The Limits to Growth Study: Some Thoughts about Its Relation to Sustainability

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This short document is intended to supplement the brief materials on *The Limits to Growth* in our power point entitled: What Is Sustainability? To access that longer power point click on:

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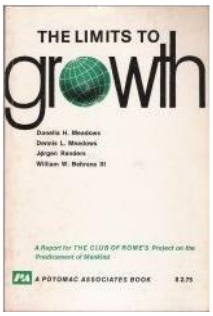
In 1972, a bombshell book appeared. *The Limits to Growth* argued that if (then) present trends in population, industrial and consumption growth continued, it was likely that "a rather sudden and uncontrollable decline in both population and industrial capacity" would occur "sometime within the next one hundred years" (Dennis Meadows 2007:404, quoting from LtG 1972:24).

A group of Massachusetts Institute of Technology (MIT) computer geeks – among the earliest of the genre – Donella Meadows, Dennis Meadows, William W. Behrens III and Jørgen Randers – were the principle authors. Their work was supported by the Volkswagen Foundation and a group called the Club of Rome founded by an Italian industrialist named Aurelio Peccei. Meadows, Meadows and Randers came out with a computer simulation of various future economic scenarios for the world under the title *The Limits to Growth: A Report to the Club of Rome's Project on the Predicament of Mankind* (Hereafter LtG).



Just as Rachel Carson had challenged a standard belief in the 1950s that chemicals could cleanse the earth of harmful pests, *Limits to Growth* took on the accepted wisdom among economists and the political establishment that economic growth could be and should be sustained forever.

Computer modeling – poorly understood even today by most lay people – was a novelty in 1972 and much of LtG requires some mathematical knowledge to follow the arguments adequately. LtG mounted an even more comprehensive attack on mainstream thinking about the environment and the earth's natural resource base than had Carson's *Silent Spring*, which had attacked primarily the chemical industry and several basic notions about the ability to isolate sections of the web of life.

So what was LtG about? The authors employed a computer program called World3 to explore past and future relations among five economic sectors: population, capital, agriculture, nonrenewable resources and pollution. One hundred total variables and 80 fixed parameters allowed the program to be set or reset to test for all kinds of possible interrelations among the variables (Costanza *et al* 2007:427). The program was set to begin in the year 1900 – based on historically available data – and to generate trend lines up to the year 2100 showing increases or decreases among the sectors depending on various assumptions chosen by the researchers. The year 1970 was a second baseline, with data points and therefore with trends from 1900 to 1970 from which projections into the next 130 years could be generated.

In 1992 the authors published an update called *Beyond the Limits* and in 2004 they came out with *Limits to Growth: the 30-year update*. We shall use the 30-year update for sampling the data (the main conclusions are the same in all three

books). In LtG 10 data runs or scenarios are presented which are thought to represent the major logically possible or empirically likely possibilities.

What If There Are No Limits?

In one logically possible run, the "infinity-in, infinity out run," – also known as "IFI-IFO," (LtG 2004:157) the earth's resources are assumed to be inexhaustible, capital for investment is always available in the amounts needed and pollution is easily brought under control. This "run" produces the following results for the year 2100: population rises to 9 billion then starts a gradual decline (how far it drops is not known since the program does not project beyond 2100), the economy grows until it is producing 30 times the year 2000 level of consumer goods, while using the same annual amount of nonrenewable resources and producing only one-eighth as much pollution per year (*LtG 2004: the 30 Year Update*:150). Average life expectancy stabilizes near 80 years worldwide; six times as much food is produced as in the year 2000. Human welfare increases enormously while resource use decreases (LtG 2004:151). In short, a high-quality human lifestyle in a sustainable world. Business as usual is all we need.

Major Concept:
Overshoot

Using a resource faster than it can renew itself, or;
Exceeding a limit, or;
A bubble (occurs when a limit is exceeded) such as the 2000 dot.com bubble or the 2008 housing bubble.

What If There Are Limits?

But is "IFI-IFO" realistic? For example: are the earth's mineral resources inexhaustible? The earth's crust contains enormous amounts of minerals, but the overwhelming percents are in highly dispersed amounts (Bardi 2011:70). Theoretically – or if prices go high enough in classical economics – even the rarest materials could be mined or substitutes could be found. However, is theoretically possible the same as technologically likely? It is not known at present how scarce minerals would be accessed or whether the technological and energy requirements could ever be met. Even if they could, unleashing vast amounts of energy to get trace minerals could result in significant overheating of

the earth's atmosphere – "thermal pollution" (Bardi 2011:81). And – finding substitutes would mean diverting capital from some other sector to try to solve the energy and/or pollution problems. In other words, it seems that at some point we would hit a limit.

Indeed, the longer we exploit a nonrenewable resource, the rarer it becomes until at some point we begin to get diminishing returns. An implicit argument of LtG is that the great expansion of human welfare (in some parts of the globe at least) is a by-product of the easy access to certain energy sources such as coal and particularly petroleum.

What If There Are Limits and Yet We Continue with Business As Usual?

The assumption of unlimited resources generated the "IFI-IFO" scenario. At the other extreme is the business-as-usual scenario in a physical world **with** limits. In other words, what if there are limits, but we proceed as if there were not? For the authors of LtG this meant projecting then existing rates of increase into the future. The authors called this "scenario one," or the "standard run." As summarized in their 2004 update:

> The world society proceeds in a traditional manner without any major deviation from the policies pursued during most of the twentieth century. Population and production increase until growth is halted by increasingly inaccessible nonrenewable resources. Ever more investment is required to maintain resource flows. Finally, lack of investment funds in the other sectors of the economy leads to declining output of both industrial goods and services. As they fall, food and health services are reduced, decreasing life expectancy and raising average death rates. (LtG 2004:168. Graphs of this run are on p. 169)

Big Idea:
Overshoot Leads Eventually to Collapse

The 20th century industrial economy has a built-in tendency towards overshoot. If left to develop naturally, one or more sectors will eventually reach overshoot and will crash the system. The crash could generate "vast human misery."

In other words, "a few decades into the twenty-first century" (LtG 2004:170) things happen that can be described as a "collapse." Or, "vast human misery."

Accumulating Scenarios

How can collapse be avoided? The LtG authors ran several combinations of assumptions changing the rates of investment, the control of pollution, the increase in population and other factors (LtG 2004:172–248). For each scenario that follows they took the "standard run," (scenario one) and added sequentially more sustainable assumptions.

- In scenario two they doubled the availability of nonrenewable resources.
- In scenario three they added easier pollution control.
- In scenario four they assumed that agricultural land would yield greater outputs.
- In scenario five they made it easier to protect land from erosion.
- In scenario six they increased technological efficiency.
- In scenario seven they added a worldwide commitment and policies to stabilize population growth starting in 2002 and "perfect birth control" (LG 2004:242).
- In scenario eight they assumed that the world would accept stable industrial output per person from 2002 on.
- In scenario nine they employed all the additions from scenarios two through eight and added pollution, resource and agricultural technologies from 2002. Finally – at scenario nine – the world's people enjoy a sustainable high quality of life on a resource base that is stable or improving.

In other words, *avoiding collapse and creating a sustainable future required the addition of nine explicit policies carried out effectively throughout the world over several decades to achieve the goal by about the year 2100*. (In a tenth scenario that appears only in the 2004 edition, they assume that all the policies in scenario nine had been implemented starting in 1982: the result was that a sustainable high quality of life was achieved sooner but also that all the variables stabilized more clearly [LtG 2004:248–250]).

Impact of *The Limits to Growth*

LtG sold millions of copies and was translated into 30 languages. It was widely used as a college course reading (LtG 2004:x; Turner 2008:397). Many regard it "as one of the most influential books of the twentieth century" (Ian Johnson in Bardi 2011:ix).

Controversies Surrounding *The Limits to Growth*

Despite its extensive sales and broad reach through translations, LtG apparently had little if any impact on policies nationally or worldwide. Perhaps one reason is contained in the section above on "Accumulating Scenarios:" LtG implicitly called for a major restructuring of the world economy, a reordering of priorities and an entirely new set of institutions that would be required to implement scenario 9, or even any scenario except the standard run. For one thing the collapse suggested in LtG appeared to happen in approximately 40 to 100 years. That would be dozens of electoral cycles away. Nor could individual policies solve problems that were so interconnected: an entire international framework would have to be developed (Blanchard 2010:97).

Another – and possibly related – reason is that LtG unleashed a storm of criticism from economists, most of whom rejected outright its general approach and assumptions or who considered it full of technical errors. However, since about the year 2000, interest in LtG has grown once again and with the economic meltdown of 2008, increasing costs of some minerals and the awareness of the threat of "peak oil" and other possible resource limits the study has re-emerged among scientists and policy experts.

Several recent reviews provide overviews of the debate on LtG through the past 40 years. Blanchard (2010) identifies four major critiques made between 1973 and 1992. These include a study from The Science Policy Research Unit of Sussex University, which argued that the assumptions underlying the LtG model were excessively pessimistic. The well-known futurist Herman Kahn and the Hudson Institute argued that LtG underestimated the role technology could play in mitigating resource depletion., A group of scholars at the Bariloche Foundation in Argentina made a case similar to Kahn's but added the idea that

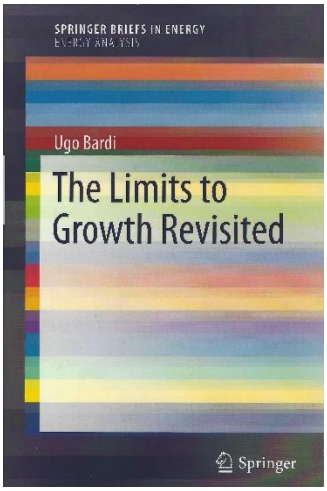
pollution is easier to control than assumed in LtG. The influential American economist William Nordhaus argued that LtG neglected the role played by prices in regulating the use of resources. He supported the view of other critics that LtG had undervalued the role of technology in solving problems of pollution and of potential resource scarcity. Blanchard's article provides full citations to the original sources.

Along with Nordhaus, probably the most thorough and detailed critique of LtG was made by science writer Ronald Bailey, first in an article in *Forbes* in 1989, then in a book in 1993 under the title *Eco-Scam: The False Prophets of Ecological Apocalypse*. Chapter 4, pages 63−78, titled "The Depletion Myth," is devoted in particular to LtG.

LtG author Dennis Meadows responds to some of the critiques in the preface of LtG 2004:ix−ii and in Chapter 1, pages 1−16. He also has an essay built partly around the original review of LtG that appeared in *The New York Times Book Reviews* in 1972 (Meadows 2007:399−415).

In 2000 the oil and energy investment banker Matthew R. Simmons posted "An Energy White Paper" entitled "Revisiting *The Limits to Growth: Could the Club of Rome Have Been Correct, After All?* This was followed in 2008 by an article by Graham Turner (2008) arguing in greater detail that recent observed data seem consistent with many of the trends in LtG, especially the "base run," or business-as-usual run.

In 2011 Ugo Bardi, a physical chemist and member of the Association for the Study of Peak Oil, came out with *The Limits to Growth Revisited*. Bardi goes into substantial detail on several major questions raised in the debates around LtG including the nature of systems dynamics models, how economists and physical scientists differ in their views of resources, peak production curves, whether mineral resources – including oil – are limited, and whether technological change could be sufficient to offset possible shortages. Bardi's book includes a lengthy bibliography leading to most of the sources



one would need to deepen one's knowledge of LtG and the debate around its assumptions, methods and conclusions.

In 1980 Jeremy Rifkin came out with *Entropy: A New World View*. Without computer simulations Rifkin argued that the Second Law of Thermodynamics – which he called the Law of Entropy – means there are "limits that place constraints on human action in the world" (1980:Author's Note). Rifkin explored various aspects of technological and economic development within a framework parallel to that of LtG. In 1977 anthropologist Marvin Harris had raised similar issues in his book *Cannibals and Kings: The Origins of Cultures*. Drawing on the research from several disciplines, Harris suggested that much of human prehistory and history could be understood as a series of intensifications, depletions, innovations, and collapses. Population growth, increasing control over energy sources, inequality, and technological innovations were the driving forces of the sequence. Harris used this approach to explain the origins of agriculture, the rise of ancient states, the industrial revolution, and the collapse of several ancient cultures such as the Maya of Central America. Harris called his next-to-last chapter "The Industrial Bubble." He warned that we were squandering resources in a period of intensifications that could lead to "the possibility of deep impoverishment," something akin to the collapse of the LtG models with which he was apparently not familiar. He did, however, cite a paper by Cornell Entomologist David Pimental *et al* published in *Science* in 1975 (Vol. 190, page 758; also Pimental 1976) that estimated if the entire world used petroleum at the per capita rates of the United States, all then known oil supplies would be exhausted in eleven to thirteen years (Harris 1977:189).

Perhaps for now, the physical chemist Ugo Bardi (2011:84) should have the last word: "…the world's resources are limited, a consequence of the way the universe is built."

References Cited

Bailey, Ronald. 1989. Dr. Doom. *Forbes*. October 16, p. 45.

Bailey, Ronald. 1993. *Eco-Scam: The False Prophets of Ecological Apocalypse*. New York: St. Martin's Press.

Bardi, Ugo. 2011. *The Limits to Growth Revisited*. New York: Springer.

Blanchard, Elodie Vieille. 2010. Modelling the Future: an Overview of the 'Limits to Growth' Debate. *Centaurus* 52:91−116.

Carson, Rachel. 1962. *Silent Spring*. Boston: Houghton Mifflin Company.

Costanza, Robert, Rik Leemans, Roelof M. MJ. Boumans, and Erica Gaddis. 2007. Integrated Global Models. In Robert Costanza, Lisa J. Graumlich and Will Steffen, eds. *Sustainability or Collapse? An Integrated History and Future of People on Earth*. Cambridge, MA: The MIT Press in cooperation with Dahlem University Press. Pp. 417—445.

Harris, Marvin. 1977. *Cannibals and Kings: The Origins of Cultures*. New York: Random House.

Limits to Growth: The 30-Year Update. Synopsis. https://systemicalternatives.org/2017/08/30/a-synopsis-limits-to-growth-the-30-year-update/

Meadows, Dennis L. 2007. Evaluating Past Forecasts: Reflections on One Critique of *The Limits to Growth*. In Robert Costanza, Lisa J. Graumlich and Will Steffen, eds. *Sustainability or Collapse? An Integrated History and Future of People on Earth*. Cambridge, MA: The MIT Press in cooperation with Dahlem University Press. Pp. 399—415.

Meadows, Donnella. 2008.*Thinking in Systems: A Primer*. White River Junction, Vermont: Chelsea Green Publishing. Edited by Diana Wright.

Meadows, Donella H., Dennis L. Meadows, Jørgen Randers, and William W. Behrens III. 1972. *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. New York: Signet Classics.

Meadows, Donella, Jørgen Randers and Dennis Meadows. 2004. *Limits to Growth: The 30-Year Update*. White River Junction, Vermont: Chelsea Green Publishing Company.

Pimental, David, William Dritschilo, John Krummel and John Kutzman. 1975. Energy and Land Constraints in Food Protein Production. *Science* 190:754-61. https://www.jstor.org/stable/1741584?seq=1&cid=pdf-reference#references_tab_contents

Pimental, David. 1976. Expert Says Only Hope to Feed World Is with Food Production Unlike That in U.S. *The New York Times*. December 8.

Rifkin, Jeremy. 1980. *Entropy: A New World View*. With Ted Howard. New York: The Viking Press.

Simmons, Matthew R. 2000. Revisiting *The Limits to Growth*: Could The Club of Rome Have Been Correct, After All? https://www.mudcitypress.com/PDF/clubofrome.pdf

Turner, Graham. 2008. A comparison of *The Limits to Growth* with 30 years of reality. *Global Environmental Change* 18:397—411.