IS GROWTH POSSIBLE?
THE HIGH COST OF GROWTH IN THE INDUSTRIAL ECONOMY AND ECOLOGICAL CIVILIZATION IN AN ECOZOIC AGE

Is economic growth, on the macro-scale, possible? By macro-scale the author is referring to the global economy, not to growth or degrowth in particular nations. And in terms of economy, the author is referring to the current industrial economy. Growth in this economy has been measured by GDP growth. Growth in GDP has been powered by fossil fuels and has been coupled with increases in material throughput and unabsorbed waste.

This article supports the position that further growth in the global economy in real terms is not possible. We have already reached and surpassed its sustainable limits. While the global economy will continue to grow for a period as measured by GDP, in the next decade or so it will reach absolute limits and decline. These limits will result from a combination of biophysical, ethicosocial and security factors. Of the limiting factors, this article will focus on two—global warming and energy. They will have profound effects on human civilization and nature as well.

We live in an economic age. Our economics misinforms us about what is happening. It tells us that continued industrial growth offers a promising future. Instead it will lead humans to general decline, another Dark Age or worse, and severely degrade nature. The way forward is Earth community. We must move from the economic age to an ecological age, from industrial civilization to ecological civilization. This is the way of life.

A Note About the Use of the Term "Industrial Economy" and the Author's Experience in Researching and Writing this Article.

The Term "Industrial Economy"

The term "industrial economy" as used in this article is a shorthand way of referring to the contemporary global economy and to the model of economic development that has come into being over the last 200 years since the industrial revolution began. It is an inexact term for many reasons, not the least of which is because the industrial economy is dynamic—the nature of this economy has changed dramatically over the years. It will continue to change and in some ways become more "green." So some would argue that it is misguided to criticize the industrial economy for what it is today, because the industrial economy has significant powers of innovation and adaptation.

The author is using the term "industrial economy" in the sense of a paradigm. As long as our economics stays within this paradigm, options will be limited. The industrial economy is energy and capital intensive, based on extracting and processing natural resources, and has as its primary objective increasing the material well-being of humans. Though a bit of a caricature, its logic is that the faster people can pull things out of the ground, process them, ship them, sell them, consume them, and redeposit them in the Earth as waste, the better off everyone will be.

The Author's Experience

When the author began researching this paper, he decided to focus on climate change and peak oil. He expected to conclude that growth would not be possible in the industrial economy because of peak oil. This would result in a crisis in the economy and require re-thinking basic principles. Humanity would be forced to move to a lower energy economy. The task in writing the paper would be to document this and provide guidance on the actions to be taken now and actions to be taken when the crisis occurred. Global warming was seen as an issue but one that would be resolved in the context of this energy crisis.

The author's research, however, led him to understand that peak oil only means peak conventional oil, not peak oil (taking into account unconventional sources) or peak energy. This means there will be no natural boundary to the industrial economy within the coming 25-year timeframe that climate scientists say CO_2 emissions need to be significantly reduced. Fossil fuel-based energy and CO_2 emissions will continue to grow during this period, not decrease. While renewables and low carbon energy will also grow, they will only provide a small portion of total energy. Consequently, it is highly unlikely that global warming in this century will remain within 2^o Centigrade (C) of the pre-industrial temperature level.

Reluctantly the author came to see that geoengineering may be necessary to avoid catastrophic climate change and this introduced a range of issues not previously considered by him. It is a way of buying time only. It will no more be an answer to excessive CO_2 concentrations in the atmosphere, than kidney dialysis is an answer to kidney failure.

Originally expecting to find answers in the energy literature that would allow the author to say "Do this and we can save the world," he was required to consider what should we ask of ourselves when we cannot save the world? In the context of climate change and energy, not being able to save the world means saying that mitigation, while needed, is unlikely to avoid dangerous climate change. Given this, rather than providing answers, the author proposes directions to take and why he believes these are the proper directions.

He agrees with David Orr that these are the qualities of transformational leadership in the "long emergency"[1] of the twenty-first century:

1. We will need leaders first, with the courage to help people understand and face what will be increasingly difficult circumstances.

2. Second leaders will need uncommon clarity about our best economic and energy options.

[1] David Orr and the author take this term from the book by James Howard Kunstler entitled *The Long Emergency: Surviving the Converging Catastrophes of the Twenty-First Century* (New York: Atlantic Monthly Press, 2005).

3. The third quality of leadership in these circumstances is the capacity to foster a vision of a humane and decent future.[2]

He, though wondering if it will really take centuries, has also come to agree with this statement regarding authentic hope by David Orr:

> The news about climate, oceans, species, and all of the collateral human consequences will get a great deal worse for a long time before it gets better. The reasons for authentic hope are on a farther horizon, centuries ahead when we have managed to stabilize the carbon cycle and reduce carbon levels close to their preindustrial levels, stopped the hemorrhaging of life on Earth, restored the chemical balance of the oceans, and created governments and economies calibrated to the realities of the biosphere and to the diminished ecologies of the postcarbon world. The change in our perspective from the nearer to the longer term is, I think the most difficult challenge we will face. We have become a culture predicated on fast results, quick payoffs, and instant gratification. But now we will have to summon the fortitude necessary to undertake a longer and more arduous journey. Rather like the builders of the great cathedrals of Europe, We will need stamina and faith to work knowing that we will not live to see the results.[3]

Now let's consider these matters of growth, global warming, energy, contemporary economics and ecological civilization in depth.

We Have Already Surpassed the Sustainable Limits of the Global Economy

In considering whether growth is possible in the industrial economy, the author begins with the determination by the Global Footprint Network that in 2007 the ecological footprint of humans was 1.5 Earths. And further, "even with modest UN projections for population growth, consumption and climate change, by 2030 humanity will need the capacity of two Earths to absorb carbon dioxide waste and keep up with natural resource consumption."[4] The condition of humans living beyond the capacity of Earth to regenerate renewable resources and absorb waste is called "overshoot."

Even if the global economy is already in overshoot, this doesn't mean that there cannot be continued growth in the economy for a time. Just as a person can draw money from a bank account faster than interest can replenish it, so humans can draw down renewable resources, such

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[2] David Orr, *Down to the Wire: Confronting Climate Collapse* (New York: Oxford University Press, 2009), xi-xiii.

[3] Orr, xiii.

[4] *WWF Living Planet Report 2010: Biodiversity, Biocapacity and Development* (Gland, Switzerland: WWF, 2010), 34, 86; available at http://www.footprintnetwork.org/press/LPR2010.pdf (accessed November 14, 2010). The "ecological footprint" calculation balances human demand on the biosphere against its regenerative capacity and takes into account renewable resources used, areas occupied by infrastructure and the areas needed to absorb waste, in particular C02. Ibid. 32-35. The current overshoot is due not only to increased demand, but also on the declining capacity of Earth resulting from human demands

as fish stocks, faster than they can be replaced. Further, since GDP counts loss of ecosystem services as a benefit rather than a cost, it is conceivable that the economy as measured by GDP can continue to grow even as the capacity of Earth declines.[5]

In the Next Decade or So the Global Economy Will Reach Absolute Limits to Growth that Will Result in Economic Decline

It is a common sense notion that since Earth is a finite and, with the exception of solar radiation, a mostly closed system, at some point in time economic growth will reach absolute limits. Speaking to economists who seemed to believe otherwise, Herman Daly quipped that "he would accept the possibility of infinite growth in the economy on the day that one of his economist colleagues could demonstrate that Earth itself could grow at a commensurate rate."[6]

Not many of Daly's economist colleagues, however, would disagree with the proposition that there are limits to economic growth. The question under debate is whether we are approaching those limits or are far from them. Those who argue against limits in our present situation often have a more optimistic assessment of resources than those who believe limits are near. Further to the extent they recognize limits, they believe technological progress will overcome them. One of the most optimistic assessments of technological possibilities is presented in the Ray Kurzwell's book, *The Singularity Is Near: When Humans Transcend Biology*. While acknowledging there are limits, he argues they are "virtually unlimited limits."[7]

Some scoff at predictions of limits to growth as warmed over Malthusian arguments. They observe that Malthus was wrong in predicting that growth in food production would not keep pace with population growth. They point to similarly wrong forecasts by those who recently have forecast limits to growth based on overall ecological impacts. For example, in 1972 the famous report to the Club of Rome, *The Limits to Growth*, [8] predicted that conventional oil would run out by 1990.

[5] For example, if a wetland is drained to create a subdivision, this increases GDP. For a discussion of the limits of GDP as a measure of the real economy, see Eric Zencey, "G.D.P. R.I.P." *New York Times*, August 9, 2009, available at http://www.nytimes.com/2009/08/10/opinion/10zencey.html?_r=4&pagewanted=1&emc=eta1 (accessed November 15, 2010).

[6] Herman Daly quoted in Andrew Simms, Victoria Johnson and Peter Chowla, *Growth Isn't Possible: Why We Need a New Economic Direction*, ed. Mary Murphy (London: UK, New Economics Foundation 2010), available at http://www.neweconomics.org/publications/growth-isnt-possible (accessed November 14, 2010), citing Herman Daly Beyond Growth: The Economics of Sustainable Development (Boston: Beacon Press, 1996).

[7] Ray Kurzwell, *The Singularity Is Near: When Humans Transcend Biology* (New York: Penguin, 2006), xiii. The term "singularity," coined by Kurzwell refers to the theoretical limitlessness of exponential expansion. Ibid., 8-12.

[8] Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, and William W. Behrens III, *The Limits to Growth* (New York: Universe Books, 1972).

Arguments against no near-term limits are so readily made and evidence is so readily found to support the arguments that one rapidly finds him or herself on the defensive in making the limits to growth argument.

So why does the author argue here that in the next decade or so we will reach absolute limits to economic growth? The basic reason is that he believes the expectation that there will be continuing growth is based on wishful thinking—belief in technological innovations that have not been realized and will not be sufficiently realized to achieve the conditions for continuing economic growth; inadequate assessment of the factors sustaining the present economy, of the inertia in the economic and political systems and of the declining ecological base for civilization; basing projections for the future on the highly unusual period of the last 200 years; adherence to economic, political and philosophical ideas that exclude critical information in decision-making processes or that do not permit contrary conclusions; and an existential naiveté on the part of some that the human condition itself, which is inherently one of limits, can be transcended.

Of course, the author could be wrong, so let's look at some of what he is seeing that brings him to this position.

Conceptual Limits to Growth

Perhaps the best theoretical overview of the limits to economic growth was given by Herman Daly in his book, *Beyond Growth*.[9] There he described two "fundamental limits: the biophysical and the ethicosocial":

Biophysical Limits to Growth

> The biophysical limits to growth arise from three interrelated conditions: finitude, entropy and ecological interdependence. The economy, in its physical dimensions, is an open system subsystem of our finite and closed ecosystem, which is both the supplier of its low-entropy raw materials and the recipient of its high-entropy wastes. The growth of the economic system is limited by the fixed size of the host ecosystem, by its dependence on the ecosystem as a source of low-entropy inputs and as a sink for high-entropy wastes, and by the complex ecological connections that are more easily disrupted as the scale of the economic system (the throughput) grows relative to the total ecosystem. Moreover, these three basic limits interact. Finitude would not be so limiting if everything could be recycled, but entropy prevents complete recycling. Entropy would not be so limiting if environmental sources and sinks were infinite, but both are finite. . . . If entropic costs (depletion and pollution) are mainly inflicted on the terrestrial environment, as in a modern industrial economy, then they interfere with complex ecological life-support services rendered to the economy by nature. . . .

[9] Herman Daly, *Beyond Growth: The Economics of Sustainable Development* (Boston, MA: Beacon Press, 1996).

Standard growth economics ignores finitude, entropy, and ecological interdependence because the concept of throughput is absent from its preanalytic vision, which is that of an isolated circular flow of exchange value . . . .[10]

Ethicosocial limits

Daly gives these key points on ethicosocial limits:

1. The desirability of growth financed by the drawdown of geological capital is limited by the cost imposed on future generations.

2. The desirability of growth financed by takeover of habitat is limited by the extinction or reduction in number of sentient subhuman species whose habitat disappears.

3. The desirability of aggregate growth is limited by its self-canceling effects on [human] welfare.

4. The desirability of aggregate growth is limited by the corrosive effects on moral standards resulting from the very attitudes that foster growth, such as glorification of self-interest and a scientistic-technocratic worldview.[11]

The author would note that with respect to Item 3 above, the self-canceling effects include global warming, declining ecosystems, increasing inequity and injustice and growing insecurity.

Daley's argument is that aggregate growth when it presses against limits inhibits rather than fosters total welfare. When this becomes apparent, humans will choose to limit growth. In the absence of this social disruption or biophysical conditions will limit growth.

Security

We would add to Daly's list, one other fundamental limit, and that is security.

Competition for resources, for waste sinks (such as rights to emit and restrictions on emitting CO_2) and for compensation for ecological degradation (such as the demand that developed nations pay developing nations for ecological debt and for clean development and adaptation costs) are leading lead to friction between groups within nations and between nations. This competition will become more severe where survival is at stake. For example, take food security: Lester Brown in his new book *World on the Edge* forecasts food shortages resulting from global warming, water scarcity, peak oil and other causes, will prove to be the greatest threat to civilization.[12] Already military planners are seriously taking climate change scenarios into account.[13]

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[10] Ibid., 33.

[11] Ibid., 35-37.

The human race seems to be on two paths, one to global apartheid as a means of security and the other to Earth community. There are security issues related to environmental conditions, however, that cannot be solved by global apartheid even if it could otherwise be successful. These are the effects of pollution, depletion of resources and global warming that transgress all human boundaries. One may live in a protected space in Beijing, but one breathes the same air as any other citizen of the city. Indeed if one lives in Japan or California, one breathes this air.[14]

That there are links between continued economic growth and growth in security risks and costs, in terms of military and para-military activity and environmental impacts on human health and well being, will limit the continued growth of the industrial economy. In the perverse logic of GDP, however, all of the money spent on security, on repairing damage, on caring for the sick and adapting human communities to global warming may actually increase GDP, but surely this cannot count as a growth in the real economy.[15]

Practical Limits to Growth

These conceptual limits to growth are being played out in real time. The report of London's New Economics Institute called *Growth isn't possible: Why we need a new economic direction* (*NEF Report*) describes this.[16] This report focuses on climate change and energy. The two are interrelated. Energy produces greenhouse gas emissions and this causes climate change. Climate change affects energy choices and limits energy use. Energy limits will limit the growth of the industrial economy.

Climate Change

The *NEF Report*, based on the Intergovernmental Panel on Climate Change's *Third Assessment Report*, gives five reasons for concern about climate change:

1. Risks to unique and threatened systems – e.g., coral reefs, tropical glaciers, endangered species, unique ecosystems, biodiversity hotspots, small island states and indigenous communities.

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[12] Lester Brown, *World on the Edge: How to Prevent Environmental and Economic Collapse* (New York: W.W. Norton, 2011), 10-15; pre-publication copy of first chapter available at http://www.earth-policy.org/books/wote/wote_table_of_contents (accessed November 19, 2010).

[13] See, e.g., Gwynne Dyer, *Climate Wars: The Fights for Survival as the World Overheats* (Oxford, UK: One World Publications, 2010), chapter on "The Geopolitics of Climate Change, 3-28.

[14] See, e.g., Keith Bradsher and David Barboza, "Pollution From Chinese Coal Casts a Global Shadow," *New York Times*, June 11, 2006, http://www.nytimes.com/2006/06/11/business/worldbusiness/11chinacoal.html?ex=1307678400en=e9ac1f6255a24fd8ei=5088partner=rssnytemc=rss (accessed March 18, 2009).

[15] For a good description of problems associated with using GDP to measure the health of the economy, see section on "Limitations of GDP to Judge the Health of an Economy," in "Gross domestic product," *Wikipedia*, available at http://en.wikipedia.org/wiki/Gross_domestic_product (accessed November 15, 2010).

[16] See citation in footnote 4 above.

2. Risk of extreme weather events – e.g., the frequency and intensity, or consequences of heat waves, floods, droughts, wildfires, or tropical cyclones.

3. Distribution of impacts – some regions, countries and populations are more at risk from climate change than others.

4. Aggregate impacts – e.g., the aggregation of impacts into a single metric such as monetary damages, lives affected or lost.

5. Risks of large scale discontinuities – e.g., tipping points within the climate system such as partial or complete collapse of the West Antarctic or Greenland ice sheet, or collapse/reduction in the North Atlantic Overturning Circulation.[17]

The *NEF Report* then presents scientific predictions that humans are on a course to exceed the limits of CO_2 that would keep global warming within of 2^o C, the commonly accepted standard for avoiding extreme effects.[18] The report cites, for example, the calculation by Malte Meinshausen of the Potsdam Institute for Climate Impact Research and others that to avoid global warming in excess of 2^o C with a risk tolerance of 25%, greenhouse gas emissions should not exceed one trillion metric tons of CO_2 equivalent between 2000 and 2050, and if emissions were to continue at the average annual levels that occurred between 2000-2006, this allowance would be exhausted by 2030.[19] They also cite an article published in the *Proceedings of the National Academy of Sciences* that predicted if emissions were kept at 2005 levels, global warming by the end of the 21st century would be 2.4^o C.[20] Emissions levels, however, are not being held at 2000-2006 average levels or 2005 levels. In those years emissions were increasing at greater than 3% a year[21] and they continue to rise.

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[17] *NEF Report*, 27.

[18] James Hansen, one of the most respected climate scientists, in 2008 changed his position on acceptable global warming. He now believes 2^o C over pre-industrial temperatures would be disastrous. He and his colleagues lowered there estimate of acceptable levels of CO_2 are at most 350 parts per million ("ppm") (down from the current 385 ppm. James Hansen, et al, "Target Atmospheric CO2: Where Should Humanity Aim?" available at http://www.columbia.edu/~jeh1/2008/TargetCO2_20080407.pdf (accessed November 21, 2010). The target most frequently given for achieving no more than a 2^o C increase is 450 ppm.

[19] Malte Meinshausen et al, "Greenhouse-gas emission targets for limiting global warming to 2°C," *Nature* 458, 1158-1162 (30 April 2009), available at http://www.nature.com/nature/journal/v458/n7242/full/nature08017.html (accessed November 17, 2010).

[20] V. Ramanathan and Y. Feng "On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead" *Proceedings of the National Academy of Sciences* 105 (September 17, 2008): 14245–14250.

[21] See, e.g., Michael Raupach, *et al.* (2007), "Global and regional drivers of accelerating CO2 emissions," *Proc. Natl. Acad. Sci. U.S.A.* 104 (24) (June 12, 2007): 10288–93, at 10289, available at http://www.pnas.org/content/104/24/10288.full.pdf (accessed November 18, 2010), which states that the growth rate from 2000-2004 was 3.2% per year.

That global warming has occurred and will continue does not mean growth in the economy is not possible, only that if it did continue it would do so under warmer conditions.

In fact, however, actual and potential global warming is affecting economic growth. With regard to present actual effects, extreme and abnormal weather events are following patterns predicted by climate change scientists. For example, the recent floods in Pakistan affected 20,000,000 people and damaged or destroyed 1,890,000 homes.[22] Record breaking heat in Western Russia in the summer of 2010, at times 25^{o} Fahrenheit above normal, combined with over 800 wildfires, resulted in hundreds of deaths, left over 3,000 homeless and a state of emergency was declared in 28 regions for farmers whose crops had failed because of drought.[23] A reservoir fed by glaciers in the Tuni Condoriri range provide 80% of the drinking water to La Paz and neighboring El Alto, home to 2 million people. Between 1983 and 2006 the area of the glaciers in the range were reduced by 33%. Glacial melt is especially important in supplying water to the reservoir in the dry season and the glaciers are expected to disappear by 2050.[24]

With regard to potential effects, because future negative effects of global warming are known risks, climate change is affecting growth in another way. Governments, as well as other sectors of society, across the world are taking seriously the call to keep global warming below 2^{o} C and that emissions reduction is necessary for this to occur. This changing policy environment is the centerpiece of the International Energy Agency's, *World Energy Outlook 2010*, released on November 10, 1020 (the *WEO Report)*.[25] The report states:

> The world energy outlook to 2035 hinges critically on government policy action and how that action affects technology, the price of energy services and end-user behaviour. In recognition of the important policy advances that have been made recently, the central scenario in this year's *Outlook—The New Policies Scenario*—takes account of the broad policy commitments and plans that have been announced by countries around the world, including the national pledges to reduce greenhouse gas emissions and plans to phase out fossil fuel subsidies even where the measures to implement these commitments have not been identified or announced.[26]

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[22] Singapore Red Cross, "Pakistan Floods: The Deluge of Disaster - Facts & Figures as of 15 September 2010," available at http://www.reliefweb.int/rw/rwb.nsf/db900SID/LSGZ-89GD7W?OpenDocument (accessed November 18, 2010).

[23] Michael Schwirtz, "Moscow Weather Back to Normal After Fires," *New York Times* (August 19, 2010), available at http://www.nytimes.com/2010/08/20/world/europe/20moscow.html (accessed November 18, 2010); and Andrew Kramer and Kevin Drew, "Wildfires Ravage Swaths of Russia," *New York Times* (August 6, 2010); available at http://www.nytimes.com/2010/08/07/world/europe/07russia.html?_r=1 (accessed November 18, 2010).

[24] James Painter, "Farewell to a melting glacier," BBC News (April 3, 2007), available at http://news.bbc.co.uk/2/hi/americas/6496429.stm (accessed November 18, 2010).

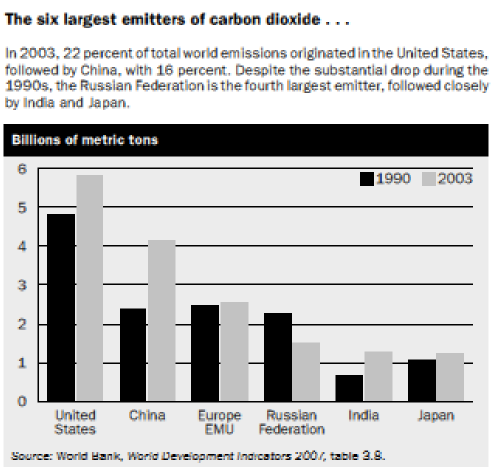
[25] International Energy Agency. *World Energy Outlook 2010: Executive Summary* (Paris, France: International Energy Agency, 2010), released November 10, 2010, available at http://www.iea.org/weo/index.asp (accessed November 18, 2010) (hereafter, *WEO Report*)

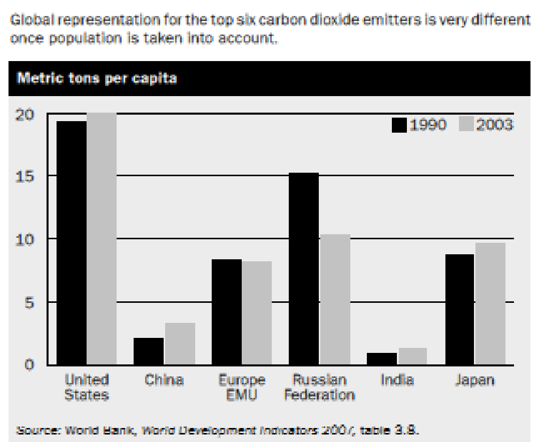
[26] Ibid., 4.

While there remain many climate doubters, from a global policy standpoint, the train to deal with global warming has already left the station.

Measures to reduce emissions taken by nations will impact growth. The industrial economy has been built on energy derived from cheap fossil fuels. A portion of the low cost of the fuels has resulted from governmental subsidies and also from accounting standards that do not count the environmental impacts of fossil fuels as a cost.[27] Restrictions placed on fossil fuels, removal of subsidies, taxation of fossil fuels, and measures that internalize the environmental costs of fossil fuels will all increase the cost of energy and reduce its availability to consumers.

Another way that measures to reduce emissions will affect growth concerns the competition for carbon sinks and for financing of clean energy. According to the *WEO Report*¸ 93% of total energy increases projected through 2035 will occur in non-OECD countries,[28] and 100% of increases in petroleum demand.[29] China alone is expected to account for over 80% of net demand for coal between 2008 and 2035.[30] The fact that emerging economies will account for most of the increase in net energy demand through 2035 will not change the fact that on a per capita basis energy consumption by the old industrial economies, especially the United States and Canada, will remain higher on a per capita basis than in the emerging economies.





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[27] "Pumping oil, refining it into gasoline, and delivering the gas to U.S. service stations may cost, say, $3 per gallon. The indirect costs, including climate change, treatment of respiratory illnesses, oil spills, and the U.S. military presence in the Middle East to ensure access to the oil, total $12 per gallon. Similar calculations can be done for coal." *World on the Edge*, 8.

[28] *WEO Report, 5.* OECD countries include all of the Western industrialized countries, as well as Korea and Japan, but does not include the emerging industrial countries, such as India, Russia, Brazil, China Arabia, other Middle Eastern countries or other less-developed countries.

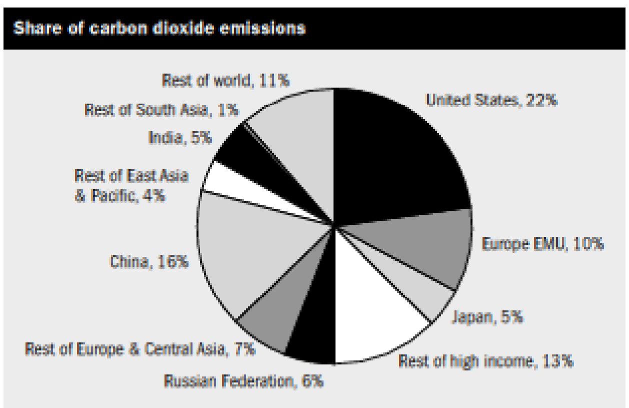
[29] Ibid. 6.

[30] *WEO Report: Key Graphs*, 4

Further, while the emerging economies are expected to be increasingly large CO_2 emitters, 73% of global cumulative emissions that have occurred since 1750 are attributable to the North[31] and 59% of global emissions in 2004.[32] This means the South, including such emerging giants as China, India and Brazil, home to a substantial majority of the world's people, must advance in a carbon constrained world, and emissions in the North must shrink rapidly to permit such growth. This struggle for control of the commons of the atmosphere as a sink for CO_2 and for financing of low emissions energy will significantly affect prospects for industrial growth in the North and South.[33]

Global distribution of carbon dioxide emissions, 2003

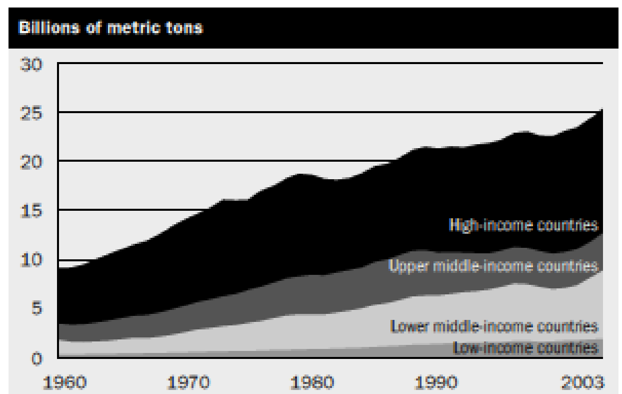
In 2003 nearly half the world's carbon dioxide emissions from cement manufacturing and the combustion of fossil fuels came from high-income countries. The largest emitter is the United States. In the developing world China and India are the major emitters.



Source: World Bank, *World Development Indicators 2007*, table 3.8.

Trends in global carbon dioxide emissions

Emissions worldwide topped 27 billion metric tons in 2003, an increase of 19 percent over 1990 levels. During that time the relative share of emissions coming from high-income and developing countries has changed substantially.



Source: Carbon Dioxide Information Analysis Center.

Energy

An extensive amount of the *NEF Report* considers peak oil, peak gas and peak coal. The authors make the case that production of each of these fossil fuel energy sources will peak by 2025. If this were the case then, without substitutes for these sources of energy, the economy would decline.

James Howard Kunstler in *The Long Emergency: Surviving the Converging Catastrophes of the Twenty-First Century,* describes the importance of cheap, abundant fossil fuels to the modern economy.

> Everything characteristic about the condition we call modern life has been a direct result of our access to abundant supplies of cheap fossil fuels. Fossil fuels have permitted us to

[31] The North comprises Europe (including Turkey), the Former Soviet Union (FSU), North America, Japan, Australia and New Zealand. The South comprises Asia (excluding Japan and the FSU), Africa, the Middle East, Latin America, the Caribbean and the Pacific islands.

[32] Michael Raupach et al, 10288.

[33] The graphs on this page and the following page are taken from World Bank's *Little Green Data Book 2007* , available at http://siteresources.worldbank.org/INTEEI/936214-1146251511077/21329572/LGDB2007.pdf (accessed November 29, 2010).

> fly, to go where we want to go rapidly, and move things easily from place to place. Fossil fuels rescued us from the despotic darkness of night. They have made a pharonic scale of building commonplace everywhere. They have allowed a fractionally tiny percentage of our swollen populations to produce massive amounts of food. . . .
>
> All of the marvels and miracles of the twentieth century were enabled by our access to abundant supplies of cheap fossil fuels. . . . [34]
>
> Before fossil fuels—namely coal, oil and natural gas—came into general use, fewer than one billion humans inhabited the earth. Today, after roughly two centuries of fossil fuels, and with extraction now at an all-time high, the planet supports six and a half billion people. Subtract the fossil fuels and humanity has an obvious problem.[35]

Not only were the fossil fuels cheap and abundant, but one, oil, also had unique characteristics:

> Oil is an amazing substance. It stores tremendous amounts of energy per weight and volume. It is easy to transport. It stores easily at regular temperature in unpressurized metal tanks, and it can sit there indefinitely without degrading. You can pump it through a pipe, you can send it all over the world in ships, you can haul it around in trains, cars, and trucks, you can even fly it in tanker planes. . . . It can be refined by straightforward distillation into many grades of fuel—gasoline, diesel, kerosene, aviation fuel, heating oil—and into innumerable useful products—plastics, paints, pharmaceuticals, fabrics, [fertilizers,] lubricants.
>
> Nothing really matches oil for power, versatility, transportability or ease of storage. [Oil has been] cheap, abundant, versatile.[36]

He then makes the case that "the lack of these qualities is among the problems with the putative alternative fuels proposed for the post-cheap-energy era."[37] Nothing is a substitute for conventional oil and the alternative fuels proposed to replace it currently consume conventional oil in their production.[38] Thus, the more expensive, higher emissions substitutes for conventional oil will also affect the cost and environmental impacts of the alternative fuels.

Many peak oil experts believe that no combination of existing and emerging technologies will be able to provide industrialized nations with sufficient energy to even maintain the current

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[34] Kunstler, 23.

[35] Ibid., 31.

[36] Ibid., 31.

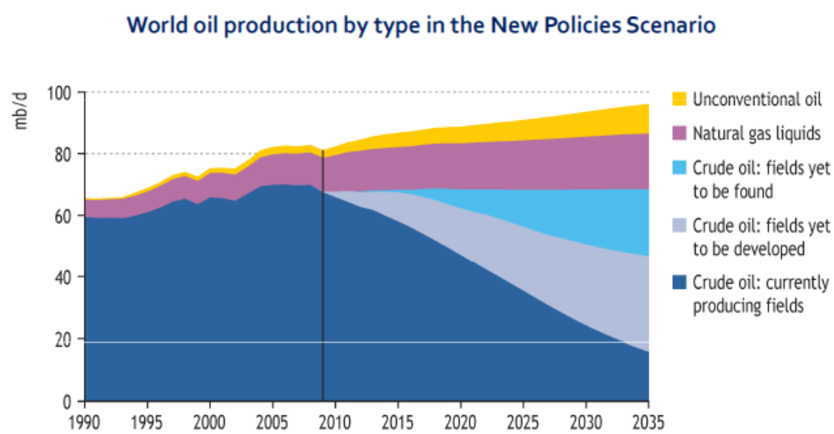
[37] Ibid.

[38] Even in the case of nuclear power, fossil fuels are needed "to support the construction, manufacture, maintenance, mining and processing activities that are necessary to create and service nuclear reactors." Ibid., 141.

economy.[39] In other words for them, there are no substitutes for oil that will allow continued economic growth.

The *WEO Report*, however, presents a different picture. In that report, production of each of oil gas, and coal continue to increase over the next 25 years.[40] In other words there will be no need for substitutes, because there will be sufficient supplies of fossil fuels. This appears to contradict the *NEF Report* but a closer reading finds considerable agreement and reveals a deceptive aspect to the term "peak oil." The *NEF Report* states with reference to peak oil, "The oil transition is not necessarily a shift from abundance to scarcity, but a transition from high quality resources [(conventional petroleum)] to lower quality resources [(oil from tar sands and oil shale, synthetic fuels from coal, liquid natural gas, and biofuels)] that have potentially higher levels of environmental damage [(in extraction, processing and emissions)]."[41] And, "counter-intuitively, the imminent global onset globally of the peak, plateau and decline of the key fossil fuels, oil and gas, will not help arrest climate change. If anything, it could be a catalyst for worse emissions and accelerating warming."[42]

The graph to the right from the *WEO Report* shows production of conventional oil is plateauing in the next 25 years, [43] but it also shows total oil production, including oil produced from unconventional sources, increasing. This is good news for the industrial economy, but bad news for global warming as the production, distribution and consumption of unconventional oil emits more greenhouse gases than conventional oil.



Global oil production reaches 96 mb/d in 2035 on the back of rising output of natural gas liquids & unconventional oil, as crude oil production plateaus

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[39] See, e.g., Richard Heinberg, *The Party's Over: Oil, War and the Fate of Industrial Societies*, 2d ed. (Gabriola Island, BC: New Society Publishers, 2005)

[40] *WEO Report*, 5.

[41] NEI, 79.

[42] NEI, 69

[43] Note that the estimate that current levels of conventional oil production will be maintained is based largely on "fields yet to be developed" and fields yet to be found. This raises doubt whether conventional oil production will plateau in the next 25 years as indicated in the *WEO* Report, or decline. According to the Association for the Study of Peak Oil and Gas, annual discoveries of new oil in recent years have been around one-fourth of annual oil usage. *Association for the Study of Peak Oil and Gas Newsletter*, No. 99 (March 2009), 2, available at http://aspoireland.files.wordpress.com/2009/12/newsletter99_200903.pdf (accessed November 19, 2010).

Renewables—meaning such energy sources as wind, solar, hydropower, geothermal and biofuels—and nuclear are not true substitutes for fossil fuels, especially for oil, as cheap, portable, highly concentrated fuel and as feedstocks for a myriad of products from plastics to fertilizers. They do, however, offer many advantages and, in the context of global warming, the advantage of reduced of CO_2 emissions as compared with fossil fuels.[44] Thus, substitution of alternative fuels and nuclear for fossil fuels where possible and as rapidly as possible is desirable to reduce CO_2 emissions. This will not happen at the rate needed to stop further growth in fossil fuel production and consumption in the next 25 years.

According to the *WEO Report*, renewables will have the greatest impact in generating electric power where the percentage of power generated will increase from 19% in 2008 to around one-third in 2035, with the increase coming mainly from hydro and wind. Solar is projected to provide only 2% of electric power in 2035. The use of biofuels for transport will also rapidly increase, but is only projected to provide 8% of world transport fuel in 2035. Renewables will provide 16% of heat production in buildings and industry in 2035.[45] Altogether, the share of renewables in total primary energy production will rise from 8% in 2008 to 14% in 2035.[46]

Given that, according to the *WEO Report*, even under its New Policies Scenario, primary energy demand is expected to increase by 1.2% per year or more (36% in the aggregate) between 2008 and 2035 and that renewables will provide only 14% of total primary energy in 2035, coal, oil and gas will account for the majority of the increase in energy production over this period and, in each case, more will be consumed in 2035 than in 2008. The reason that renewables will not grow faster include that capital costs for renewables are higher, the cost of energy produced more expensive, and renewables require a change in the energy infrastructure. Even the increases in renewables projected are predicated on the investment of $5.7 trillion dollars (in 2009 dollars) between 2010 and 2035, plus annual government subsidies for renewable energy production ranging from $57 billion in 2009 to $205 billion (in 2009 dollars) in 2035, not counting governmental costs for integrating renewable energy production into the grid.[47]

The difficulty in scaling up renewables has led many to advocate nuclear power as the answer. Energy and living standards are often equated. Thus, James Howard Kunstler writes, “Unless we

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[44] This is less true for biofuels. A significant amount of fossil fuel energy is expended in producing biofuels. There may be no emissions reduction at all for corn ethanol because the energy consumed in producing corn ethanol nearly matches the energy available in the corn ethanol. Nancy Stauffer, “MIT ethanol analysis confirms benefits of biofuels,” *MITnews* (January 8, 2007), available at http://web.mit.edu/newsoffice/2007/ethanol.html (accessed November 22, 2010). Another problem with biofuels in terms carbon emissions is that forests are being cleared to produce biofuel crops. The forest clearing and burning causes carbon emissions.

[45] *WEO Report*, 9.

[46] Ibid., 5.

[47] Ibid., 9.

want living standards in the United States to slide far beyond premodern levels in the absence of cheap oil and natural gas, we will have to use nuclear fission as our principal method for generating electricity from some time into the twenty-first century . . . while we scramble to make other arrangements."[48] And noted Earth systems scientist James Lovelock writes, "We should regard nuclear energy as something that could be provided in five years and could see us through the troubled times ahead when the climate changes and there are shortages of food and fuel and major demographic changes."

We are not on a course to do this. The *2010 World Energy Outlook* projects that while nuclear power will double between 2008 and 2035, its share of total primary power will only increase from 6% in 2008 to only 8% in 2035.[49]

Joe Romm of the Center for American Progress Action Fund gives these reasons that growth in nuclear power will be limited:

- Prohibitively high, and escalating, capital costs
- Production bottlenecks in key components needed to build plants
- Very long construction times
- Concerns about uranium supplies and importation issues
- Unresolved problems with the availability and security of waste storage
- Large-scale water use amid shortages
- High electricity prices from new plants[50]

In 2009, Craig Severance, an expert in the costs of nuclear power plants released a study that showed the costs of constructing nuclear plants more than doubled between 2000 and 2008. [51] A 2008 *Wall Street Journal* article stated that the cost of a single nuclear plant would be in excess of $8 billion.[52] Even this estimate is uncertain, as actual costs of nuclear plants built in the 1960s and 70s were more than 200% of the original estimates.[53] The uncertainty of costs is such that

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[48] Kunstler, 140.

[49] *WEO Report*, 5. The International Energy Agency's projection for nuclear energy is higher but not greatly so. See International Atomic Energy Agency, *Nuclear Technology Review 2010*, (Vienna, Austria: International Atomic Energy Agency, 2010), 10-11.

[50] Joseph Romm, *The Self-Limiting Future of Nuclear Power* (Washington, D.C., Center for American Progress Action Fund, 2008), 1.

[51] Craig Severance, "Business Risks and Costs of New Nuclear Power," available at http://climateprogress.org/wp-content/uploads/2009/01/nuclear-costs-2009.pdf (accessed November 21, 2010), 13, citing a study by Cambridge Energy Research Associates available at: http://www.cera.com/aspx/cda/client/report/reportpreview.aspx?CID=9491&KID=209 (accessed November 29, 2010). See also Yangbo Du and John E. Parsons, "Update on the Cost of Nuclear Power," MIT Center for Energy and Environmental Policy Research (May 2009), 2.

[52] "New Wave of Nuclear Plants Faces High Costs," *Wall Street Journal*, May 12, 2008.

[53] Severance, 11.

contractors for plants will not give fixed estimates of construction costs.[54] Further time delays are the norm, and in some cases plants under construction are never completed. As a result, it is primarily economic factors that have limited new construction in the United States[55] and even today not a single new nuclear plant is under construction.[56] Thus, not even one could be completed by 2020 making nuclear a non-factor in reducing carbon emissions in the United States in the next ten years. This is true for the OECD countries generally.[57]

Aside from cost considerations, the obstacles to scaling up production are immense because of the state of the nuclear industry. Romm states, "Only two companies in the whole world can make heavy forgings for pressure vessels, steam generators, and pressurizers that are licensed for use in any OECD country [and only one can] make the nuclear reactor's containment vessel in a single piece, reducing the risk of a radiation leak" with a maximum capacity at the time of the report of four per year.[58]

And a counter movement to the production of new nuclear plants is the decommissioning of existing nuclear plants, many of which are more than 40 years old. This led one commentator to question whether there would be any net increase in global nuclear energy production before 2015.[59]

In addition to the cost and supply issues, the safety of nuclear is a serious concern. Proponents argue that the historical record of current nuclear facilities has been good. Opponents point out that this historical record is, however, incomplete, given the very long-life of nuclear waste. Opponents also argue that the catastrophic potentials of nuclear energy are so great—the risks of more Chernobyls, nuclear terrorism (both use of nuclear in terrorism and terrorist attacks on nuclear facilities), spread of nuclear weapons, and environmental and human health concerns related to nuclear materials from mining to transport to operations to disposal—that even low probabilities of risks are intolerable. These issues feed into public attitudes, governmental policies and the economics of nuclear.

And finally there is the concern that nuclear is not carbon free. In terms of reducing carbon, solar wind, hydro and geothermal are better. [60]

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[54] Ibid., 14.

[55] Ibid., 3.

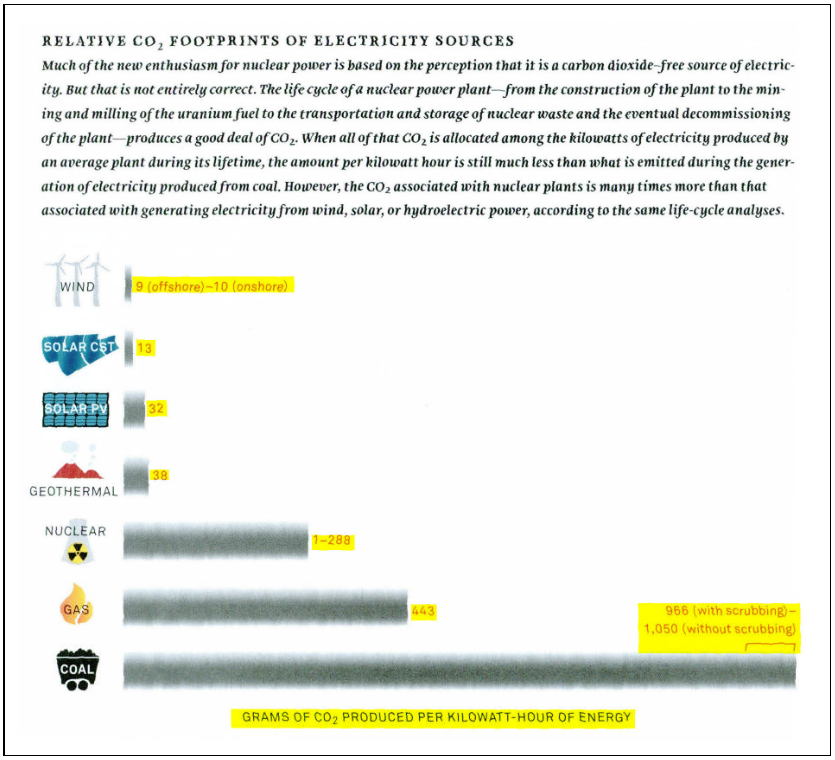
[56] Romm, 2.

[57] This is generally true for the OECD countries as a whole, with only South Korea undertaking significant construction of nuclear plants (6 currently under construction). Of 56 nuclear plants under construction only 11 are in OECD countries with South Korea and Slovakia accounting for 8 of those. *Nuclear Technology Review 2010*, 7-9

[58] Romm, 9.

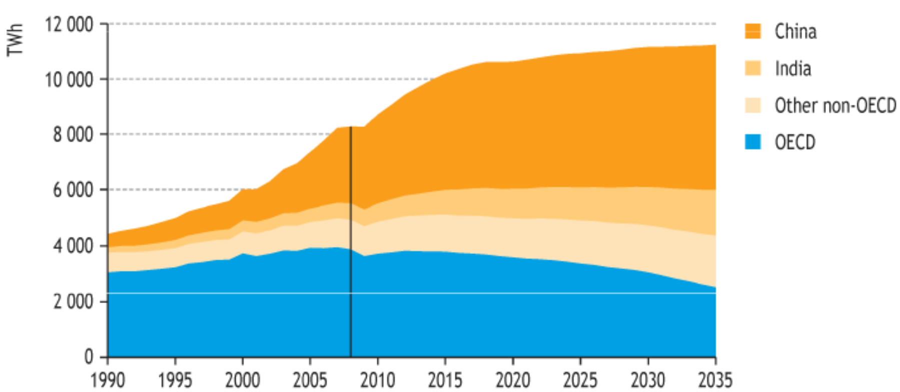
[59] Francois Cellier, "The Future of Nuclear Energy: Facts and Fiction - Part I: Nuclear Fission Energy Today," (August 5, 2009), available at http://europe.theoildrum.com/node/5631 (accessed November 21, 2010)

[60] Graph from Al Gore, *Our Choice*, __



There simply is nothing on the horizon that will meet the energy needs of an expanding industrial economy in the next 25 years other than increasing the use of fossil fuels, more oil (albeit increasingly from unconventional and more difficult and costly sources and with more CO_2 emissions per unit of energy), more natural gas and especially more coal.[61]

Coal-fired electricity generation by region in the New Policies Scenario



A drop in coal-fired generation in the OECD is offset by big increases elsewhere, especially China, where 600 GW of new capacity exceeds the current coal capacity of US, EU & Japan

[61] *WEO Report: Key Graphs*

A Brief Primer on Global Warming Metrics and Targets

Before assessing where we are with regard to the intersection of energy and climate change, it is necessary to understand the metrics and targets used by scientists and policy makers. The author is not intending to make a scientific presentation, but rather to make observations about what the most commonly accepted standards seem to be. The author drew heavily on the IPCC's *Fourth Assessment Report*, the United Nation Environmental Program's recently released *Emissions Gap Report*,[62] information from ClimateTracker,[63] and articles of which the lead authors were James Hansen,[64] Joeri Rogelj,[65] and Susan Solomon.[66]

Target levels of CO_2=450 ppm (most common) or 350 ppm or 550 ppm

Currently the concentration of CO_2 is about 385 ppm (up from 250 ppm in the preindustrial period) and the concentration is increasing by 2 ppm per year. Temperature has risen by 0.7^o C since the preindustrial period and a greater than 2^o C rise (an additional 1.3^o C rise in the twenty-first century) is commonly accepted as dangerous. A target 450 ppm maximum of CO_2 is commonly accepted as sufficient to achieve the target 2^o C maximum temperature increase.

Recently, however, James Hansen and others have been calling for a reduction of CO_2 to below 350 ppm. Hansen calls for the lower target because of a reassessment of the amount of warming already in the pipeline due to slow feedback loops. Slow feedback loops include the time it takes for oceans to warm (which both increases overall warming and results in release of CO_2 from the ocean) and the time it takes for ice sheets to disintegrate (decreasing the amount of radiation reflected back from Earth). In other words present concentrations of 385 ppm, in Hansen's analysis, would already, in the long-term, cause the temperature to increase to 2^o C over the preindustrial level, and those concentrations are continuing to increase. Because of the inertia in ocean warming and ice sheet disintegration emissions can exceed 350 ppm for a short period of time. Hansen proposes ways to remove CO_2 from the atmosphere and sharply reducing CO_2 emissions largely from phasing out coal use in the next 25 years except where carbon can be sequestered.[67] As discussed above, the International Energy Agency projects that coal use will steadily increase over this period.

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[62] United Nations Environmental Program, *The Emissions Gap Report: Are the Copenhagen Accord Pledges Sufficient to Limit Global Warming to 2.0° Centigrade or 1.5° Centigrade* (Nairobi, Kenya: United Nations Environmental Program, 2010).

[63] Niklas Höhne, Michiel Schaeffer, and Bill Hare, "Copenhagen Climate Deal—How to Close the Gap?" , available at www.climatetracker.com/________.

[64] Cited in footnote 18.

65 Cited in footnote 22.

[66] Susan Solomon, et al, "Irreversible climate change due to carbon dioxide emissions" PNAS February 10, 2009 _ vol. 106 _ no. 6, 1704-1709.

[67] See generally Hansen.

Business groups sometimes give a target of 550 ppm, which is considered well above the safe level by scientists.

Atmospheric carbon and climate change last a long time

Another key concept is that carbon in the atmosphere stays there for a long time. One set of figures is that 50% stays for decades, 30% for centuries, and 20% for thousands of years. A recent article, however, finds that 40% of the peak over preindustrial levels (using 280ppm as that level) will be present at the end of 1,000 years. By this formula if concentrations were to peak at 550 ppm and all emissions were to drop to zero, then at the end of 1,000 years the concentration would still be 388 ppm.[68]

The significance of this longevity, as well as the slow feedback loops mentioned above, is that no matter what is done about future emissions, CO_2 already in the atmosphere will continue to affect climate for a very long time. Further any additional increases in the concentrations of CO_2 will also continue to affect climate for a very long time.

Emissions targets for developed and developing countries

The IPCC's *Fourth Assessment Report* called for developed countries to reduce their emissions in relation to 1990 levels by -25% to -40% by 2020, and by -80% to -95% by 2050. The report also called for global emissions to peak by 2020 in order not to exceed the 450 ppm target. These targets are commonly given as -30% by 2020 and -80% by 2050 for developed countries.

The IPCC did not set specific targets for developing countries other than that they should cut their emissions growth below business-as-usual by 15% to 30% by 2020. This is commonly stated as 20% below business-as-usual by 2020.

Another way targets for targets are stated to stay within 2° C, is that emissions must not exceed 44 gigatons (Gt) CO2-eq in 2020. The business-as-usual projections are for 2020 are 57 CO2-eq.

A commonly stated goal for global emissions reductions by 2050 for all nations is 50% below 1990 levels. This was contained in the draft Copenhagen Accord but was stricken from the final document.

The importance of emissions peaking by 2020

The difficulty of achieving target emissions depends in part on how soon emissions peak and how high the peak is. A later peak and a higher peak both require steeper emissions reductions rates to meet the 2050 target of halving global emissions.

Global emissions in 2010 are about 46 GtCO2-eq. In order to stay within the 2° C limit for global warming with a high degree of probability emissions would have to peak before 2020,

[68] Solomon, et al, 1705.

decline to 44 $GtCO_2$-eq by 2020, and decrease at a rate of 2.5% per year (compared to 2000 levels) between 2020 and 2050.

What it would take to keep global warming within 2° C

According to the United Nations Environmental Program's *Emissions Gap Report* of November 2010,

> Emission pathways assessed in this report that provide a "likely" (greater than 66 per cent) chance of staying within the 2° C limit, have the following characteristics:
>
> A peak in global annual emissions before 2020.
>
> 2020 global emission levels of around 44 $GtCO_2eq$ (range: 39-44 $GtCO_2eq$).
>
> Average annual reduction rates of CO_2 from energy and industry between 2020 and 2050 of around 3 7 per cent (range: 2.2 - 3.1 per cent).
>
> 2050 global emissions that are 50-60 per cent below their 1990 levels.
>
> In most cases, negative CO_2 emissions from energy and industry starting at some point in the second half of the century.

Leaving Fossil Fuels in the Ground

Achieving emissions targets runs counter to full exploitation of fossil fuels. The issue in meeting the targets is not how great are fossil fuel reserves, how much additional fossil fuels can be produced to sustain economic growth, and how long will reserves last. Rather the issue is leaving fossil fuels in the ground. For example, Hansen calls for phase out of coal except where carbon can be sequestered by 2030. At present there are only two demonstration carbon-capture-and-storage demonstration coal plants in the world and one of them is not presently sequestering carbon due to local protests.[69] In 2003, George Bush announced the construction of a demonstration plant in the United States called "FutureGen." Not only is the plant not yet in operation, in August 2010 the town where the plant was to be sited backed out of the project.[70]

[69] Dyer, 171-72.

[70] David Mercer, "Illinois Town Backs Out of FutureGen," *Huffington Post* August 11, 2010), available at http://www.huffingtonpost.com/2010/08/11/illinois-town-backs-out-o_n_679344.html (accessed November 30, 2010).

Where we are

Here are recent statements regarding global warming that take into account the pledges made by countries pursuant to the Copenhagen Accord of December 2009:

> Current pledges mean a greater than 50% chance that warming will exceed 3 °C by 2100.[71]
>
> [If] countries hit their lowest stated ambitions, take advantage of surplus allowances and use credits fully, . . . 2020 emissions from developed countries [may be] 6.5% above 1990 emissions,"[72] not 25% to 40% below 1990 emissions as called for by the IPCC.
>
> The United States, which is responsible for about a quarter of the world's emissions, has pledged only a 17% reduction in emissions by 2020 over 1990 levels. In 2010, twenty years after 1990, the United States has had no reductions only increases, except in 2009 after the financial crash.
>
> China's Copenhagen pledge to lower its CO2 emissions per unit of gross domestic product by 40–45% compared to 2005 levels given China's rate of GDP growth is only "business-as-usual development."[73] China is the world's largest emitter and will account for most of the increase in energy use and emissions in the next 25 years.
>
> Japan's delegates to the December 2010 United Nations talks in Cancun said that Japan does not intend to renew its carbon-cutting pledge under the Kyoto Protocol when it expires in 2012.[74] Japan has the world's second largest economy,
>
> Global emissions are expected to be 49 $GtCO_2eq$ to 53 $GtCO_2eq$ in 2020 based on Copenhagen Accord commitments and how they are implemented. These figures are well above the 44 $GtCO_2eq$ target. If we start from these levels of emissions expected in 2020 and then follow the range of these pathways through to 2100, we find that they imply a temperature increase of between 2.5 to 5° C before the end of the century.[75]
>
> [The trends of emissions growth based on the pledges made under the Copenhagen Accord] are in line with stabilising the concentration of greenhouse gases at over 650 ppm CO_2-eq., resulting in a likely temperature rise of more than 3.5° C in the long term.[76]

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[71] Joeri Rogelj, et al, "Copenhagen Accord pledges are paltry," *Nature*, Vol. 464 (22 April 2010), 1126.

[72] Rogelj, 1127,

[73] Rogelj, et al, 1126.

[74] "Stance on Kyoto pact draws fire," *The Japan Times* (December 3, 2010), 2.

[75] *Emissions Gap Report*, 9.

[76] *WEO Report*, 11.

The *WEO Report* summarizes the situation this way:

> The modest nature of the pledges to cut greenhouse-gas emissions under the Copenhagen Accord has undoubtedly made it less likely that the 2° C goal will actually be achieved. Reaching that goal would require a phenomenal policy push by governments around the world. An indicator of just how big an effort is needed is the rate of decline in carbon intensity—the amount of CO_2 emitted per dollar of GDP—required in the 450 Scenario, intensity would have to fall in 2008-2020 at twice the rate of 1990-2008: between 2020 and 2035, the rate would have to be almost four times faster. The technology that exists today could enable such a change, but such a rate of technological transformation would be unprecedented. And there are major doubts about the implementation of the commitments for 2020, as many of them are ambiguous and may well be interpreted in a far less ambitious manner than assumed in the 450 Scenario.

Gwynne Dyer more bluntly makes the point that the targets will not be reached without a phenomenal policy push and concludes it won't happen:

> In 2007 the Intergovernmental Panel on Climate Change stated that global emissions of greenhouse gases must peak by 2015 if we are to have any chance of keeping the temperature rise to 2 ^{o} Celsius (and thus have a reasonable chance of not tripping the feedback mechanisms that could pitch us into runaway heating). . . . Only massive mobilization and wartime-style controls in every major industrialized and industrializing country could stop the rise in greenhouse gas emissions by 2015, and we know that is not going to happen. So we are going to bust the boundaries.

Dyer then says we are at childhood's end—he doesn't believe in the "climate fairy" anymore. Geoengineering will be needed to buy us time while we undertake the larger job: "The job, for the rest of this century is repairing the damage we did over the past two centuries of industrialization to the homeostatic, Gaian systems that we didn't even realize we depended upon until relatively recently."[77]

World population is growing, the world economy is growing, world energy use is growing, world fossil fuel energy is growing and world emissions are growing. The ability to change this prognosis is limited by political, social and technological arrangements and constraints. The global human community will not achieve the 450 ppm (or 350 ppm) target, the 2 ^{o} C target, the peak before 2020 target, or the other targets.

We Live in an Economic Age that Misinforms Us About What Is Happening

Part and parcel of the industrial age is the economic age. Adam Smith's *Wealth of Nations* was published in 1776, the same year as America's Declaration of Independence, and at the same time as the beginning of the industrial revolution.

[77] Dyer, 271.

Paul Schafer writes about the economic age in *Revolution or Renaissance*:

> Like every age, the economic age is predicated on a very specific way of looking at the world, acting in the world, and valuing things in the world. It is based primarily, if not exclusively on economics, which yields an "economic worldview" that is by far the most powerful worldview in existence today. This worldview is based on the conviction that satisfaction of people's needs and wants in all areas of life can be attended to most effectively by making economics and economies the centerpiece of society, and the principal preoccupation of individual, institutional, municipal, regional, national and international development. Through commitment to this conviction, it is believed that wealth can be increased most effectively, the supply and demand for goods and services can be satisfied most efficiently, living standards and the quality of life can be improved most fully, population growth can be curtailed most judiciously, poverty can be reduced if not eliminated, and the natural environment can be managed and turned to humanity's advantage. . . .[78]
>
> Economics and economies in general, and economic growth and development in particular, are seen as the principal means for increasing material and monetary wealth, and making improvements to society. . . . [79]
>
> [Even non-economic factors of society are dependent on the economic base.] The economic base must be given priority over everything else. If people want more artistic, social, educational, religious, spiritual, recreation, and other amenities, the only way they can get these amenities is to expand commercial, industrial, agricultural, business, financial and technological activities and increase economic growth . . . .[80]

Modern economics exists to increase growth and the now globalized civilization largely uncritically assumes that economic growth is the primary social priority that makes all good things possible, even a clean environment. What newspaper or magazine can you read, or what TV program or radio program, whether conservative or liberal, that does not extol growth?

How the economic worldview distorts our understanding is illustrated by the lead editorial in the December 3, 2010 issue of *The Economist*.[81] The leader states that there is a growing acceptance that the effort to avert serious climate change has run out of steam and that in all likelihood the world will keep getting warmer and by the end of the century will be at least 3^{o} C warmer than in pre-industrial times. Acknowledging that this will cause suffering for many, it gives its prescription for how to best deal with global warming:

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[78] D. Paul Schafer, *Revolution or Renaissance: Making the Transition from an Economic Age to a Cultural Age* (Ottawa: University of Ottawa Press, 2008), 93-94.

[79] Ibid., 3.

[80] Ibid., 104.

[81] "How to live with climate change," Leader, *The Economist* (November 27th, 2010), 15.

> The best protection against global warming is global prosperity. Wealthier, healthier people are better able to deal with higher food prices, or invest in new farming techniques, or move to another city or country, than poor ones are. Rich economies rely less on agriculture, which is vulnerable to climatic change, and more on industry and services, which by and large are not. Richer people tend to work in air-conditioned buildings, poor ones tend not to.

One of the corollary benefits it gives of global warming is that the Russians will be able to able to exploit Arctic oil as the ice melts. That global warming will cause many deaths is too bad, "evolution works that way." It calls global warming "the craziest experiment mankind has ever conducted" and concludes "the human race must live with the problem as best it can."

We must move from the economic age to an ecological age, from industrial civilization to ecological civilization. This is the way of life.

So what if the world as we know it is ending? So what if we cannot save the Earth? So what if it is already too late?

It would relieve us from going around changing our light bulbs and buying carbon credits for our air fares. It would dispel the notion that wind farms and biofuels are anything more than money grabs, more business as usual. It would expose environmentalists as no better than those in England who sought to achieve peace by appeasing Germany prior to World War II. We would stop trying to save the Earth, and get busy at saving ourselves—at least so says, James Lovelock, a harsh observer of our situation and the actions we are taking.

Lovelock admits he is a doom-sayer and upset that the world did not wake up when his penultimate book, *The Revenge of Gaia*, was published. He has been roundly criticized as offering no hope, over the top, seeking attention and declining with age (he is 91 in 2010), and also as taking an Olympian view—observing the world's suffering and error and at the same time distancing himself from it.

The author has no interest in defending many of the observations and statements Lovelock makes though in some way, as to our situation, they present information similar to that in this paper. The author does, however, find some of Lovelock's insights quite penetrating and as providing a point of departure for creative action in this new world.

Lovelock and his colleagues, notably Lynn Margulis, were the first to recognize Earth as an integrated, self-regulating system, and in that sense as having characteristics associated with a living organism. The name originally given to this concept was "Gaia theory." Gaia was the name of the Greek goddess of Earth. The idea that Earth was a kind of organism was as roundly criticized as Lovelock's recent remarks, but no doubt in part because of a failure to understand what Lovelock was observing. What he was observing was that it was not the physical aspects of Earth, that gave the planet its distinctive character, including its atmosphere, rather the biosphere did. The biosphere through self-regulating processes created and maintained the conditions for life as we know it on Earth.

True, there have been perturbations in the physical conditions of Earth that have sometimes preceded biological self-regulation or adaptation, but this is the point—when conditions change life reinvents itself and in doing so reinvents the conditions and atmosphere of Earth. Lovelock puts it this way, "

> Since life appeared on Earth three and a half billion years ago, its temperature and surface composition have been set by the preferences of whatever organisms made up the biosphere.. . . The manager of climate is and has always been Gaia, the Earth system of which the biosphere is a part. The disastrous mistake of twentieth-century science was to assume that all we need to know about the climate can come from modeling the physics and chemistry of the air in ever more powerful computers, and then assuming the biosphere merely responds passively to change rather than realizing it is in the drivers seat." [82]
>
> The atmosphere whose physics they model, is not some simple gift of the Earth's geological past; it is, apart from about 1 percent of the so-called rare or noble gases, [99 percent] the product of living organisms, including humans, at the surface. . . .[83]
>
> [Even biologists have only] grudgingly . . . acknowledge[d] that organisms adapted not to the static world . . . . described by their geologist colleagues, but to a dynamic world built by the organisms themselves. . . ."[84]
>
> Gaia needs the ecosystems, the forests and other vegetation on land, and the algae of the oceans to sustain life. Otherwise our planet would move inexorably to the intolerably hot and utterly barren equilibrium state . . . .[85]

Lovelock criticizes scientists for seeming to see Earth as a "ball of rock, moistened by the oceans and sitting within a tenuous sphere of air [that somehow they] can improve or manage."[86] In place of a richly diverse, sometimes scary and threatening, wild forest, they put a monocutlure tree plantation. They do not understand that "the natural world outside our farms and cities is not there as a decoration, but serves to regulate the chemistry and climate of the Earth, and the ecosystems are the organs of Gaia that enable her to maintain our habitable planet."[87] "They even see Mars as a place to be developed when Earth is no longer habitable. They do not yet see Earth as a live planet that regulates itself."[88]

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[82] James Lovelock, *The Vanishing Face of Gaia* (New York: Basic Books, 2009), 22-23.

[83] Ibid., 46.

[84] Ibid., 48.

[85] Ibid., 86.

[86] Ibid., 21.

[87] Ibid., 15.

[88] Ibid., 21.

If the mistake of scientists is to view Earth in a reductionistic, physicalistic way, the mistake of government and business, according to Lovelock, is to see climate change as both reversible and profitable.[89] He says we shouldn't believe for a minute that the green business ideas under discussion will save the planet. "Earth does not need saving. It can, will and always has saved itself, and it is now starting to do so by changing to a state much less favorable for us and other animals. What people mean by [save the planet] is 'save the planet as we know it,' and that is impossible."[90]

To illustrate this impossibility, Lovelock writes of he 'heat latency' in the melting of ocean ice. It takes a great deal of energy to melt ocean ice, eighty-one times as much as to raise the same amount of water one degree. So once the ice is gone, solar energy will raise the temperature of the ice-free water quickly. Once the ice is gone, for example in the Arctic, Earth will not return to its present state until all the ice that melted is frozen again.[91] How is that going to happen in a warmer world? Similarly for the biosphere, when the biosphere changes, Earth could not be the same as we know it now unless the biosphere is restored to what it is today. Everywhere the biosphere is changing and losing much of its diversity. To think we can compensate for such loss by, for example, biotechnology is merely to delude ourselves. Such observations bring home why David Orr states that recovery from global warming may take centuries.

Lovelock's message to humans is to stop trying to save the planet and save yourselves. Do this first and foremost by understanding that Earth is a living system and we are part of it. Unless we take this into account we will be able "neither to understand nor forecast Earth's behavior."[92] "To survive in this new world we need a Gaian philosophy and to prepare ourselves to fight a barbarian warlord out to seize our territory and us."[93] Paradoxically, a Gaian philosophy recognizes that "the health of the Earth is primary, for we are utterly dependent upon a healthy planet for survival."[94] If we can keep civilization alive in the difficult days ahead and bring ourselves to an understanding of our living Earth, then one day our descendants, as a planetary intelligence, may engage with her in her fine-tuned self regulation, bring her back from the disabling impacts of the present, and live in communion with her.

The movie *Mindwalk* and the book *The Great Work* by Thomas Berry make a similar point as Lovelock with regard to understanding Earth as primary and as a living system. In *Mindwalk* Liv Ullman plays the role of a disenchanted scientist whose invention was used against her will for military purposes. She travels to Mont St. Michel in France to brood. After much study and thought, she has a chance meeting with an American politician who had become discouraged by

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[89] Ibid., 7.

[90] Ibid., 19.

[91] Ibid., 16-17.

[92] Ibid., 13.

[93] Ibid., 30.

[94] Ibid., 36.

the political process and his friend an American poet living in France. They engage in a day-long dialogue in which she describes Earth as a living system and the need for an ecological worldview. The politician tries to pin her down on what problem she would address first and she keeps returning to the point that the fundamental problem is one of perception.

Thomas Berry wrote that the great work of our time "is to reinvent the human—at the species level, with critical reflection, within the community of life-systems, in a time-developmental context, by means of story and shared dream experience."[95] When he repeated this in talks, the author has heard him stop after "within the community of life systems" and say this is the most important of all. It's a problem of perception.

As for Lovelock, for Berry Earth is primary. For him, the great illusion of the industrial age is that we can "advance human well-being by plundering the planet [and destroying its] geological and biological structure and functioning"[96] He lamented, "We have changed the very chemistry of the planet, we have altered the biosystems, we have changed the topography and even the geological structure of the planet, structures and functions that have taken hundreds of millions and even billions of years to bring into existence."[97] Earth in all of its processes is the supreme norm of reality and value. It is "the primary lawgiver, the primary economic corporation, the primary scientist, the primary technologist, the primary healer, the primary revelation of the divine, the primary artist, the primary teacher, and indeed the primary source, model and ultimate destiny in all earthly affairs"[98] "The ecological community is not subordinate to the human community. Nor is the ecological imperative derivative from human ethics. Rather, our human ethics are derivative from the ecological imperative. The basic ethical norm is the well-being of the comprehensive community and the attainment of human well-being within that community."[99]

Though at times Berry was as alarmed about our future prospects as Lovelock, he never saw Earth as a barbarian warlord or something we were overagainst. Earth can be harsh in its discipline, but in the larger sense is always a faithful ally. For Berry Earth is not living simply in the sense of being a geophyscal reality with living beings on it, rather every element of Earth has an aspect of psychic participation in a cosmic adventure. Earth is a communion of subjects, not a collection of objects. Further Earth as a whole is a subject and guided by an inner process with meaning and purpose.

Berry's work provides the basis for an ecological civilization as the successor to industrial civilization. Basing many of his ideas on Berry's, the author would describe such a civilization this way: Ecological civilization is grounded in the awarenesses that

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[95] Thomas Berry, *The Great Work: Our Way into the Future* (New York: Bell Tower, 1999), 159.

[96] Ibid., 58.

[97] Thomas Berry, *The Dream of the Earth* (San Francisco: Sierra Club Books, 1988), xiii.

[98] Berry, *The Great Work*, 81.

[99] Ibid., 105.

- Earth is a single sacred community bound together in interdependent relationships.
- Earth is a communion of subjects, not a collection of objects.
- We learn from creation and from that we learn to live the good and sustainable life in harmony with creation.
- Earth's processes and components developed over long periods of time. They offer possibilities, impose constraints, and require respect.
- Earth's special purposes are to create, sustain and enhance life and consciousness.
- The key roles of humans are celebrating and caring for the community of life in conscious self-awareness.

And ecological civilization

- Understands Earth as *oikos (*Greek*) or* eco (English), which means our Earth home. Ecology is the understanding of all the relationships in our Earth home.
- Lives by standards of fundamental justice and fairness for all humans. It places survival and human welfare outcomes above products, profits and markets as means.
- Recognizes the rights of all species to habitat, nourishment, and dignified participation in the community of life.
- Honors the all living components and processes of Gaia in their qualitative dimensions as well as their functional roles.
- Is grounded in local communities and bioregions, and in historic cultures and classical civilizations.
- Protects the commons at global, regional and local levels.
- Is unified by a shared sense of the sacredness of Earth community.
- Is a process concept, not something to be arrived at, but something ever to be created.

To move into ecological civilization is to move beyond seeing Earth in a reductionistic, physicalistic way and climate change as reversible and profitable. Ecological civilization is not a romantic idea. We move into it out of necessity to face the challenges of the long emergency of the coming decades.

Ecological civilization is not derivative of industrial civilization, nor is it the opposite of it. It is not the opposite because much that we have learned and much that we do must be carried forward into it. It is not derivative, because it cannot be attained by refining industrial civilization. We must be lifted out of it.

This will not happen because we attain scientific knowledge or because we are alarmed by adversities that may lie ahead. It will happen because of the new perception that we are part of a living Earth. The dawning of this perception will come to people at different times like a religious insight or a dream experience. Thomas Berry says, "We might think of a viable future for the planet less as the result of some scientific insight or as dependent on some socio-economic arrangement than as participation in a symphony or as a renewed presence to the vast cosmic liturgy."[100] He also says, "The fulfillment of the Earth community is to be caught up in

[100] Ibid., 20.

the grandeur of existence itself and in admiration of those mysterious powers whence all this has emerged."[101]

Those who move into ecological civilization as pioneers will experience themselves as living in two worlds: an ecological, or as Berry puts it an "ecozoic," world where the questions, the guiding principles, the inputs, the outputs and the accountabilities will all be different; and the industrial world ensnared in its own principles and presuppositions, asking questions and offering solutions that threaten the demise of that which we hold most dear—a habitable planet.

Those who will be fortunate in the coming days will not be those who are rich, who seek to profit on adversity, or cling to what is passing away, but rather those who gain an understanding or what is happening and undertake the journey willingly of change and of caring for people and nature in this transition.

Those who pioneer ecological civilization will be teachers and advocates. After realizing they cannot save the world as we know it, they will change the light bulbs anyway because it is the right thing to do . . . and maybe later they will change their homes and their jobs. They will know that change is bottom up—what we do as individuals and communities—and top down—what we do as governments and institutions. They will realize ecological civilization has to be built soon. They will do their best to stop wrong policies and actions from doing harm. They will be clear that ecological civilization is not the opposite of industrial civilization nor is it derivative from it. They will know that the changes that are needed are not incremental changes in industrial civilization, but transformation. They will believe in their hearts that ecological civilization will happen, that what is necessary will be done. As with the builders of a cathedral, knowing it will not be finished in their lifetimes. they will lift the heavy stones and they will be happy.

When Gwynne Dyer imagined the human community that might survive global warming, he wrote, "This global society will live or die as a high energy enterprise."[102] He saw the wealth of the world being more evenly distributed, but the remaining five to six billion people having "access to the full industrialized lifestyle," yet living more lightly upon Earth in a decarbonized, more efficient, and still high tech economy and possibly with synthetic meat grown in vats.[103]

The author cannot believe that ecological civilization will be industrial civilization lite. Gaia is teaching us something. In the future, we will live closer to Earth. The global monetary economy will be smaller and will not dominate society as it does now. We will probably be fewer in number. We will have less in the way of material goods and high-power energy, but more of what is essential. We will all be ecologists. We will not be mesmerized by the dream of an industrial paradise, we will be caught up in the dream of the Earth.

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[101] Ibid., xi.

[102] Ibid.

[103] Ibid., 272-74.