



# Book Factor Five

## Transforming the Global Economy through 80% Improvements in Resource Productivity

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Earthscan, 2010  
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### Recommendation

Recycling garbage, turning off lights, taking shorter showers: All these actions contribute to the reduction of energy consumption. Written as a joint project by Ernst von Weizsäcker, the author of *Factor Four*, and by four experts from The Natural Edge Project, an environmental research group, this call to action argues for a “whole-system approach” that unites engineers, designers, scientists and builders to create new products, processes, buildings, homes, factories and stores to reduce energy consumption by 80%, diminishing it to one-fifth of current usage, by 2050. A mountain of research, statistics, case studies and examples provide a strong, documented case that achieving “sustainable consumption” without forgoing prosperity not only is possible but necessary. *BooksInShort* recommends this work to policy makers, executives, engineers, designers and all those who want to know why they should keep separating their plastic from their glass.

### Take-Aways

- Human development finally has matched the Earth’s ability to sustain growth.
- Ecological stresses must drop 80%, or by a factor of five, by 2050.
- Eight “Factor Five” practices can balance economic growth with environmental concerns.
- They are: “energy efficiency, fuel switching, heat and power recovery, renewable energy, feedstock change, product change, material efficiency” and greenhouse gas reduction.
- The effects of climate change will hit global GDP harder than the 2008 recession did.
- Green government stimulus efforts return more economic value than other investing.
- A “whole-system approach” integrates design, engineering and building to answer society’s needs in an energy-efficient way.
- Whole-system thinking seeks to provide needed goods and services with less environmental impact.
- These efforts encompass four sectors: “heavy industry, agriculture, transportation” and “building,” the latter of which accounts for almost 40% of greenhouse gas emissions.
- The technology needed to achieve Factor Five exists, but the political will is absent.

### Summary

#### “Factor Five”

The whirlwind pace of human development, accelerated by the past century’s technological progress, finally has matched the Earth’s ability to sustain such growth. “The truth...is that we are damaging our planet to the point that it may not be able to maintain the conditions we have come to take for granted.” Depleting natural resources

and handling the detritus of human existence – pollution, waste and greenhouse gas emissions – stresses the environment. In the 21st century, such stresses will exceed the planet's limits to withstand them. Unless mankind modifies the ways it relates to and uses the Earth's resources, "the environment will change how it interacts with its inhabitants." Climate change will grossly alter living conditions for future generations. Mankind's "ecological footprint" – the land and resources individuals need to support their lifestyles – already has surpassed the Earth's "biocapacity." By 2005, "humanity's demand...exceeded the regenerative capacity of the planet by about 30%."

"We stand at a crossroads, where the size of the impacts from our global community is now rivaling the size of our home's ability to cope."

To address these issues, nations have agreed to work to reduce environmental stresses by 80%, or by a factor of five, by 2050. "Factor Five" means an 80% "reduction of environmental impacts per unit of economic output." Factor Five isn't antigrowth or anticapitalist. However, gross domestic product (GDP) should not be the only measure of a society's advancement. Preserving the Earth's natural assets and refraining from damaging the environment should factor into every commercial decision. Business should direct capital into profitable activities that safeguard natural resources, and regulation should deter investments that damage the ecology. Allowing free markets to slow ecological degradation doesn't work; the environment – like law and order, education, and infrastructure – is a "public good" that requires state oversight. "Balancing economic aspirations with ecological imperatives" is what Factor Five is all about.

## Go Green

In 2009, the world economy declined by 7%, leading to negative global GDP growth (-1.3%). This downturn had a devastating impact worldwide. However, one economist, Sir Nicholas Stern, estimated that, absent any significant action to lessen the impact of climate change, the world's GDP will drop between 5% and 20% every year, which would lead to a global economic catastrophe. Yet, according to Stern, a joint international effort to "stabilize greenhouse gas emissions at an acceptable level" would cost just 1% of global GDP per annum.

"We contemplated a future that saw the societies of the world truly harnessing 300 years of industrialization to create a low-impact existence that could sustain life as we know it."

The 2008 economic crisis led governments around the world to issue economic stimulus incentives, some of which addressed environmental concerns. HSBC bank analyzed 17 nations' stimulus funding and found that an average of 10% went toward green activities – ranging from South Korea's 80.5%, the EU's 58.7% and China's 37.8% to the US's 9.8%, the UK's 6.9% and Italy's 1.3%. The bank found that the greatest "economic multipliers," or the activities that had the greatest returns, were investments in "energy efficiency, renewable energy technologies, low-carbon vehicles, rail transport and... 'smart' grid and 'smart' meters."

"It would take about five planet Earths if all humanity adopted American lifestyles."

A "Global Green New Deal" – based on the US's New Deal recovery programs of the Great Depression – means government spending for investments and jobs in building a green economy. Much like the steam engine, the railroad and the computer, green technologies are ushering in a new wave of economic advancement that is environmentally grounded. This era's watchwords are "sustainability," "green sciences" and "renewable energy." Under the Green New Deal, resource productivity will exceed labor efficiency as a main driver in economic progress.

## The Framework

Getting more out of resources and dealing with ecological impacts requires a "whole system approach" that integrates the fields of design, engineering and building to work toward an understanding of how products, processes and industries intersect with society's needs. That knowledge begins with the question: "What is the required service or product, and how else can this same service or product be provided with less environmental impact?" For example, videoconferencing can replace business travel, natural sunlight can replace electric lighting in offices, and restaurants can employ better-insulated appliances to reduce the amount of heat generated in their kitchens, which they currently combat by using wasteful air conditioning.

"Achieving a Factor Five transition is as much a technical challenge as it is a social one."

### The whole system approach to Factor Five considers eight strategies:

1. **"Energy efficiency"** – Techniques for saving energy are the "quickest, easiest and most cost effective" ways to cut greenhouse gases. Driving energy-efficient cars, insulating homes and offices, and opting for energy-saving lighting and appliances all contribute to resource conservation. The US would use 50% more energy today if it hadn't instituted energy-efficient standards in the 1970s.
2. **"Fuel switching"** – Industry traditionally has used the cheapest, most readily available fuels. But efforts to replace fossil fuels with biofuels and waste materials in the steel and paper industries are cutting emissions, and saving energy and money.
3. **"Heat and power recovery"** – For every energy unit people use, they waste two, usually through heat loss. Up to three-quarters of the energy that people use to produce electricity dissipates during the generation process, and up to 9% of the energy escapes when electricity travels over long distances. To recover some lost energy, many restaurants, bakeries and supermarkets recycle the "waste process heat" their equipment emits.
4. **"Renewable energy"** – Power sources such as solar, wind, wave, tidal, geothermal and hydro are becoming cheaper to implement and exploit. Renewable energy provides 25% of California's energy capacity, 33% of Sweden's, 50% of Norway's and 75% of Iceland's. The reliability of these natural sources is growing, paving the way for their increased service in generating electricity.
5. **"Feedstock change"** – Reusing scrap or waste material in manufacturing delivers energy savings of up to 95% in aluminum production, 88% in plastics and 68% in glass. Recycled aluminum now comprises a third of the global aluminum supply. While Germany and Finland recycle up to 90% of their glass, the US reuses less than 30%.
6. **"Product change"** – By 2012, General Electric's line of energy-efficient "Eco-magination" appliances will boost energy savings by 30%, while doubling appliance revenues for the corporation. Japan mandated product energy efficiency levels for its manufacturers in 1979, and now Japanese companies lead their international competitors in energy innovations. Australia, Canada and the EU have taken the lead in outlawing wasteful incandescent lighting.
7. **"Improving material efficiency"** – Raising the productivity of water usage in households, industry and agriculture reduces energy consumption. For example,

increasing electrical efficiency in heating and cooling homes and offices cuts the amount of water required. Some dairy farmers remove the water from the milk they produce, which is made of 95% water, instead selling a solid milk product and reusing the water on their farms. Restaurants that switch to serving tap water save energy. Serving tap water uses just one two-thousandth of the energy that bottled water requires.

8. **“Reducing non-CO2 greenhouse gases”** – While carbon dioxide (CO2) accounts for 75% of greenhouse gas emissions, the other greenhouse gases – methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride – contribute more to climate change and exist longer in the atmosphere than CO2. Of these gases, only CO2, methane and nitrous oxide occur naturally. Refrigerator and flat-screen TV manufacturers are devising substitutes for non-CO2 greenhouse gases in their processes, which potentially can lower global warming and save energy.

## The Four Crucial Sectors

Four sectors must change their practices to achieve Factor Five:

1. **“The buildings sector”** – Residential and commercial buildings are “responsible for close to 40% of global greenhouse gas emissions” and “for 12% of global water use.” In home construction, “Passive Houses” eliminate 90% of the typical energy needs of an average dwelling; they use no “active heating and cooling systems.” They depend on “passive solar design” to capture natural light and heat, superior insulation and windows, and efficient climate systems. More than 12,000 Passive Houses existed by 2008. Walmart’s Burlington, Ontario, store uses geothermal energy for its heating and cooling, energy-saving lighting that senses daylight from skylights and adjusts accordingly, light-reflecting roofing material, and refrigeration machinery that recycles the heat it generates.
2. **“The heavy industry sector”** – The steel and cement industries, combined, use close to 50% of the energy expended in industrial production and manufacturing. US steel producer Nucor has adapted its processes so that it now uses 17% less energy per ton of steel, and 80% of its production now comes from recycled scrap steel. Concrete is the second most-utilized commodity in the world (water is first), and concrete produces massive amounts of greenhouse gases. Cement emits 25% of China’s greenhouse gases; in the US, “cement is...the second-largest source of industrial CO2 emissions.” Different aggregates now used in cement can reduce these emissions by up to 80%. Ironically, this new cement is chemically similar to the materials used in Roman constructions such as the Coliseum, which have withstood time and decay.
3. **“The agricultural sector”** – Farming is responsible for 70% of global water usage, so conserving water is critical to achieving Factor Five. Agriculture is most at risk from global warming’s effects: Changes in rainfall, climate and water availability will threaten the livelihoods of the rural poor in developing countries. A whole-system approach to farming entails “advanced irrigation management,” crop rotations and rainwater recycling. In California, farmers applying new techniques of irrigation have experienced a 13% drop in water use while enjoying an 8% increase in crop yields.
4. **“The transport sector”** – Oil fuels almost all transportation in the developed world, making the global economy vulnerable to recession from petroleum price hikes. Studies show that renewable sources of energy could replace oil as the major energy provider for transportation by 2050. Shifting freight to rail would reduce dependence on fossil fuels, as well as limiting air pollution, lessening traffic congestion and cutting transport costs. China’s BYD (Build Your Dream) and Germany’s Loremo (Low Resistance Mobile) are joining other automakers in designing fuel-efficient passenger vehicles, either through hybrid technology or by using lighter materials and aerodynamic construction. Today’s jets are 70% more energy-efficient than those of four decades ago; the innovative “blended wing body” design augurs even greater fuel savings since these “flying wing” aircraft can carry more passengers.

## “Making It Happen”

Financial crises and environmental threats have set the stage for Factor Five to become a reality, today more so than at any other time in history. The technology exists to accomplish Factor Five; what’s missing in many countries is the political will to see it through. Curbed air and water pollution is a good example of how state regulations successfully have turned around potentially devastating ecological conditions, all without negatively affecting economic growth. The “Visible Hand” of government must forcefully direct the adoption of Factor Five standards in everyday life. Under the rubric of “corporate social responsibility,” major corporations are recognizing their roles in contributing to energy efficiency. Fiscal solutions to energy management, in the form of carbon trading and “green taxes,” are gaining acceptance.

“The World has enough to fulfill all our needs but not our greed.” (Mahatma Gandhi)

Yet growing populations, higher demand and increased industrialization in developing countries may generate “the rebound effect” in which an “increase of resource productivity...can even lead to an overall increase in consumption levels.” Whatever the obstacles, the global community must practice “sustainable consumption” to ensure the Earth’s viability for future generations.

## About the Authors

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