The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Dennis Meadows - Economics and Limits to Growth: What's Sustainable?

Posted by Gail the Actuary on January 4, 2010 - 10:27am
Topic: Economics/Finance
Tags: dennis meadows, limits to growth [list all tags]

Dr. Dennis Meadows is one of the authors of the well-known 1972 book "Limits to Growth," plus two updates of the book. He has received a number of awards for his work, most recently the prestigious Japan Prize from the Science and Technology Foundation of Japan.

Dr. Meadows recently gave a talk for the Population Institute. Both the presentation and a podcast of Dr. Meadows giving his talk can be downloaded from the Population Institute site. In this post, I summarize what I understand Dr. Meadows to be saying in that talk. Readers with time are encouraged to listen to the Podcast and look at the presentation themselves. Dr. Meadows did not cover all of his slides in his talk. This post relates only to those that he did cover.

The number one take-away for me from this talk is **The end of growth does not come from depletion, but from rising capital costs.** In some ways, this is intuitive. When you put this statement together with the work I have been doing that shows that debt cannot continue rising in the face of peak oil, it makes this issue even more important.

A second major take-away for me (besides the importance of population in the equation) is **Changes in technology may delay the end of growth by a few years, but they do not avoid it, and do not avoid the decline.** A third observation I found interesting is that the biggest stresses are likely to occur at the time when growth ceases--that is now--not, as is popularly believed, as the result of the decline itself.

What follows is my summary of the presentation. The more technical parts are fairly close to a transcript. For precisely what was said, I recommend the recording itself, free from i-tunes. The application runs on MacIntosh machines. I am not certain about Windows.

Economics and Limits to Growth: What's Sustainable?

Dennis Meadows
at
The Population Institute
Washington, DC
October 6, 2009

Slide 1

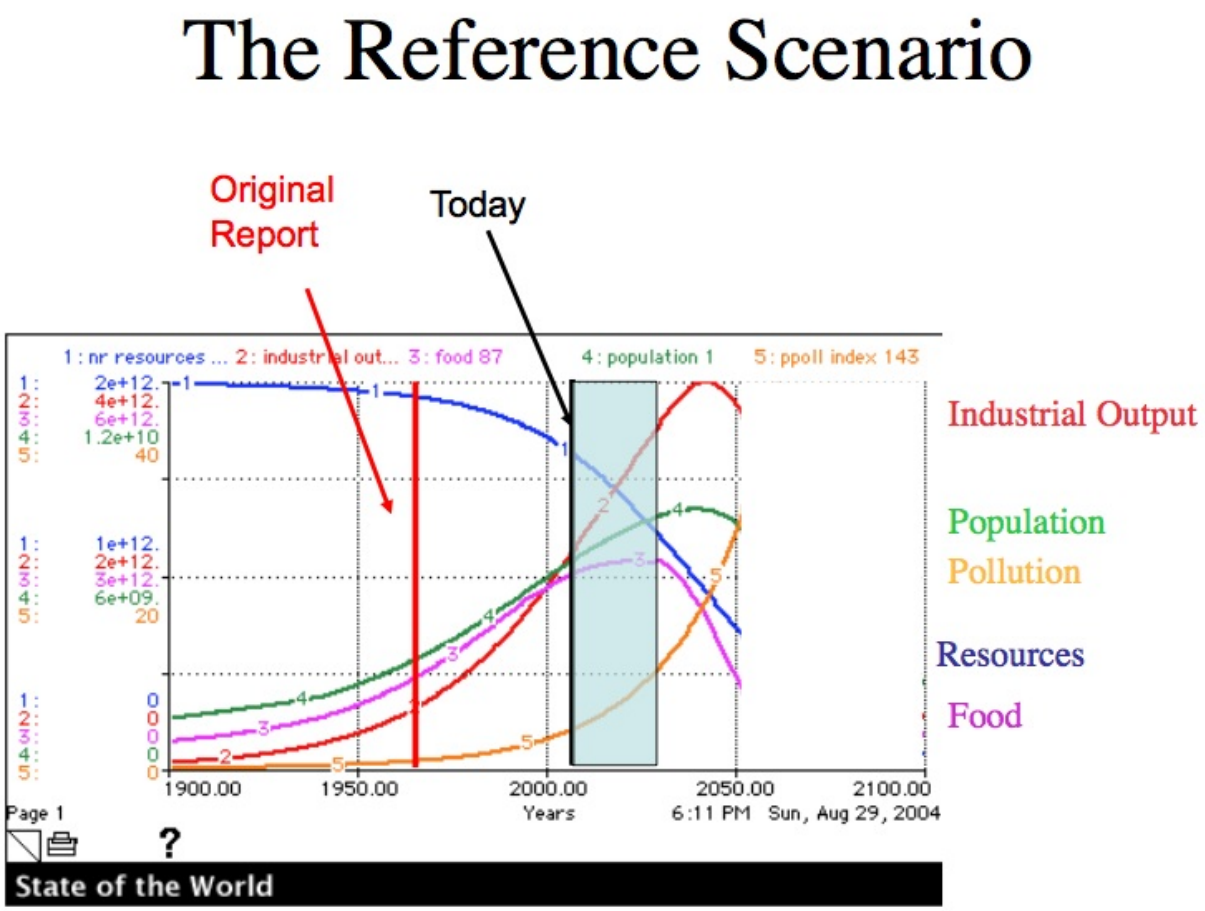
The reason I [Dr. Meadows] am giving this talk is because I think that there is the possibility of positive change.

Much of the way that we conduct ourselves is based on habit. For example, we get into the habit of crossing our arms with our right hand (or left hand) on top. It is not that putting the right hand or left hand on top is better or worse. We have just developed a habit of crossing our arms in a particular way.

If we are going to solve the population problem, we need to learn new habits. I am hopeful that like learning to cross our arms in a different way, we can inspire people to learn new habits that will limit population growth--something that is needed with finite resources.

My [Dr. Meadows'] views regarding what is sustainable are different now than they were 40 years ago. At that time, I worked with others at Massachusetts Institute of Technology to build a simple computer model that might offer some insight into the impact of limits to growth. We did not expect the model to be predictive--only that the scenarios might provide a rough boundaries regarding what might happen in the future.

In our reference scenario in 1972, we expected growth to continue for 40 to 80 more years. The major difference I see in looking at the situation now is that things seem to be developing more rapidly than we expected then.



Slide 2

Let's start by looking at our reference scenario. The red line shows where we were when the model was first developed. I have blocked out the fourth quadrant of the chart, because the world situation is likely to be so different from the situation we modeled that the model is likely to be totally irrelevant. The area shaded in light blue represents the time period that might possibility be changed by the policies we implement today.

Main Insights from the Scenario

- In 1972 we expected another 40-80 years of growth.
- All our scenarios showed growth ending in the period 2010-2050.
- The preponderant mode was overshoot and decline, not gradual slowing within a limit.
- Changes in technology may delay the end of growth by a few years, but they do not avoid it, and they do not avoid the decline.
- Social changes are essential for the attractive futures.
- What are today considered to be problems are actually symptoms. The real problem is physical growth in material and energy flows pressing against the limits of a finite planet.

Slide 3

In 1972, we expected another 40 to 80 years of growth in the various scenarios. While some of the scenarios we looked at ended in orderly decline, most of the scenarios we modeled ended in collapse. This likely outcome was later confirmed by William Catton in his book *Overshoot*.

You will note I say that technology may delay the end of growth a few years, but it does not avoid the end of growth or the decline. I have worked in science and technology, and I have a scientific degree, so I am not saying this because I am unaware of what technology can do. When we put together models using phenomenally optimistic assumptions, it just moved the decline date back a few years.

Social changes are essential for a better outcome. Take population for example. There are two ways population can decreased:

1. The birth rate can go down, or
2. The death rate can go up.

A key factor to understand is that what are normally considered problems today--for example, climate change, energy shortages, and erosion, aren't really problems. Instead, they are symptoms of attempted infinite growth in a finite world.

In some ways, the situation is like if you have a friend who has cancer, and because of the cancer he has a headache. It is not nice to have a headache, so you give your friend pain relievers, but

you don't imagine you have cured the problem. The problem is cancer, and until you deal with the problem, there will be one or another manifestation, such as a head ache.

We talk a lot about climate change today. I predict that in three or four years, we won't be talking about climate change. We will be talking about energy scarcity or food shortages or declining water supplies. This will occur not because we have dealt with climate, but because it is one of a large family of pressures which are going to mount until finally physical growth stops.

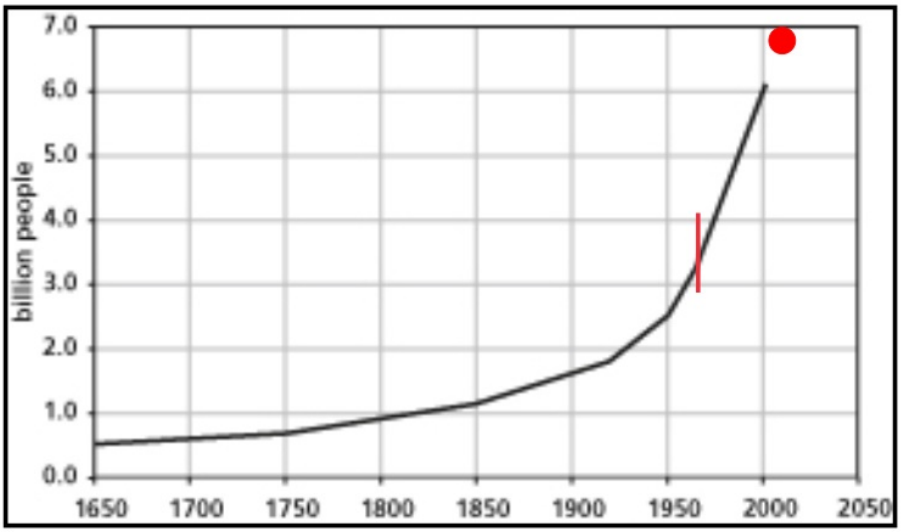
Main Points of My Speech

- Growth has continued until we are now past sustainable levels.
- The global society will change more over the next 20 years than in the past 100. Design policies for what is coming, not what has been.
- The main forces for change will be climate change and resource scarcity - especially fossil fuels and water.
- The end of growth does not result from total depletion, but from rising capital costs.
- The most important scarcity is the absence of a longer-term perspective.

Slide 4

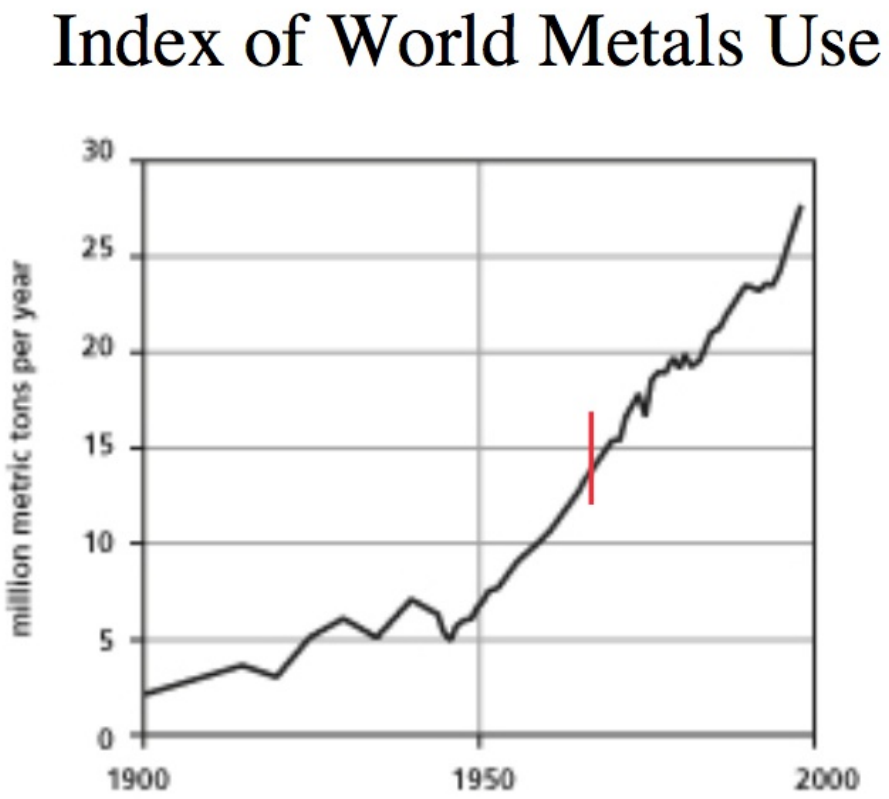
[I do not believe that Dr. Meadows spoke directly about this slide, but I thought it was important for completeness.]

World Population



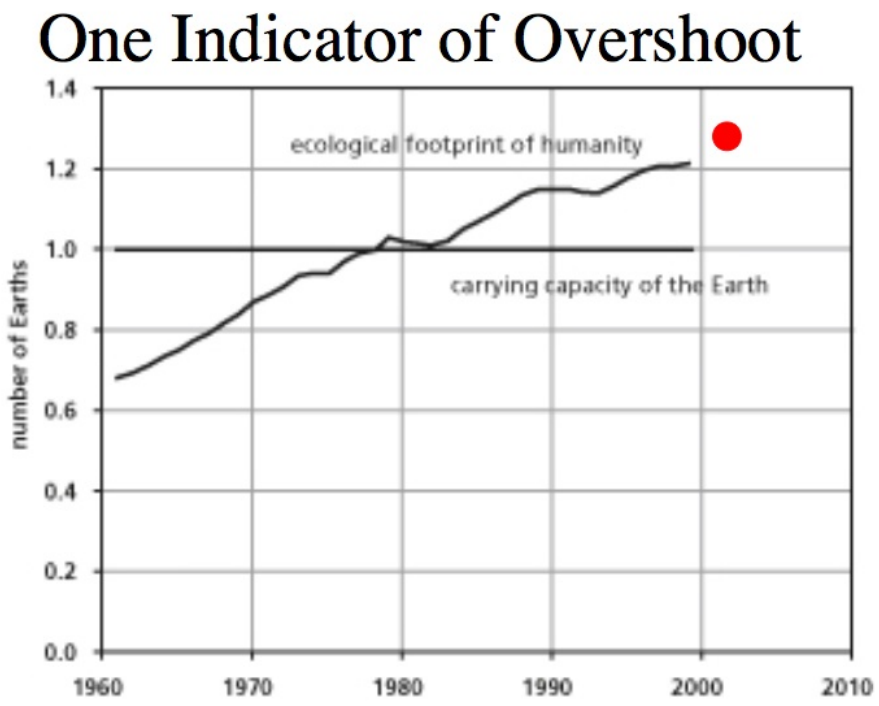
Slide 5

World population has been rising rapidly, and in our models, continues to rise.



Slide 7

World metal use is also rapidly increasing.

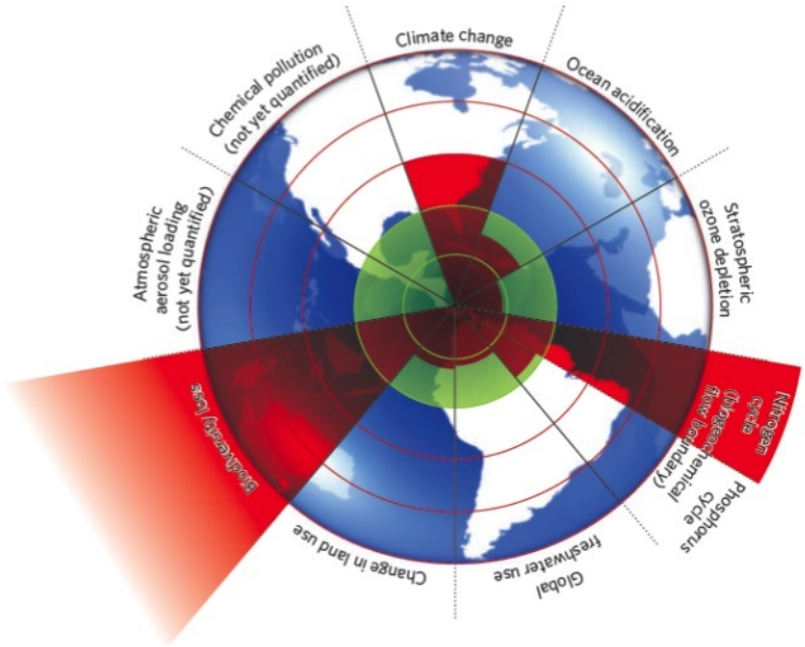


Slide 9

We have now reached overshoot. According to Wackernagel's analysis, we passed global capacity in 1980, eight years after our book was published. We are now about 40% above carrying capacity, according to his analysis.

In the early days, we had only models to tell us we were beyond carrying capacity. Now, we can look at the newspapers and get confirmation of the fact.

Other Indicators of Overshoot



Slide 10

Kevin Noone published this image in *Nature* showing various areas where overshoot may manifest itself. Except for ozone, we are not making much progress in keeping physical stresses in limits. Some sectors appear not to have problems, but that is only because we do not have the situations quantified.

The Sequence of Objections

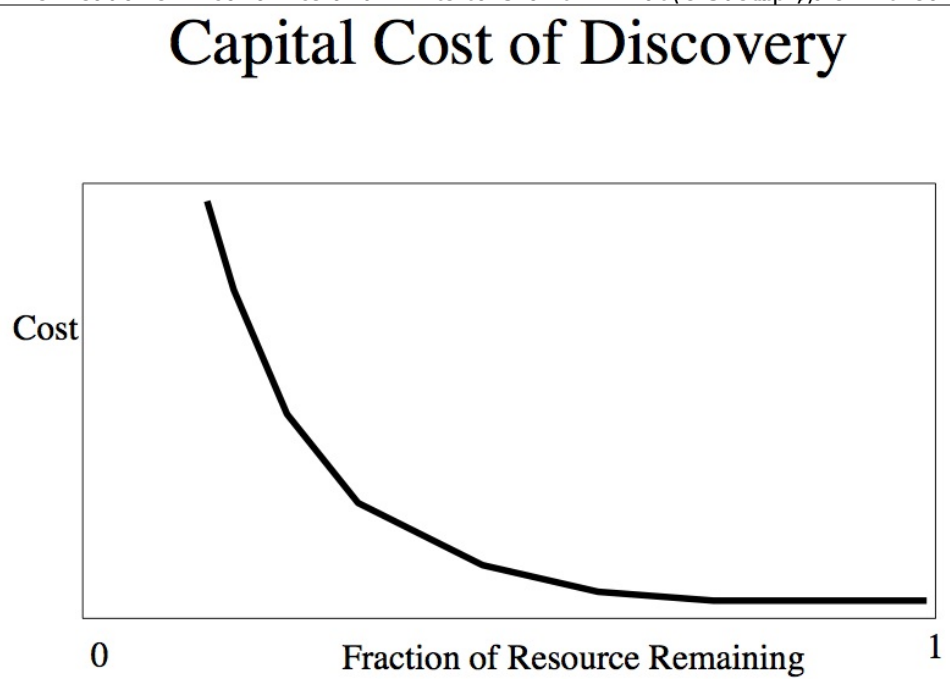
- 1970s: There are no limits.
- 1980s: There are limits, but they are distant in time.
- 1990s: The limits are near, but they are irrelevant, since they will be dealt with by the market.
- 2000s: The market is not adequate, but new technologies will let us evade the limits without requiring that we stop growth.

Slide 11

It was astonishing to me in 1972 that people could start from the assumption that there are no limits. It has been even more amazing to see the evolution to this thinking. Initially, the assumption was that people were just uninformed. The assumption was that if we can manage to give them the facts, they will change their opinion, and fall into line. Nothing I have seen in 40 years gives me support for that opinion. If you marshall enough facts to disprove an objection, then the critics will just find another objection. There are an infinite number of objections, so you are never going to come to the end of the process.

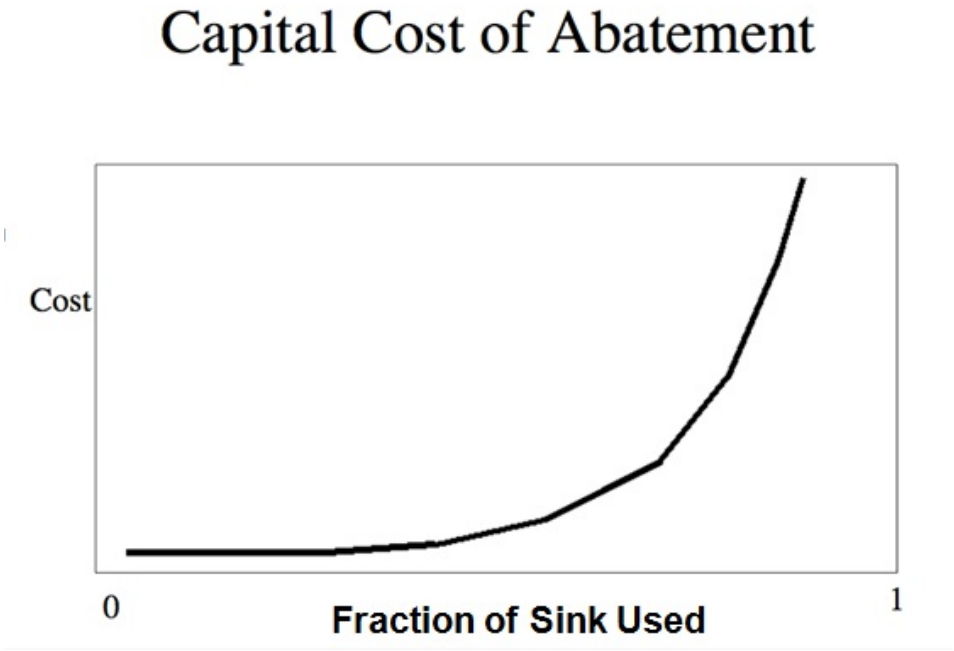
The above slide shows the sequence of objections. Now that it is clear that markets will not fix the situation, the belief is that technology will be the solution. Technology doesn't deal well with limits either. There are thermodynamic proofs of this.

Let me discuss some key assumptions in our model. William Catton mentions that there are three different ways we use space--one for extraction; one for activity; and one for basically dumping stuff. The first and third of these have costs associated with them.



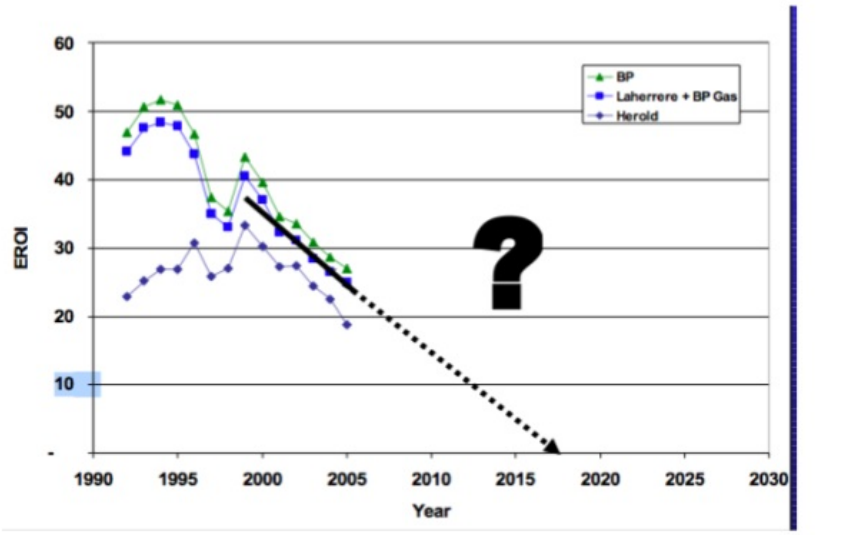
Slide 12

This is a generic curve, but I could show you empirically based versions of this curve for particular reserves. When you have 100% of a given resource, you can start to use it up, and you don't perceive any particular cost increase. It is only when you get past maybe 50%, 60% depletion that you start to see a radical rises in cost of extraction. We don't have time here, but I could explain why it behaves that way, and the reasons are not ones that can be changed by technology. Technology can shift the curve a little bit, but it can't alter the fact that well before you get to zero resource, the cost will become infinite.



Slide 13 - (Above slide has been revised from that used in the original presentation, at the request of Dr. Meadows.)

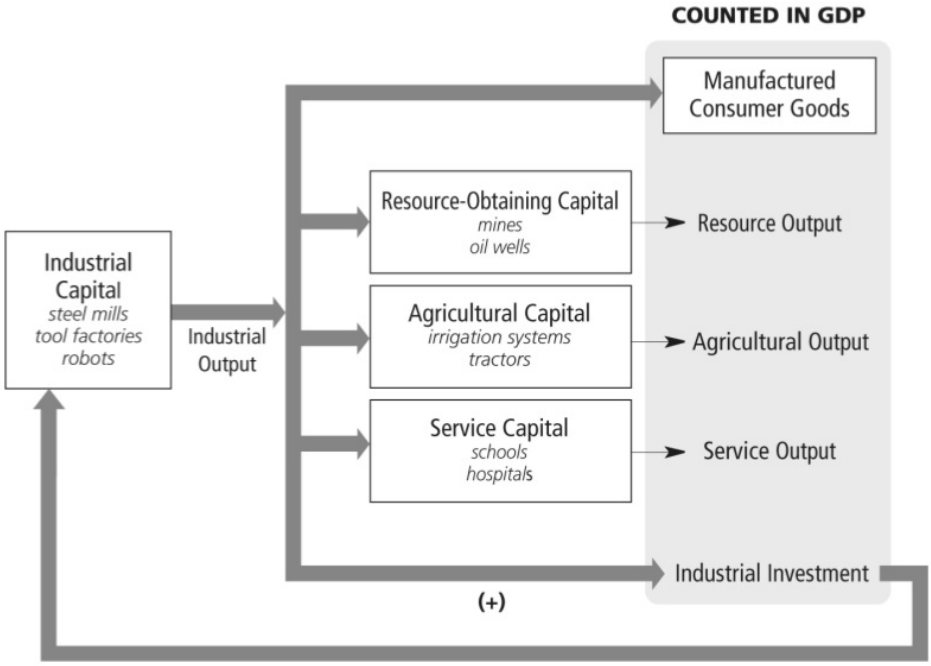
And there is an analogous curve for dumps, where we try to put stuff. As the fraction of the sink is slowly occupied to a greater and greater extent, the cost of dealing with the consequences of production goes up rapidly.



Slide 14

Here is one particular example of the effect of these curves. It is the declining return on investment of energy. We built this country with energy that gave 70:1 to 100:1 energy payback. With domestic resources, we are now down to 10:1, 15:1 or 20:1 energy paybacks. You can see the trends are moving in a way which mean that well before the middle of the century, we will be dealing with energy resources that hardly break even. What you can do with 100:1 payback is enormously different than what you can do with a system that is generating only 2:1 or 3:1 payback. It is just that in the case of fossil fuels, we have used up many of the resources.

In our book, we describe the consequences of declining energy return. I won't get into great detail here, except to point out a couple of important features of our model.



Slide 15

Industrial growth occurs because of the positive feedback loop that occurs, depicted on the above chart. More capital gives you more output; more output permits more investment; and more investment lets you build up your capital stock. As long as investment exceeds depreciation, you have growth--exponential growth, and rapid rates of increase. Depending on how equitable society is, people, at least some people, get richer.

However, as we start to draw down our resources and fill up our sinks, more and more of the capital has to be drawn off to provide for the other needs. Eventually, you get to the point where you can't sustain production around the industrial capital loop sufficiently to sustain growth.

In our world model, it is the failure of model to produce enough output for capital reinvestment that tips you over into decline. We are moving now into that period.

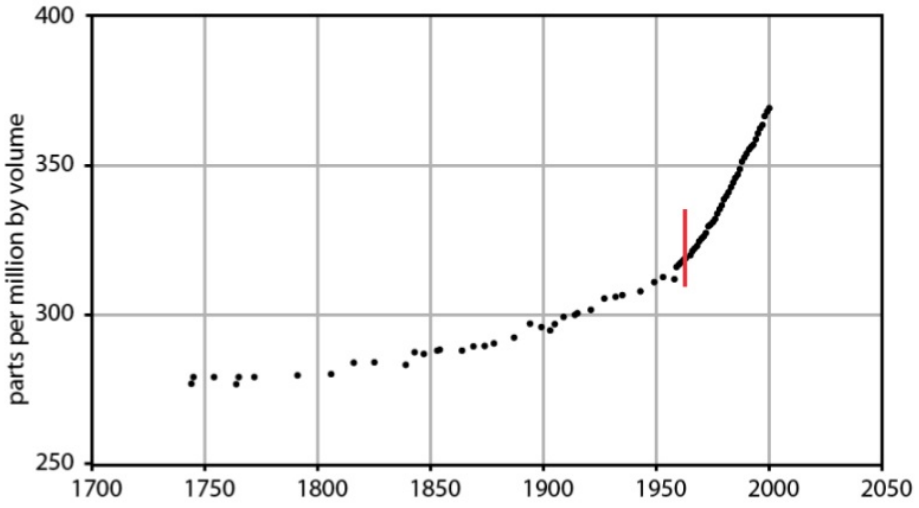
The Time of Greatest Stress

- Most people assume that the major global difficulties would occur after the end to growth.
- This is not correct.
- The globe's population would experience the most stress prior to the peak, as pressures mount high enough to neutralize the enormous political, demographic, and economic forces that now sustain growth.
- We are in the early phases of that period now.

Slide 16

Some people now looking at our curves would imagine that the periods of greatest stress would be after the peak--once the declines have set in. I don't think that is true. Right now, around the globe, we (that is corporate, political, and religious leaders) are working as hard as we can to sustain growth. For growth to stop, negative pressure have to mount until they are strong enough to offset our positive pressures. That's the period that we are in now. So I anticipate the big stresses are the ones we are going to encounter over the next couple of decades.

CO_2 Concentration

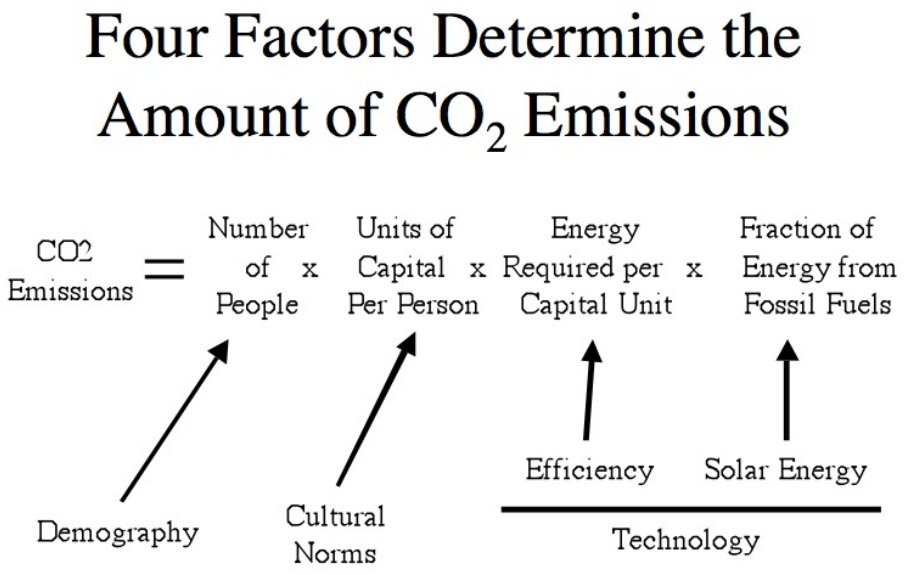


Slide 17

Let me give one very quick example in the two minutes that remain. Take CO2 concentration. Here again, we published this in 1972. You can see the red line and notice how quickly things accelerated after our book came out. No causal relationship there, but, on the other hand, it is

pretty clear that no one paid any attention either. [Note by Gail: I wonder if the shift to debt based financing in this period helped "goose" growth.]

Why is it doing this? Everyone in the world wants greenhouse gasses to go down, but, by and large, they keep going up. Not only in the United States, which didn't sign the Kyoto Accord, but in all of the countries that did sign the Kyoto Accord.



Slide 18

Well, here we see the crucial role of population. The chart shows CO2 emissions as a function of four factors:

1. Number of people.
2. Number of units of capital per person, which is a surrogate for living standards.
3. The amount of energy required to build and operate that capital.
4. The fraction of that energy that comes from non-fossil sources.

So far, our concern about climate change had manifested itself through efforts to improve efficiency and to implement alternative energy sources--the so-called technology options. I will just close by pointing out that as long as we ignore demographic and cultural issues, the growth in the first two factors will continue to offset all of the improvement we make in factors 3 and 4. And so until we can understand how to begin reducing the growth in the first two factors, climate change is a foregone conclusion.

[Dr. Meadows finished with a little clapping game to show that actions speak louder than words with respect to reducing population growth. He did not finish all of his slides--which is why I have omitted some.]

[**Postscript by Gail**. Dr. Meadows clearly sees capital somewhat differently than I have been looking at it. His model does not seem to incorporate debt. To me, it seems like debt allows resource developers effectively to obtain capital temporarily for nothing, by promising some of the future output of the positive feedback loop shown in Slide 15, including interest, back to lenders. When returns start slipping (because of the two forces Dr. Meadows mentions--higher resource extraction costs and higher costs of handling pollution sinks)--there is not enough money

to pay back money lenders, and the system starts unraveling quickly, as we have recently been witnessing.

I think that inequity in the sharing of the outputs of the resource loop shown in Slide 15 is helping the system to continue to provide the level of capital investment that is now being provided. If the outputs were being shared equally, we would find that workers would be benefiting proportionately with bankers, and rich countries would be benefiting proportionately with poor countries. Our children would have an equal chance at getting high-paying jobs that we who are parents of young adults have had. This inequity in sharing seems to me to play a big part in what funds for re-investment remain.

The recent emphasis on renewables is in the direction of causing even higher capital needs. To the extent that this takes needed capital away from unglamorous parts of the system that are necessary for the system to survive, it could lead the system to fail earlier than it otherwise would.]