

# Approaching the Limits to Growth





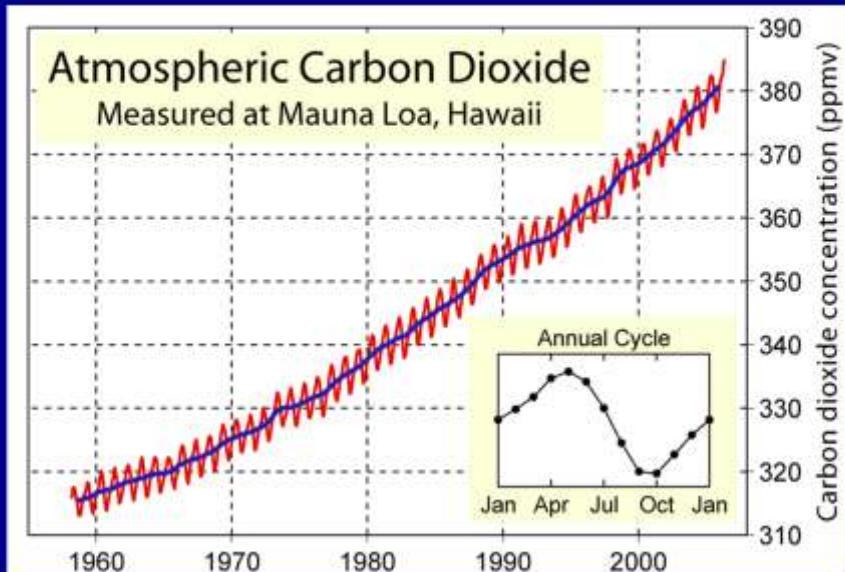
Ecological problems are caused by our prolonged unsustainable resource consumption and waste generation.

“Unsustainable” means that we conduct these activities faster than nature can cope with the consequences – faster than natural processes can replenish the resources we use or re-absorb the wastes we generate.

Of course, we also use non-renewable resources. That consumption is by definition unsustainable. Natural processes cannot replenish non-renewable resources, but they still have to deal with the waste products that result – the CO<sub>2</sub>, the mine tailings, the landfill contents etc.

I prefer the term “Ecology” to “Environment” because it makes us think of humanity as part of an interdependent planetary web of life. Our actions have consequences far beyond our own species, and affect far more than just the quality of the air, water and soil that we use for our own purposes.

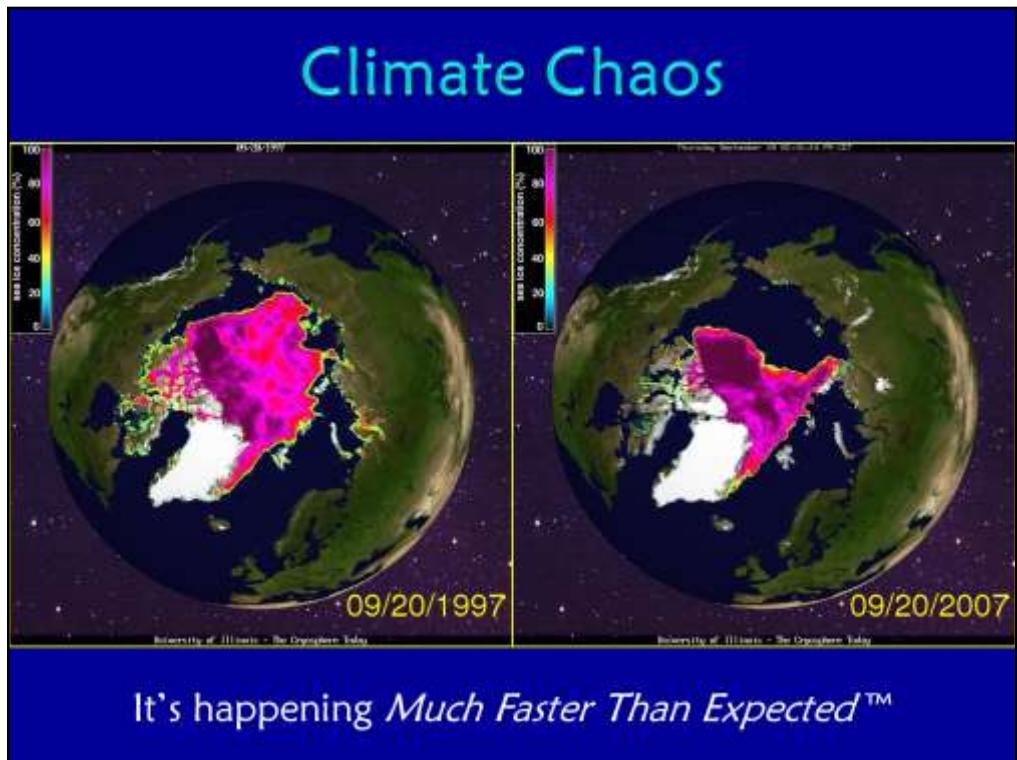
# Climate Chaos



This is the major threat everyone is aware of.

I thought it was mainly a medium- and long-term threat, but recent research into tipping points have indicated that global climate can change over a decade or two.

Atmospheric CO<sub>2</sub> is now at 394 ppm and the rate of increase is increasing.



In the last two years the Arctic Ice Cap lost a an area twice the size of France.

The Arctic Ocean may be ice-free in the summer by 2015, scientists expected this in 2040 or 2050.

Glacier flows are increasing dramatically due to water lubrication

High altitude glaciers e.g. Tibetan plateau and the Andes (water sources) are among the hardest hit

# The Death of the Oceans



The numbers of large ocean fish have fallen by 90% since 1950, and 90% of **all** fish species could collapse before 2050.

Canada's Northern Cod stocks collapsed by 99% in the quarter century leading up to the moratorium in 1992 and show no signs of recovery 15 years later.

The problem is overfishing. We are eating everything in the oceans.

It's not just the fish. The world-wide death of coral reefs is telling us we have utterly destroyed the oceans.

They will not recover so long as we continue using them as both a pantry and a garbage dump.

## Mass Extinctions



We are living in the middle of a great extinction that biologists are calling this “The Anthropocene Extinction”.

Mankind has been reducing biodiversity and causing outright extinctions for tens of millennia. The pace picked up after the development of agriculture, then accelerated again with the advent of fossil fuels.

Species are now going extinct faster than during the previous five Great Extinctions (except maybe for that asteroid...) – 75 to 200 species a day.

We are emitting carbon dioxide 10 times faster than one of the largest known volcanic eruptions – the Deccan traps – that was implicated in the Cretaceous-Tertiary extinction event 65 million years ago.

## Pervasive Pollution



This is how we all became aware of environmental problems: Rachel Carson's Silent Spring with its DDT, acid rain, the Exxon Valdez.

Canada has a growing pollution problem in Alberta due to the Tar Sands.

The world has a problem with chemical pollution of the land and the water, as well as plastic in the oceans (the Great Pacific Garbage Dump).

## Loss of Arable Land



Every year the world loses 150,000 sq. km. of cropland to urbanization, deforestation and desertification. That's an area the size of Nova Scotia, New Brunswick and Prince Edward Island combined.

## Loss of Soil Fertility and Fresh Water



About 35% of all agricultural land has been seriously damaged by intensive agriculture since WW II.

Soil fertility on the American Great Plains is half what it was a hundred years ago.

The Ogallala aquifer is being drained 100 times faster than it is being refilled.

Indian farmers have drilled 21 million water wells using oil-well technology. They take 200 cubic kilometers of water out of the earth each year for irrigation.

Over a billion people in 110 countries are now affected by desertification.

The biggest impact of Climate Change won't be rising sea levels, but changing weather patterns – droughts and floods. We are seeing the effects now, and they will get worse over the next 20 years.

## Declining Grain Supply



We have eaten more grain than we have grown in 7 of the last 8 years.

World grain stocks provided 130 days of consumption in 1986 – today, only 53 days.

Global per capita grain supply has fallen from 340 kg in 1984 to 300 kg today.

We may have maximized the yield of grains, Climate Change is cutting yields, and there are strong indications that the use of corn for biofuels is reducing the grain available for food around the world.

The United Nations FAO is now warning of growing food shortages around the world, and potentially catastrophic shortages in Africa within 15 years.

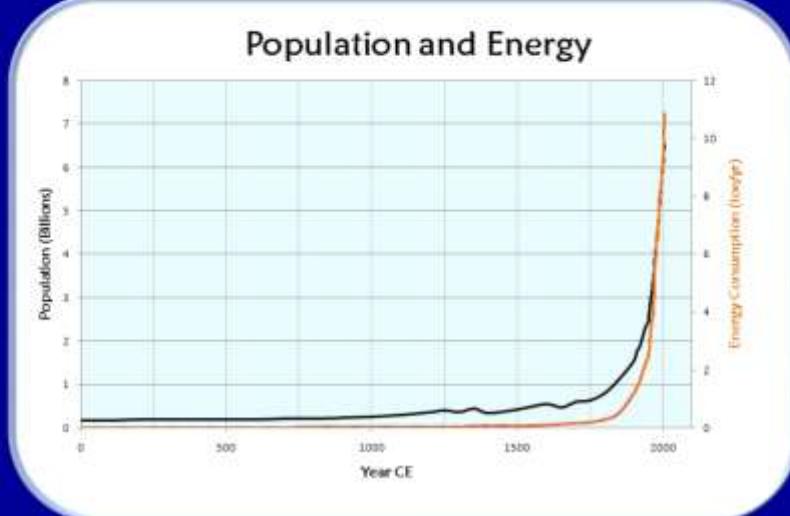
Was Thomas Malthus right after all?



The headline event is \$100 oil. What's behind that, and what does it imply for our future?

# The Story of Civilization

## The Story of Energy

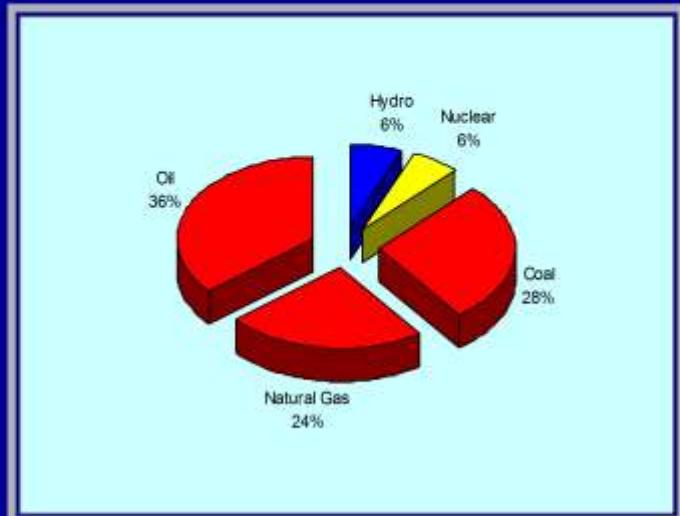


Energy is what lets our population and civilization grow.

We use food, mechanical, thermal and electrical energy.

The most important forms of energy for our civilization are oil, natural gas and electricity.

# Where Do We Get Our Energy?



60% of our energy comes from oil and natural gas.

88% of our energy is from fossil fuels.

On a global scale, renewables supply only 1% of the total energy we use.

# We Use 5 Cubic Kilometres of Oil Every Year



1000 barrels a second

85 million barrels a day

30 billion barrels a year

# How Much Energy Is That?



It's the yearly output of:

- 300 Three Gorges dams, or
- 6,000 coal or nuclear power plants, or
- 6,000,000 wind turbines, or
- 100,000,000,000 solar panels

A barrel of oil contains the energy of 20,000 hours of human labour (ten years of 8-hour days).

85 million barrels of oil a day is the equivalent of the work of over 200 billion human beings. That's like every person on the planet having 30 invisible slaves.

# Oil Is Our Master Resource

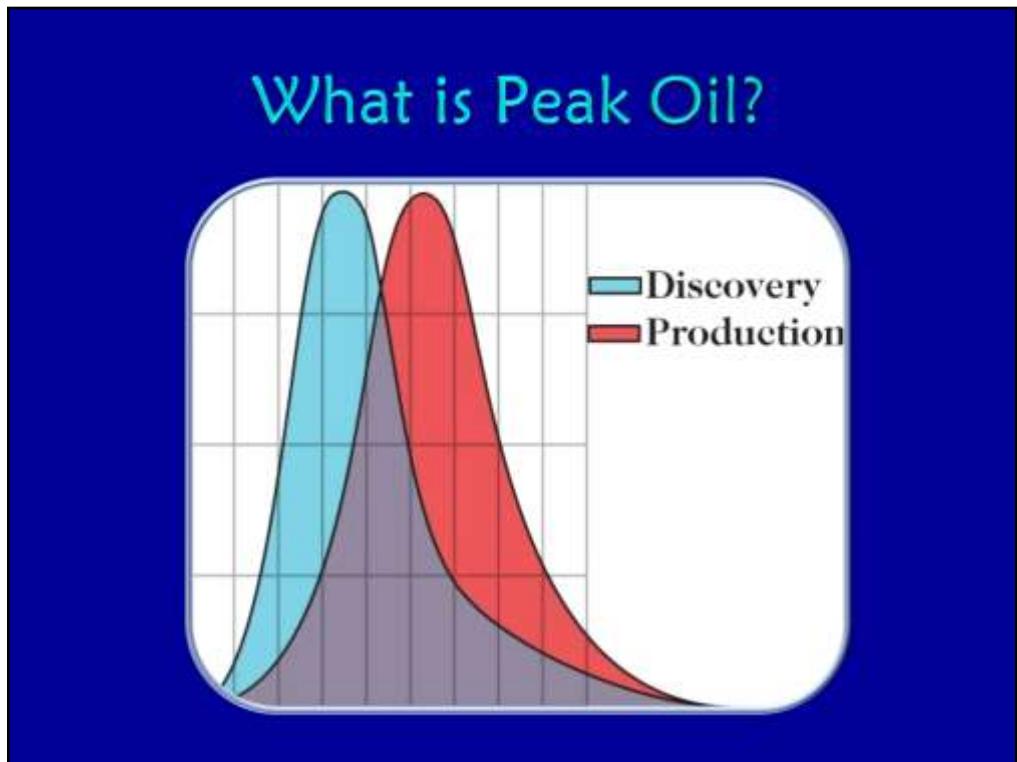
- Transportation fuel (70%)
- Heating fuel
- Asphalt
- Plastic
- Artificial fibres
- Fertilizer
- Pesticides
- Paint
- Insulation
- Adhesives
- Detergents
- Pharmaceuticals
- Look around you...



Oil is the master resource of our civilization.

Everything we do depends directly or indirectly on cheap oil.

Electricity can't replace oil in all its roles.



The production rate of an oil field follows a bell curve over time.

Production increases as the field is developed, but then slows down after **about half** the oil has been extracted.

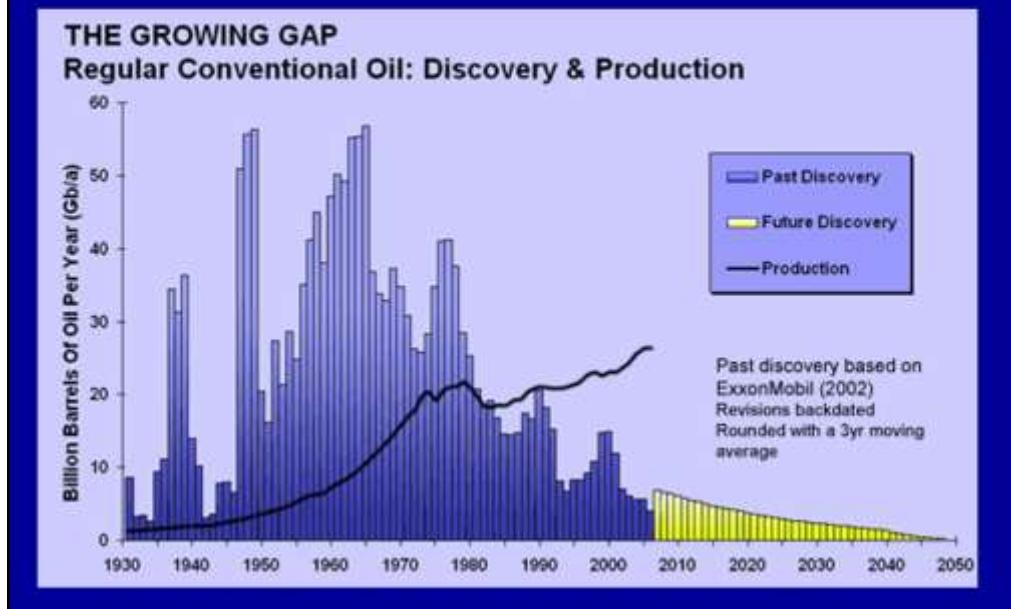
This applies to oil fields, countries and the world.

Peak Oil is a flow rate problem, not a reserves problem. We need a certain amount, every day, to keep civilization running.

It's not the size of the tank that matters, it's the size of the tap.

*We have used **about half** the world's oil.*

# Consumption Outstrips Discovery



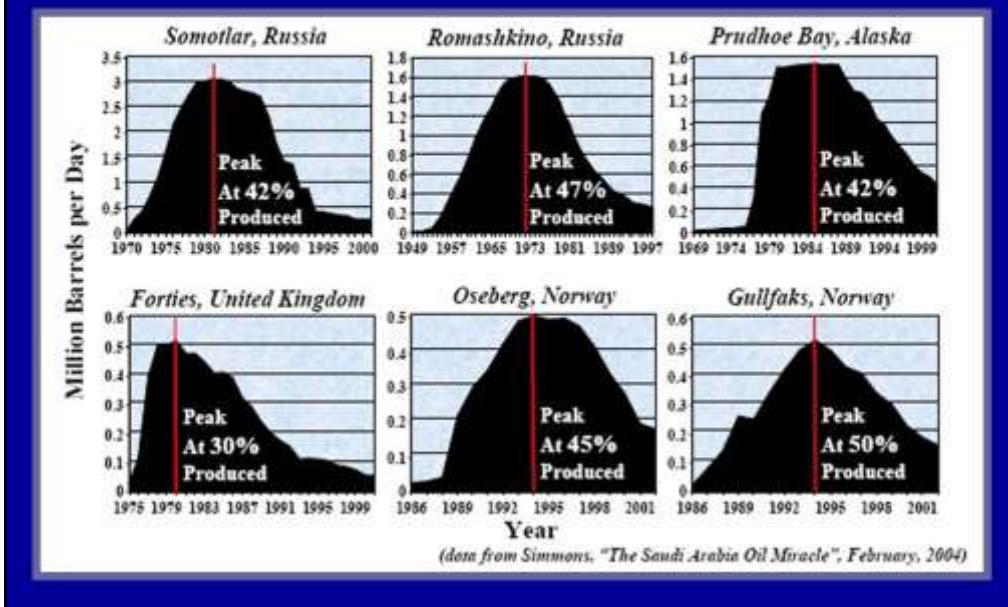
Discoveries peaked over 40 years ago.

The world has now been almost fully explored, so it's utterly unlikely that we will discover enough new oil to keep pace with our consumption.

We have been consuming more oil than we've discovered since 1985.

Today we consume 5 barrels for every one we find.

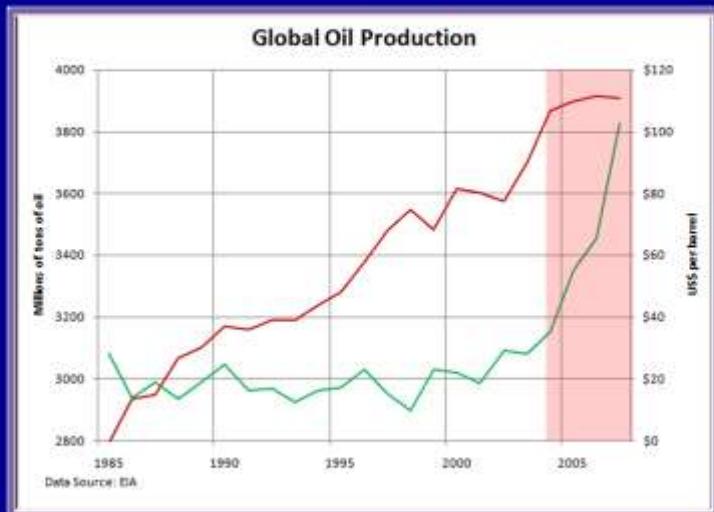
# All Oil Fields Peak



Notice how their production rates all decline after they peak.

The underlying principle of Peak Oil is that the world will behave like one huge oil field – rising over time to peak production, then entering a permanent decline.

# Is the Peak Happening Now?



Production of crude oil has been on a plateau for four years, while the price of oil has quadrupled.

Some major oil regions (USA, Mexico, North Sea) are in steep decline, and even Russia and Saudi Arabia may already be in decline.

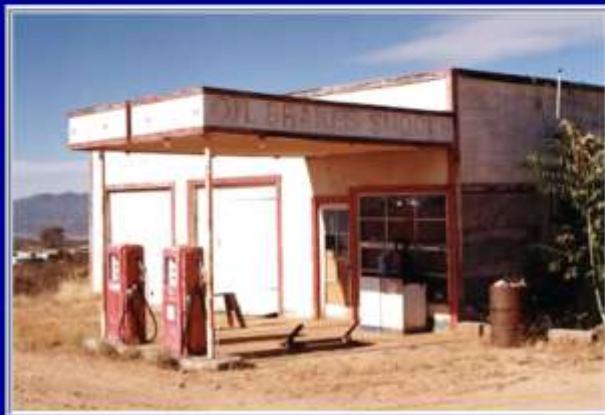
It's hard to tell what the real situation is because no oil producing nation tells the truth, the whole truth and nothing but the truth.

We will know the peak has happened for sure a couple of years after the event.

Matthew Simmons, T. Boone Pickens, Samsam Bakhtiari, Ken Deffeyes have already said they believe the peak has happened already.

# The Net Oil Export Problem

Mexico: Oil Production and Exports in 2008			
	MBPD (2007)	MBPD (2008)	YOY Change
Production	3.12	2.84	-10%
Exports	1.68	1.44	-16.3%



This is the most likely early trigger for global difficulties.

As oil prices rise, the economies of exporting countries grow.

That growth increases their domestic oil consumption.

Governments tend to satisfy domestic demand first, and export what is left over.

As their production begins to decline, their exports will fall very rapidly.

While oil production will never fall to zero, oil exports can.

There are signs this is already affecting the world export markets – China is moving from market purchases to long term contracts with suppliers.

The world oil market could be effectively empty shortly after 2030.

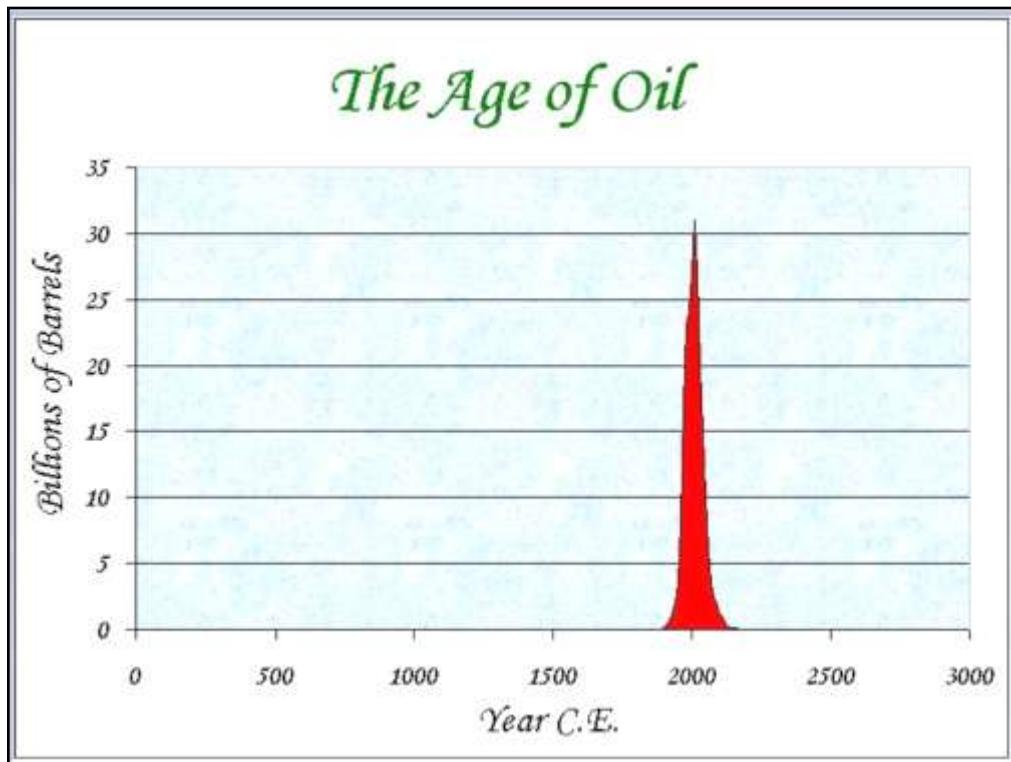
The net oil export problem will affect major importers like Europe and the USA.

As an oil exporter Canada won't have that problem, but there is NAFTA 605.

The USA will be looking north for an increasing proportion of its energy needs as suppliers like Mexico falter.

That means more pressure to develop the tar sands.

What sorts of pressure? At first political, then economic, then possibly military.



Considered over the timescale of recorded history, the era of oil use is going to be extremely brief.

The Oil Age has lasted about 100 years so far, and it probably has less than 100 years to run.

We will never completely “run out of oil”. Long before we do, oil will get extremely scarce, and as a result extremely expensive.



The global economy incorporates an assumption of perpetual growth.  
It was inevitable that it would run into some limits.

# The World Economy is Unstable



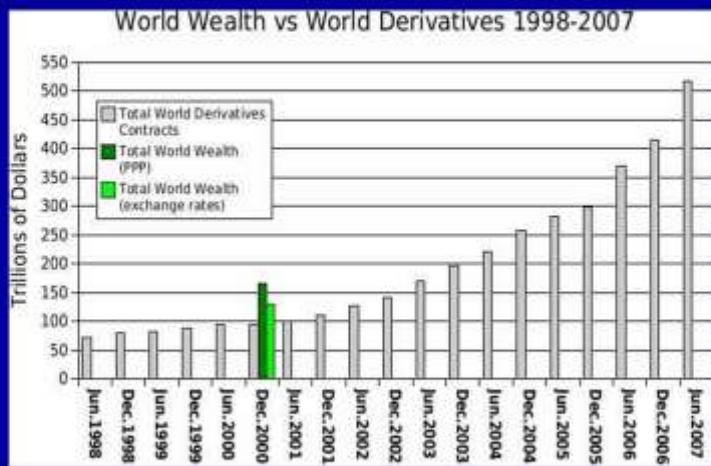
To support our economic requirement for perpetual growth the financial world has created an increasingly complex system of perpetually growing debt.

This situation is by definition unsustainable.

The debt economy is at the beginning of a massive deflationary meltdown – a global depression is becoming more and more likely.

The world's economy in 10 years is unlikely to resemble what we have today.

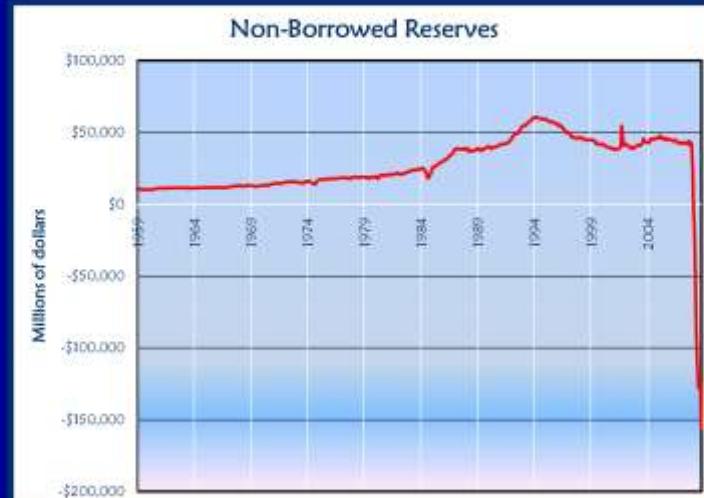
# Debt is Money



Derivatives: financial instruments that derive their value from an underlying asset (e.g. a basket of sketchy mortgages). They are often heavily leveraged – valued at many multiples of the value of the underlying asset.

The global GDP is about 60 trillion dollars, but the derivative market has a paper value of 600 trillion.

## U.S. Banks are in Trouble



## So Are Canadian Markets



The TSX has lost 30% of its value since September 1

The Dow has lost the same amount since June.

## All The Problems Interact

- Peak Oil → more coal → more Climate Chaos
- Climate Chaos → more droughts and floods → declining grain production
- Declining grain supplies → more land cleared for agriculture → desertification and biodiversity loss
- Declining economy → less capital for new energy technologies → more “old energy” like coal

The number, scope and interaction of these problems makes the whole set “hard to solve”.

These problems are known as “wicked” problems: messy, aggressive, circular and interactive.

A Gordian knot – piling on any thread just seems to tighten it.

“Hard to solve” is scientists’ code for “impossible”.

# **Shelter From the Storm**

## **How Can Individuals and Communities Respond?**

Democratically elected politicians will not be able to address the converging crisis.

Leaders that require the consent of the governed will be hamstrung by dissent, denial and resistance among their electorate. Due to the nature of democracy disruptors can't be excluded from the debate. As a result, their policy options will be quite limited, and even if leaders understand the severity of the situation they will be rendered impotent by the very nature of democracy

Non-political individuals like Al Gore or David Suzuki can influence the debate, but have limited ability to directly act on events because they are lone individuals outside the corridors of power.

As far as I can determine this means there are only two potential sources of effective action: autocrats who do not depend on consent, and consensual groups that self-select for altruism and awareness.

Individual awareness and action is the foundation of all change. However, most individuals have a limited effect on the world. To overcome this, we can form communities of interest that focus and amplify their members' actions.

As a result reasonable things can be accomplished, at least within the group's sphere of influence.

Small communities (under 150 people) have always been the building blocks of human society.

## The Doorway to Despair



Our dualistic, reductionist worldview has alienated us from the world to such an extent that the destruction of nature in the pursuit of material consumption has come to seem an acceptable, even inevitable tradeoff. Becoming aware of the damage we are doing to the world and the risks we face as a result isn't without its personal cost.

One of the possible results of looking closely at such an array of problems is a descent into negativity, depression and despair. The entire world begins to look like an enormous interlocked problem, with no possible solution. An outright collapse of civilization begins to seem not only possible, but probable. At some point in the journey, it even starts to look desirable.

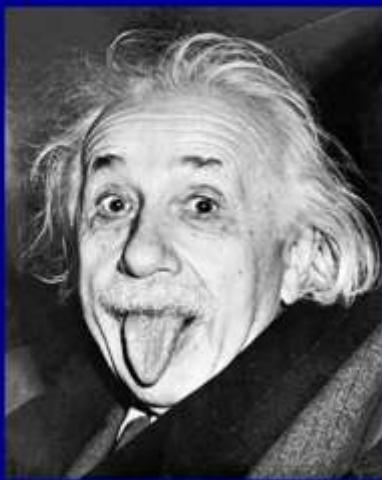
This is the path I followed for about three years.

# Humanity in the Web of Life



I came to understand that we are a part of the web of life, not apart from it. That is how we evolved for two million years. We have separated ourselves from that understanding in less than 5 thousand years. For me, this realization was crucial in coming to terms with who we are and what we are doing to the planet and ourselves. It also provided a way of looking at our actions in the world that made room for some hope. The perceptions of your connection with other human beings, and with all other life, is a very profound and reassuring feeling. There is a strong philosophical dimension to this outlook, one that is embodied in the philosophy of Deep Ecology. It can go so far as to become a spiritual position.

# The Keys to the Kingdom



**Wisdom**

**Flexibility**

Wisdom is the ability to internalize our life experiences, to bring them into alignment with the nature of the world. Wisdom is a holistic way of understanding the world as a dynamic, interactive system. We need wisdom to see through to the heart of complex situations. If we want to cope with difficulties, it's essential to deeply understand the problem. It's also essential to deeply understand the possible solutions.

Wisdom is the ability to recognize that if you have dug yourself a hole too deep to climb out of, switching to a more efficient shovel may not help.

Flexibility of mind and spirit keeps you from being overwhelmed by problems, and allows you to try different approaches if your first choice doesn't work. Wisdom helps you recognize it's not working, flexibility lets you change.

Having the combination of wisdom and flexibility means that you will make fewer bad decisions in complex situations. Developing those qualities in yourself will help you recognize and avoid dead ends, slippery slopes, and paths of no return.

## Evaluating Solution Proposals

- **Scale:** Does the proposal match the scale of the problem it addresses?
- **Timescale:** Can the proposal be implemented in time?
- **Capital Requirements:** Will enough capital be available to implement the proposal?
- **Side Effects:** Are there effects beyond the problem domain?
- **Constituency:** Will controlling stakeholders champion or at least support the proposal?

Here are five criteria I use when evaluating proposed solutions.

To be considered a general solution a proposal must pass all five.

Capital requirements are a growing concern for energy projects.

Most energy or environmental proposals I've seen fail two or more criteria.

A proposal may provide a niche solution without being a general solution.

Proposals have different chances in different regions, largely due to scale and constituency.

## Example: Proposed Substitutes For Oil

- Biofuels
  - Side Effects. Put food in our gas tanks???
- Liquids from Coal
  - Side Effects (pollution), Scale.
- Hydrogen
  - Infrastructure: Capital, Timescale.
- Electricity
  - Maybe. Electrified rail and urban mass transit (but nuclear power has problems with Constituency).

Biofuels: low net energy, competes with food

Coal To Liquids: pollution, scale – applies to tar sands as well

Hydrogen: most of it comes from natural gas, which is already in decline in North America.

Electricity: a 4% oil decline = 250,000 wind turbines?

All have **major** problems with scale, timeframe, capital requirements or environmental consequences.

This is an example of how to apply the five criteria top proposed solutions. All these may make some sense at some scale for some purposes. None of them can provide a general solution to a global oil shortage or climate change.

There appear to be very few realistic general solutions, because the problems are so wicked. There are smaller, gentler approaches that may do a lot of good. Let's look at some, starting with individual actions.

## The Usual Suspects

- Change your light bulbs? Insulate your house!
- Travel less
- Buy local food, goods and services
- Join a green electricity supplier
- Start a vegetable garden
- Reduce/reuse/recycle/repair
- Avoid overpopulation
- Eat less meat
- Get out of debt
- Become active in community groups
- Throw block parties (get to know your neighbours)

All action starts with the individual, so here are some ideas for things you can do to make your own life less expensive, more secure and more fulfilling.

There are many, many lists of actions and ideas like this on the Internet.

In addition to these, I want to present some less common ideas that might spark your thinking about individual and community responses.

## A Place: Kerala

- A state in south-western India
- 30 million people, average income \$500
- Despite that, Kerala has a very high quality of life:
  - A total fertility rate of 1.7 (not 2.9)
  - Infant mortality of 12 per 1000 (not 65)
  - Life expectancy of 73 years (not 64)
  - High levels of education
  - Excellent health care
  - Matrifocal social values
- Kerala is proof that high quality of life *can* co-exist with low consumption

People worry that the looming crisis may reduce their quality of life as well as their standard of living.

The Indian state of Kerala is evidence that this is not inevitable. With the right social policies and strong communities, quality of life can be maintained even if incomes drop substantially.

“Money doesn’t buy happiness.” Repeated studies have shown this. Family, community and getting enough sleep make you happier than money.

## A Movement: All of Us

- There are one to two million independent, local citizens' groups devoted to environmental and social justice issues.
- “*The largest social movement in the history of the world.*”
- It's **not** an organized movement.
- It is our natural response to increasing problems in society and the biosphere.
- These groups are “*Gaia's antibodies*”

The movement already exists.

It has been described by Paul Hawken in his book “Blessed Unrest”.

Each group works on local issues of its own choice.

These groups exist in every city in country on earth regardless of how tyrannical or democratic, rich or poor they are.

There is no global organization or leadership. There is no “white male vertebrate leader” setting the agenda.

## Why is the Movement Important?

- The movement is resilient.
- Its values are those of sustainability:
  - Cooperation, not competition
  - Nurturing, not exploiting
  - Consensus, not hierarchy
  - Recognition of interdependence, respect for all life
  - Acceptance of limits
  - Universal justice

Their independence makes them resilient, their wide distribution means that they will survive hard times.

They help mitigate existing problems now.

They are perfectly positioned to be the seeds of a new sustainable civilization, if such a thing is needed.

We can all participate to any extent we desire.

## A Philosophy: Permaculture

- An agro-ecological design theory
- Permanent and sustainable agricultural practices
- Expand biodiversity, reduce ecological damage
- Integrates human needs into the biosphere
- Holistic, system-oriented, respects limits
- Large movement with groups in North America and Europe (including Ottawa)

Agriculture is the single most ecologically damaging human activity.

Permaculture is a response to the ecological problems of mechanized industrial agriculture.

## A Technology: Terra Preta



### The miracle of charcoal:

- Improves soil fertility
- Sequesters carbon
- Simple and scalable

It's one of the most encouraging technologies I've discovered – better than solar panels, better than wind turbines, even better than genetically engineered soybeans.

Terra Preta is the intentional use of charcoal in soils.

**Terra preta** means “dark soil” in Portuguese. It refers to expanses of very dark, fertile patches of soil found in the Amazon Basin. It owes its name to the very high charcoal content of the soil.

Charcoal provides a home for huge numbers of microbes and fungi that improve soil fertility. It also acts as a soil amendment – it's alkaline and over time improves soil consistency by retaining water

Terra preta soils are typically 2-3x more fertile than raw soil.

The carbon in charcoal stays underground for thousands of years. This is the definition of “carbon sequestration”.

A hectare of soil could sequester up to 150 tonnes of carbon. That would reduce fertilizer needs and improve crop yields.

Charcoal can be made at any scale, from factories to back yards.

# An Economy: Barter and Local Currencies

- Local or community currency:
  - A community can establish its own medium of exchange.
  - Allows varying goods to be traded more easily than by barter.
- Barter:
  - Goods and services are traded directly with no medium of exchange.
  - Barter is easier for informal transactions – only two people need to agree on value.
- They are legal, but the tax man hates them both.

Local currencies and barter economies give individuals and communities more control over their own economic activities.

They become extremely important in times of economic crisis.

Computers and the Internet make them easier to implement and manage.

Many local currencies already exist (e.g. the Toronto Dollar) but most are tied to the regular currency system.

If that system falters, local currencies can be easily uncoupled to function on their own.

## A Social Structure: Co-Housing



- People thrive in small, close communities.
- People need privacy and a sense of ownership.
- Group effort makes alternative energy and food production easier.
- “It takes a village to raise a child”.

Co-housing has elements of cooperatives, condominiums and communes.

Members decide how they will be structured, what the important features are, what the ownership requirements are.

They are difficult to start, but can make excellent communities.

## An Attitude: I HELP

**I**nvoke yourself: Become an antibody.

**H**umanize: Form closer ties with others.

**E**conomize: Conserve wherever possible.

**L**ocalize: Reduce travel for food, work, leisure.

**P**roduce: Some of your own food and energy.

A simple mnemonic provides a high-level reminder of the kinds of things we should think about and do in the years ahead.

## Conclusions

- The converging crisis of ecology, energy and economics is already here.
- Technical approaches may not yield general solutions.
- Wisdom and flexibility, individual and community actions are the keys to an effective response.

“I get by with a little help from my friends!”

The Beatles wrote the theme song for the coming changes.

Canada's Greatest Canadian, Tommy Douglas, reminded us, "Courage, my friends; 'tis not too late to build a better world."

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