redesigning products for durability—all of these activities amount in effect to an ecological stimulus program for the economy.

It is crucial to retool not only the economy, but also economic thought. Right now, economic actors are primed to respond to quantitative growth signals. The concept of the gross domestic product, in which all economic activities are lumped together whether they contribute to or detract from well-being, still reigns supreme. A sustainable economy needs a different way of measuring human activity and of providing signals to investors, producers, and consumers. It needs a different theory, abandoning the outdated assumption that quantitative growth is unconditionally desirable and embracing instead the notion of qualitative growth.

Most fundamental, though, is a shift in human perceptions of economic value. In *Natural Capitalism*, Amory Lovins and co-authors Hunter Lovins and Paul Hawken make the case for “a new perception of value, a shift from the acquisition of goods as a measure of affluence to an economy where the continuous receipt of quality, utility, and performance promotes well-being.” In such an economy, corporate revenues and profits would no longer be associated with maximizing the quantity of stuff produced and sold, but rather with deriving the most service and best performance out of a product, and therefore from minimizing energy and materials consumption and maximizing quality.¹²⁹ And such an economy would offer much broader scope for green employment.

