

Can Renewable Energy sustain a Consumer Society?

- That's not the question.
- But here's the answer anyway.....

THE STORY SO FAR.....

- We reckon ourselves superior to the dinosaurs
- They managed 170 million years
- *We have managed 100,000 years*
- *Only in the last 10,000, did we move from hunter-gatherer*
- 200 years ago, there were 1 billion of us, largely agrarian
- 100 years ago, there were 1.6 billion of us, still largely agrarian
- Now there are 7 billion of us, 50% urban consumers
- But – we've 169,900,000 years to go.....

SCOPING THE PROBLEM

Finite planet:
(finite collection of resources)

One renewable energy-source:
(wind, hydro, tidal, are secondary solar)

Need to stay within life-supporting tolerances:
(a small matter of Holocene or hollow scene)

These parameters define our

LIMITS to GROWTH

Means we can consume away happily, as long as we keep forever within those limits

Which pretty much means we can't 'consume' finite resources at all – and must increasingly approach full recycling, full mitigation, and zero habitat-change the longer we continue

Which gives us the real heading for the talk:

SUSTAINABILITY

This is not a new discussion, other have been there before:

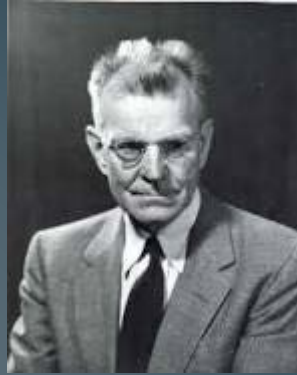
Thomas Malthus (1776 – 1834)



“No man can say that he has seen the largest ear of wheat or the largest oak that could ever grow; but he might easily, and with perfect certainty, name a point of magnitude at which they would not arrive.

In all these cases therefore, a careful distinction should be made between an unlimited progress, and a progress where the limit is merely undefined”

Marion King Hubbert (1903-1989)



“We are living in a crisis in the evolution of human and geological history.

It has never happened before, and it can't possibly happen again.

You can only use oil once. You can only use metals once.

Soon all the oil is going to be burned, and all the metals mined and scattered”

Club of Rome



The Limits to Growth



The Limits to Growth first edition cover.

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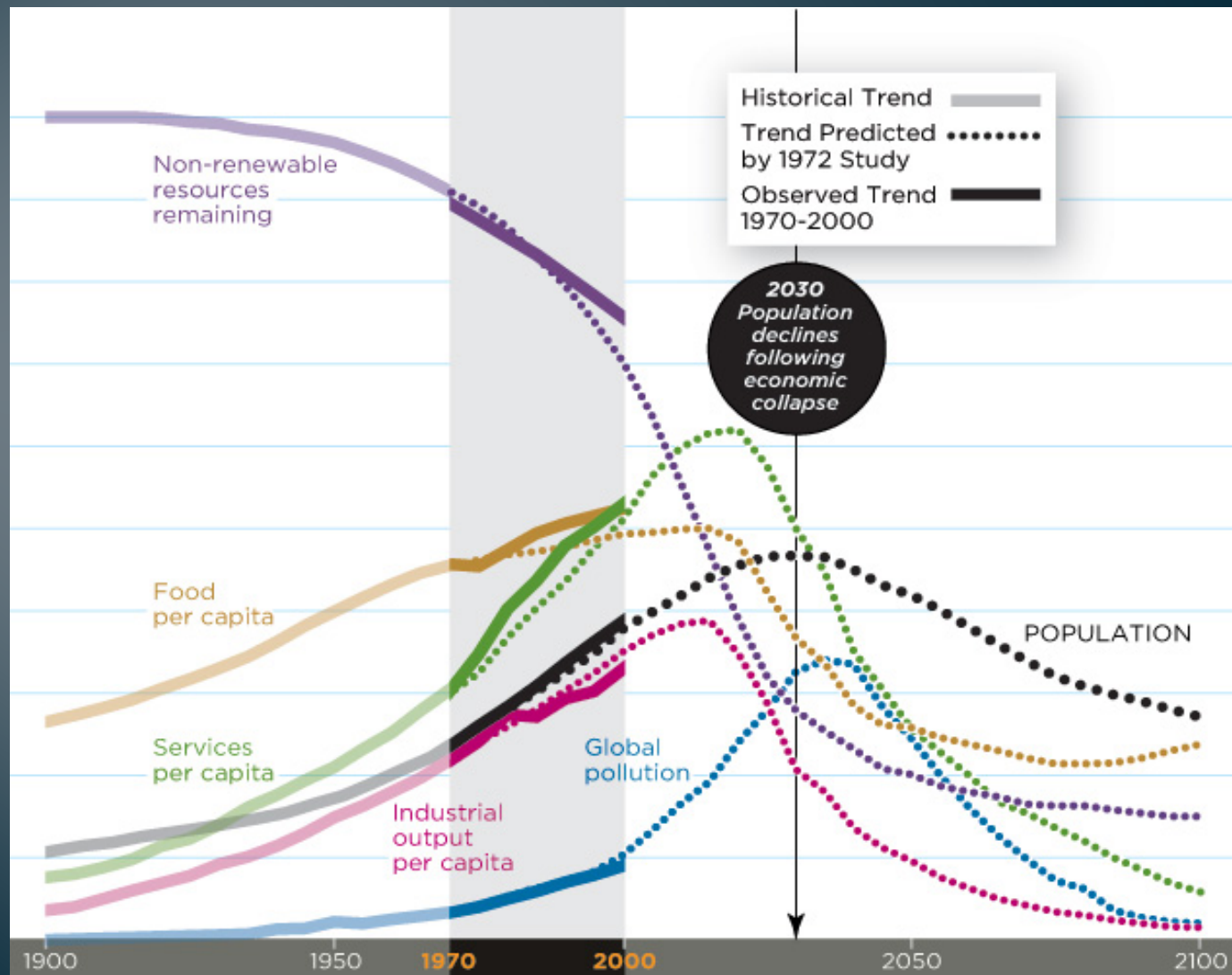
Universe Books

Publication date

1972



Limits to Growth



GROWTH

Expressed In terms of 'Doubling Time'

3% growth doubles in 24 years

10% growth doubles in 7 years

19 doublings, and you're doing a million times whatever you were doing initially

Why nobody sees it coming (chess-board, 63 moves, total wheat)

Doesn't have long to go, when the graph approaches vertical

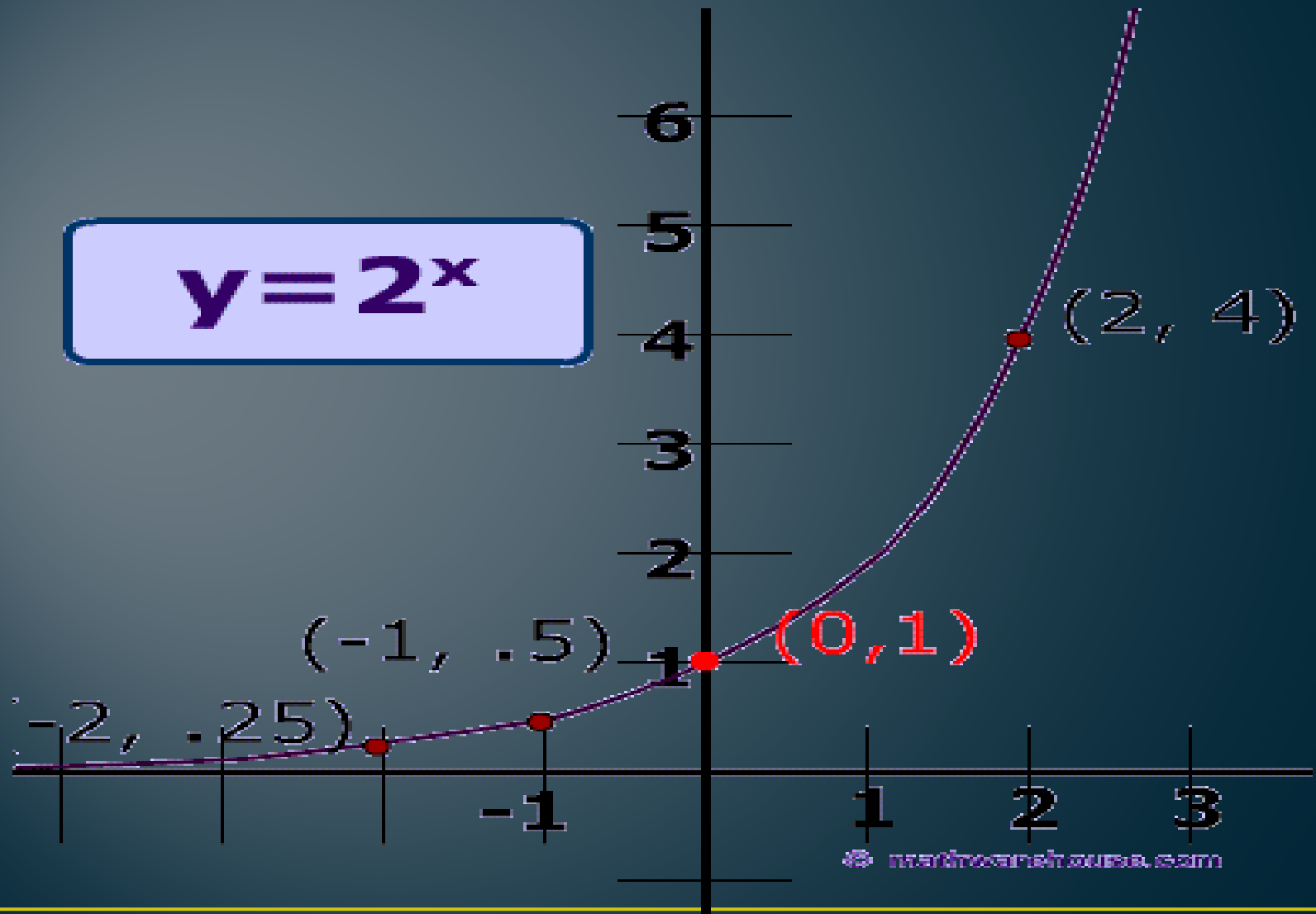
Working it backwards (gravel/shovel. 50%, 25%, 12.5%)

When applied to material things, the term "sustainable growth" is an oxymoron".

(Al Bartlett)

Doubling Time

$$y = 2^x$$

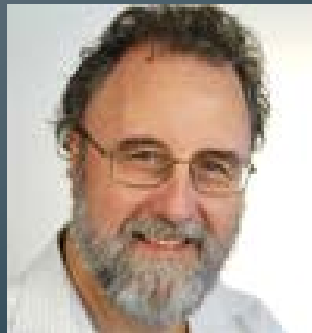


GROWTH WILL CEASE

Two scenarios; voluntary cessation, involuntary cessation

The former is preferable

Sir Robert Watson “I’d like to think we have the intelligence not to go over the cliff..... but what I’m seeing so far, doesn’t support that hope”



RESOURCES

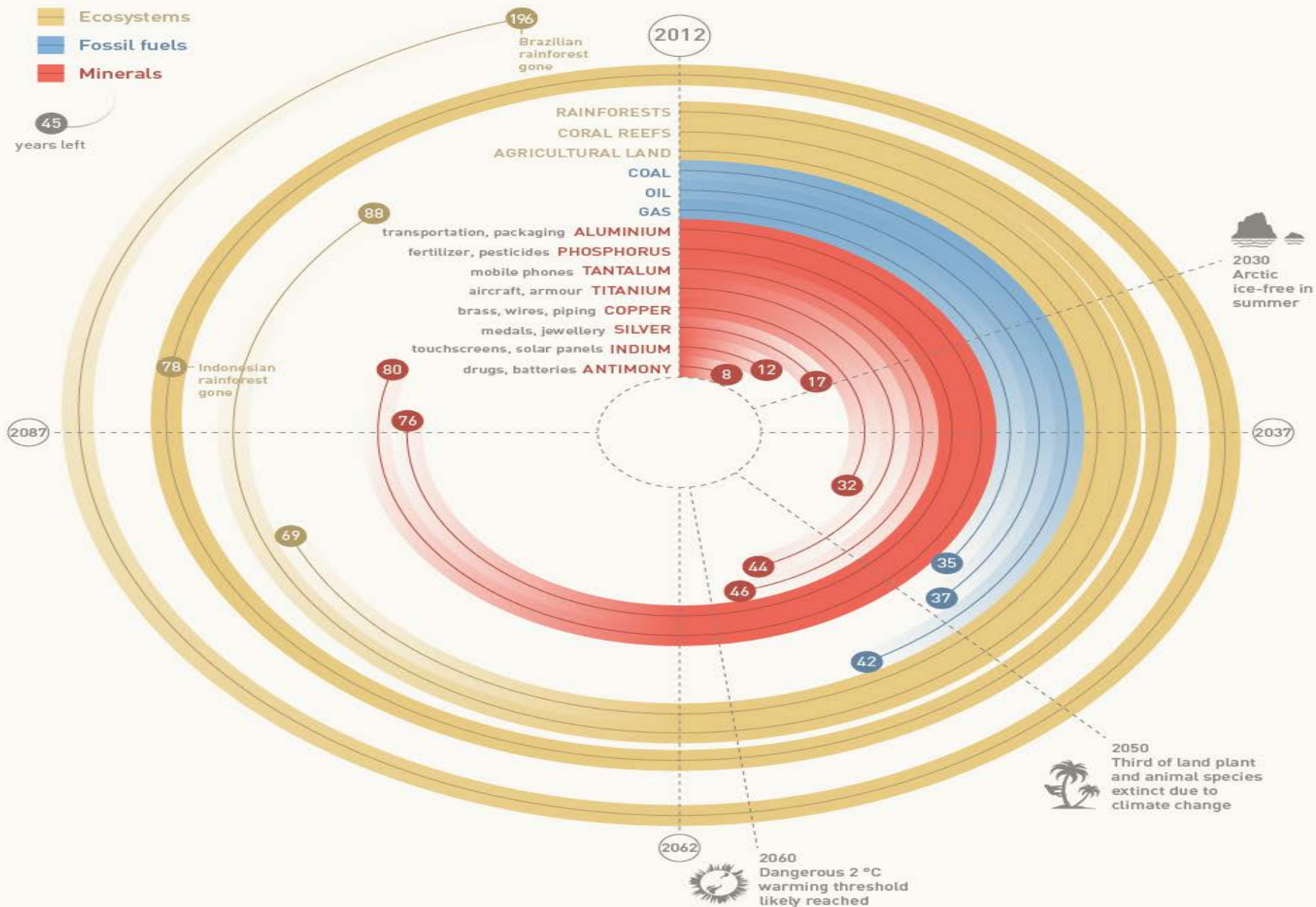
Finite or renewable

Finite options: Reuse,
 Recycle.
 (Both require energy)

Renewable options: Use at renewable rate
 Use at greater than renewable rate
 (result: misery)

Stock Check

Estimated remaining world supplies of non-renewable resources



Lifetimes of non-renewable resources for different rates of growth of consumption. Except for the left column, all numbers are lifetimes in years.

		LIFETIME OF RESOURCE IN YEARS						
ANNUAL GROWTH RATE	0%*	10	30	100	300	1000	3000	10,000
	1%	9.5	26	69	139	240	343	462
	2%	9.1	24	55	97	152	206	265
	3%	8.7	21	46	77	115	150	190
	4%	8.4	20	40	64	93	120	150
	5%	8.1	18	36	56	79	100	124
	6%	7.8	17	32	49	69	87	107
	7%	7.6	16	30	44	61	77	94
	8%	7.3	15	28	40	55	69	84
	9%	7.1	15	26	37	50	62	76
	10%	6.9	14	24	34	46	57	69
	* 0% annual growth = "at current rate of consumption"							

THE KEY RESOURCE IS ENERGY

Fossil fuels have supplied 89% of the total primary energy used throughout the world over the last 55 years, and supply 87% of the energy used today, (BP Statistical Review 2011)

There is no valid, proven, scalable replacement for fossil fuels; the accumulated store of past sunlight is too big, too compact, and our rate of using them now too great

ONE EXTERNAL ENERGY-SOURCE

Stock-piled over aeons

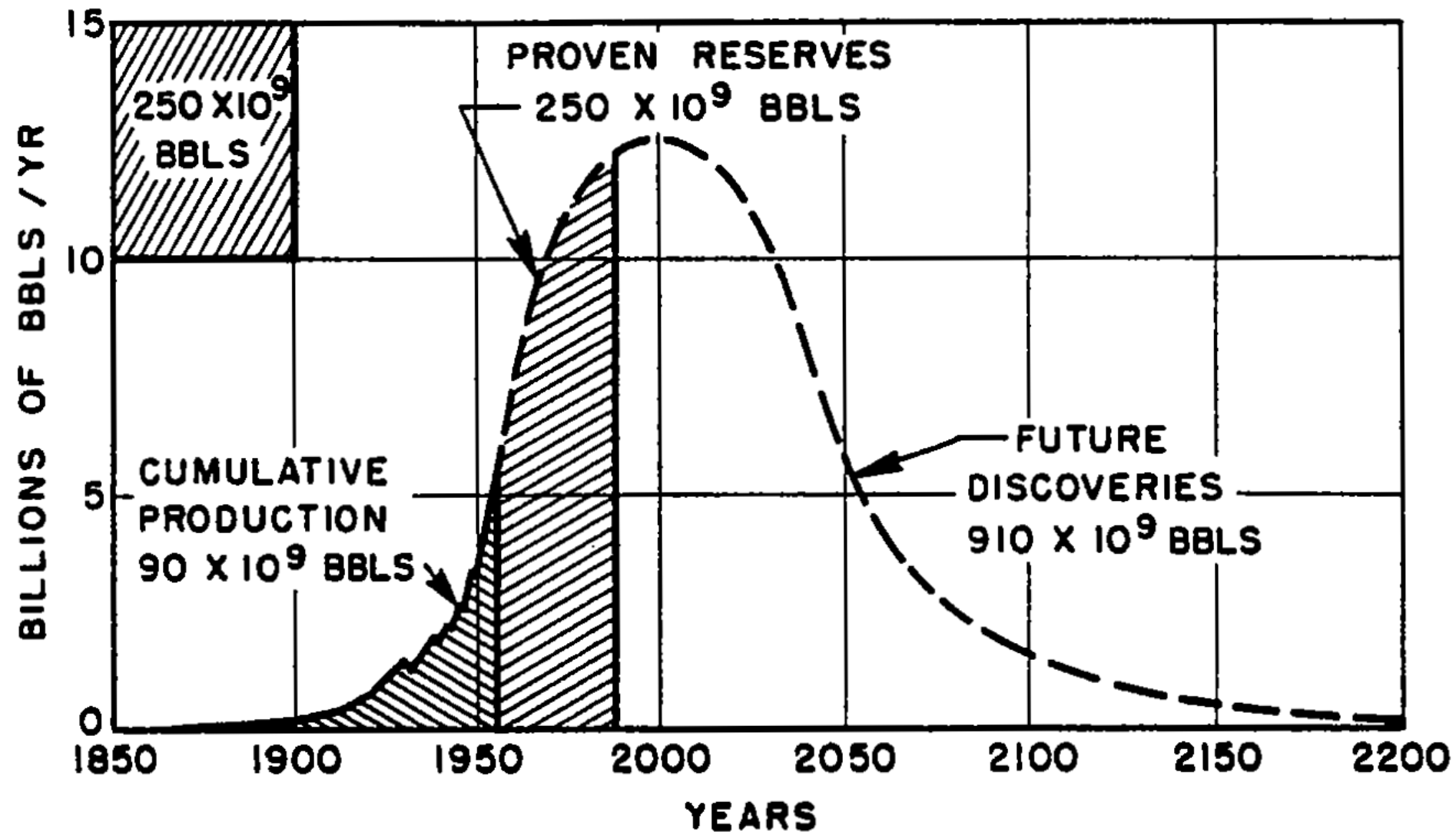
Used in the blink of an eye

Coal, gas, oil – fossil fuels

Gaussian curve – start somewhere, finish somewhere, peak in-between somewhere

Can be extended across the Peak – resulting in steeper drop-off (Seneca Event)

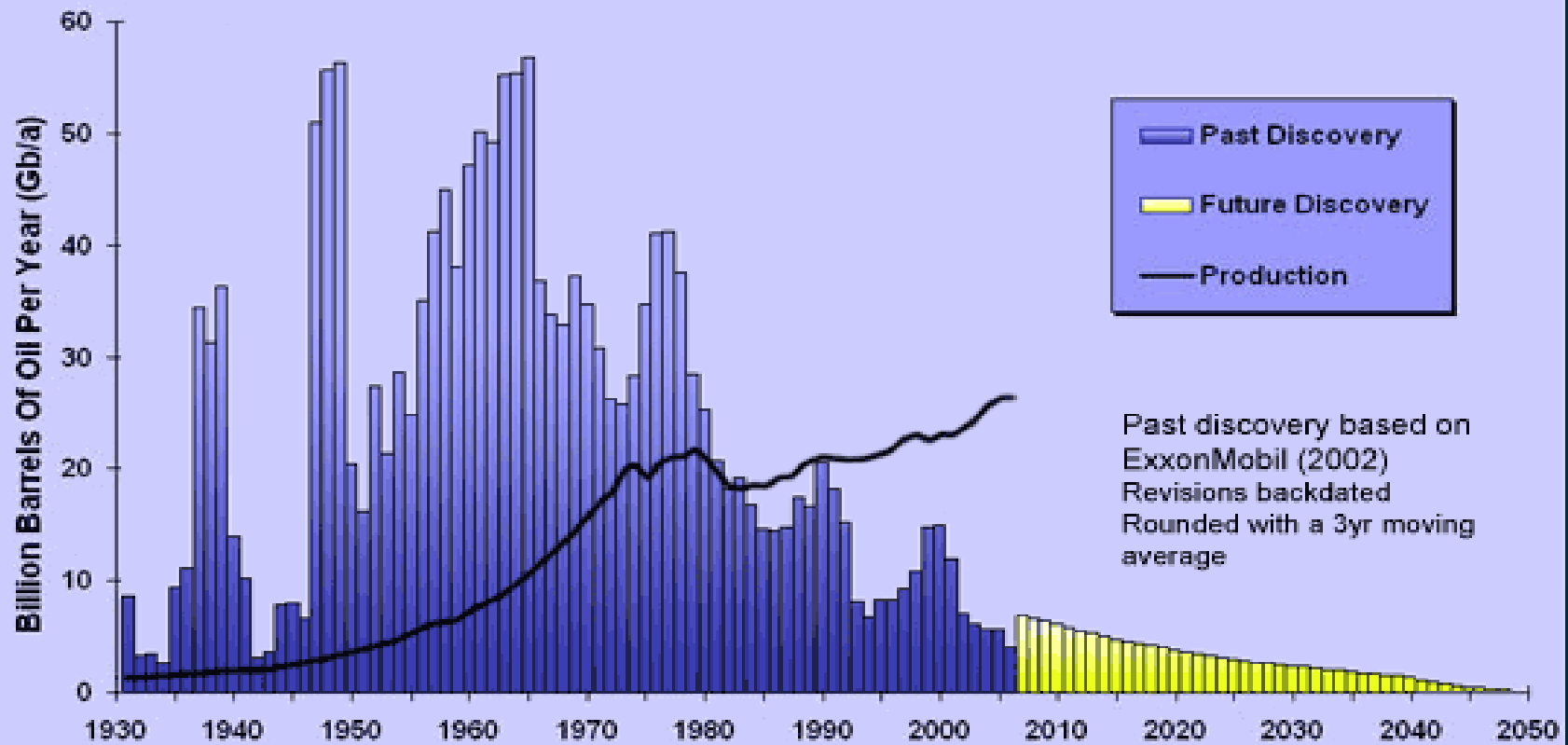
The Hubbert – Gaussian – Curve.



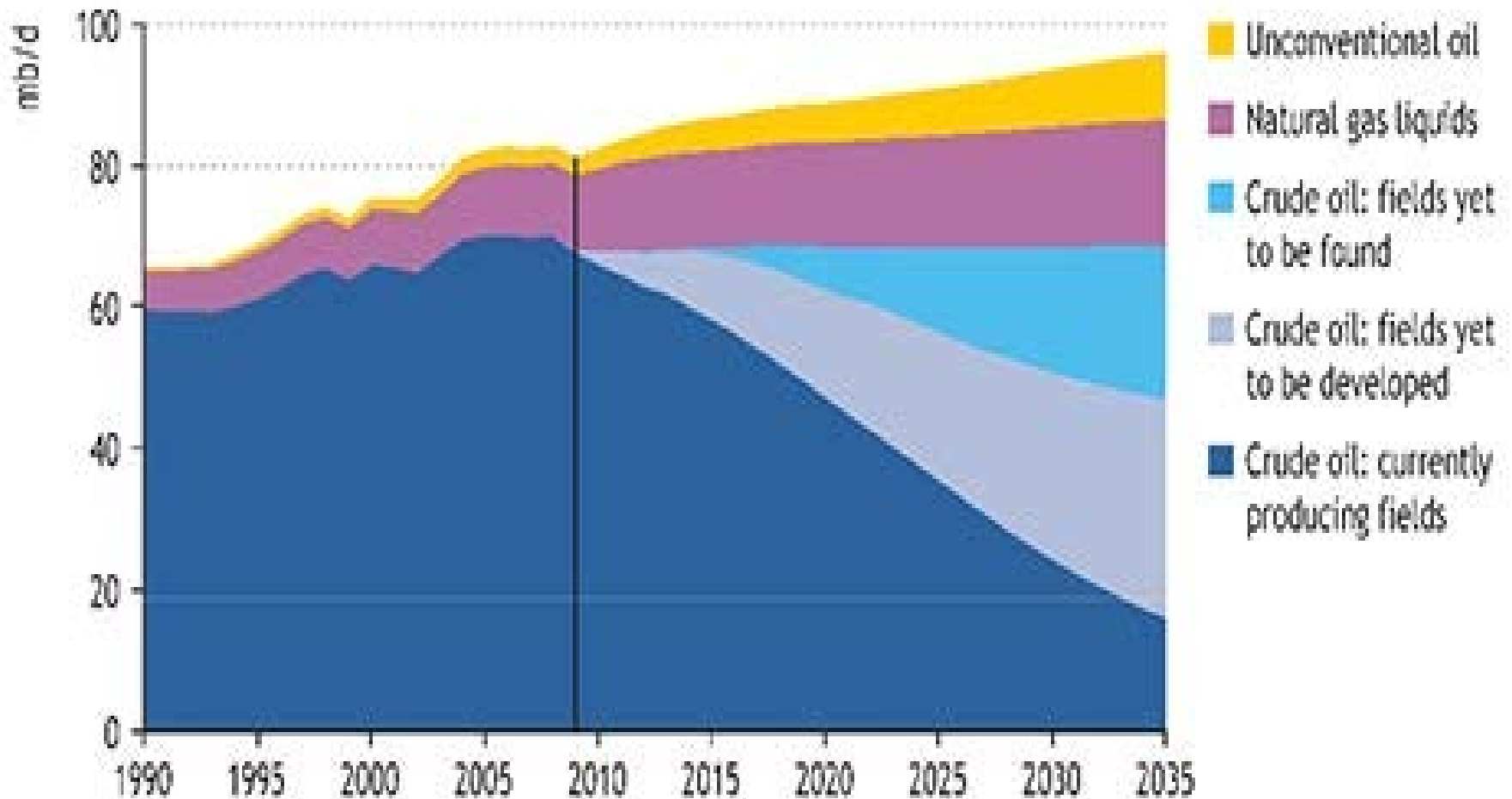
Oil – the best bang for our buck

THE GROWING GAP

Regular Conventional Oil: Discovery & Production



World oil production by type in the New Policies Scenario

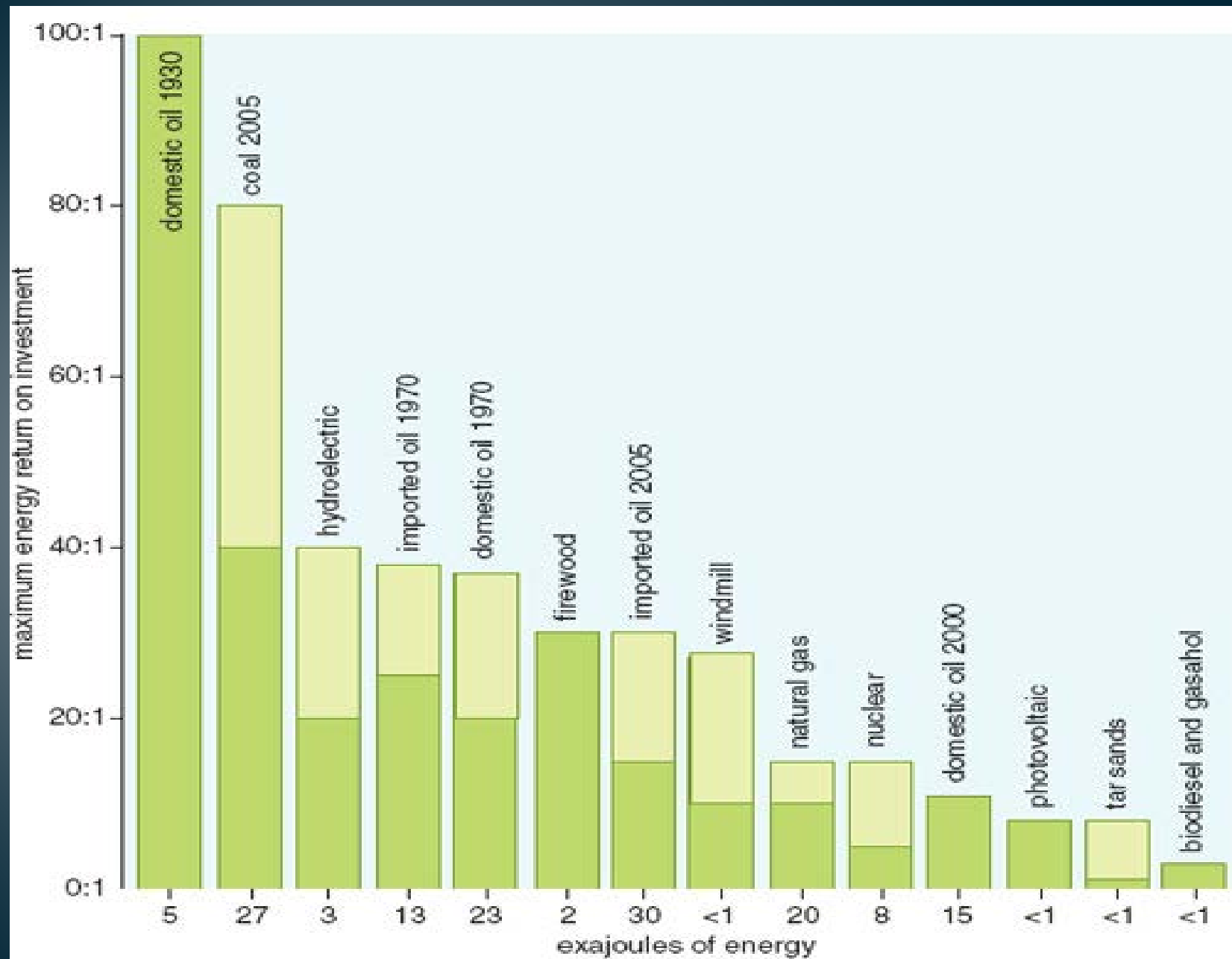


According to this chart, by 2035 roughly one quarter of all the projected oil demand is apparently to be composed of hope.

Energy Return on Energy Invested

- Known as EROEI
- “The wolf and the rabbit”
- If a wolf uses more energy chasing a rabbit, that the eating of it returns; the wolf dies. A thousand rabbits, a thousand chases, the wolf dies
- The wolf is a billionaire, the wolf dies
- No exceptions





- EROI (for US) Fuel
- 1.3 Biodiesel
- 3.0 Bitumen tar sands
- 80.0 Coal
- 1.3 Ethanol corn
- 5.0 Ethanol sugarcane
- 100.0 Hydro
- 10.0 Natural gas 2005
- 50.0 Nuclear (with centrifuge enrichment, with fast reactor or thorium reactor)
- 10.0 Nuclear (with diffusion enrichment)
- 30.0 Oil and gas 1970
- 14.5 Oil and gas 2005

- 8.0 Oil discoveries
- 35.0 Oil imports 1990
- 18.0 Oil imports 2005
- 12.0 Oil imports 2007
- 20.0 Oil production
- 6.8 Photovoltaic
- 5.0 Shale oil
- 1.6 Solar collector
- 1.9 Solar flat plate
- 18.0 Wind
- 35.0 World oil production

EFFICIENCIES

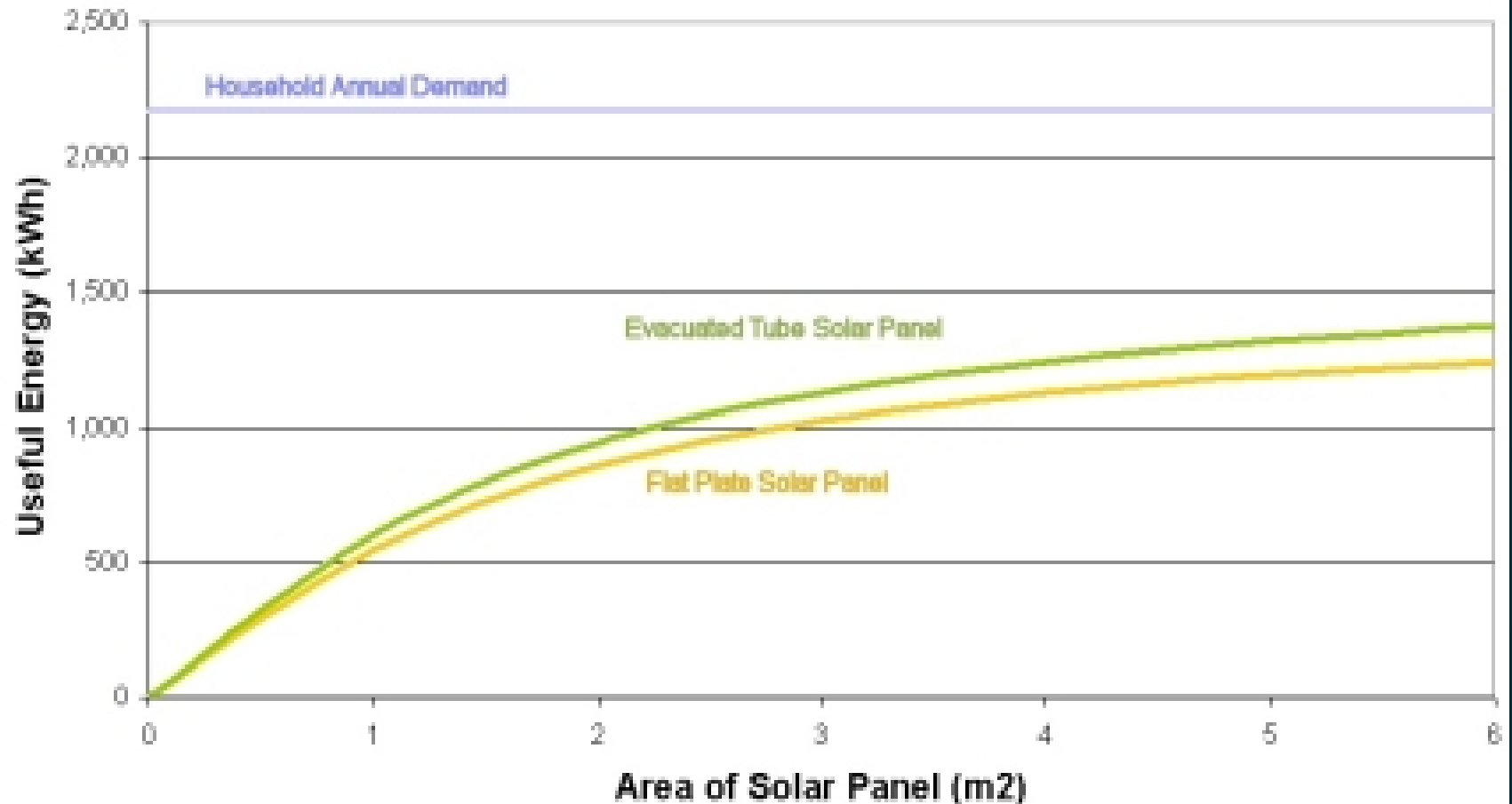
One part of 'Productivity Gains'
(the other being lowering of incomes)

Can only approach 100% in any given application
(and in practice won't)

Cherry pick the low-hanging fruit first; so follow the law of
Diminishing Returns – dams, gushers, windy hills

Moore's Law, the 'Power of the Human Brain', Technology,
relate – in Energy terms - only to Efficiencies (and by association,
to the 100% limit)

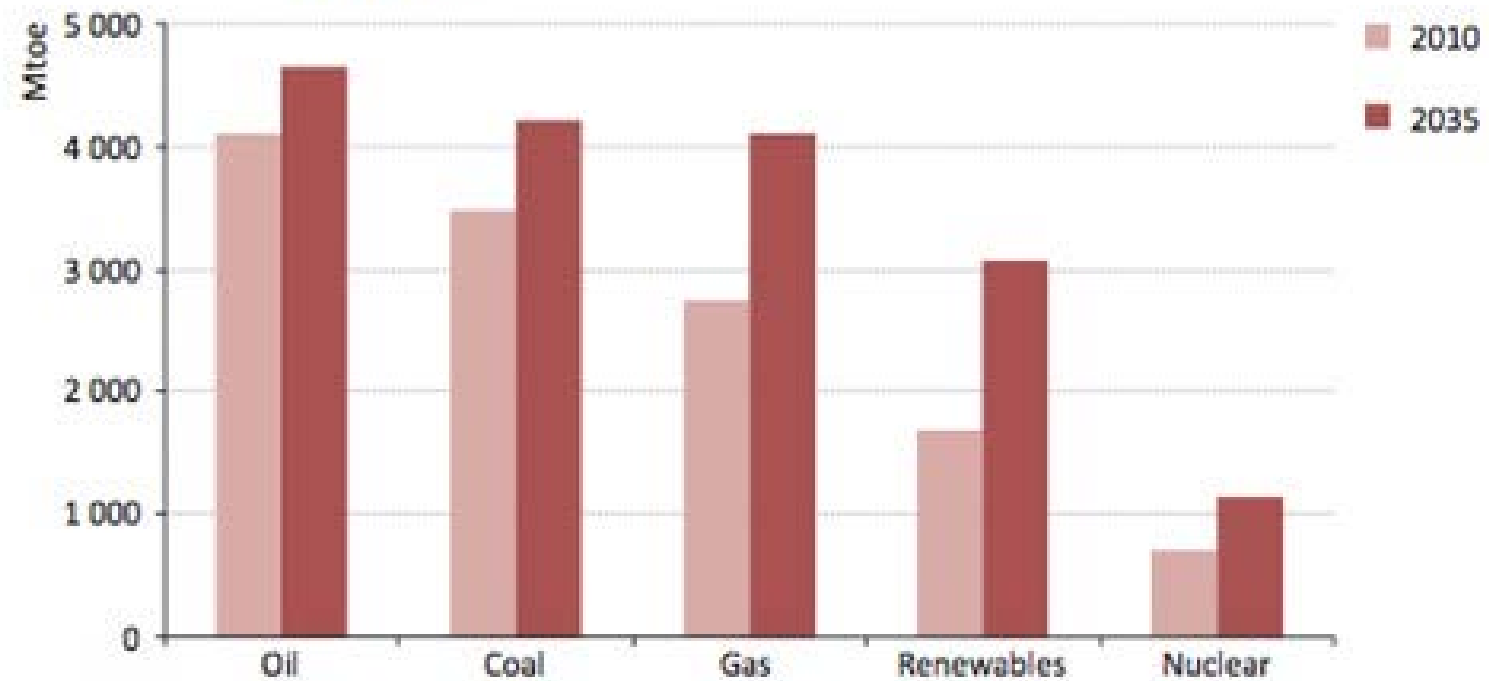
Annual Useful Solar Energy vs Area



Energy options

- Abstention
- Nuclear fission
- Nuclear fusion
- Hydrogen
- Coal (and coal-to-oil)
- Gas (and gas-to-oil)
- Lignite, Peat, Wood
- Direct solar: Thermal, PV
- Indirect solar : Hydro, Wind, Tidal

Figure 2.3 ➤ World primary energy demand by fuel in the New Policies Scenario

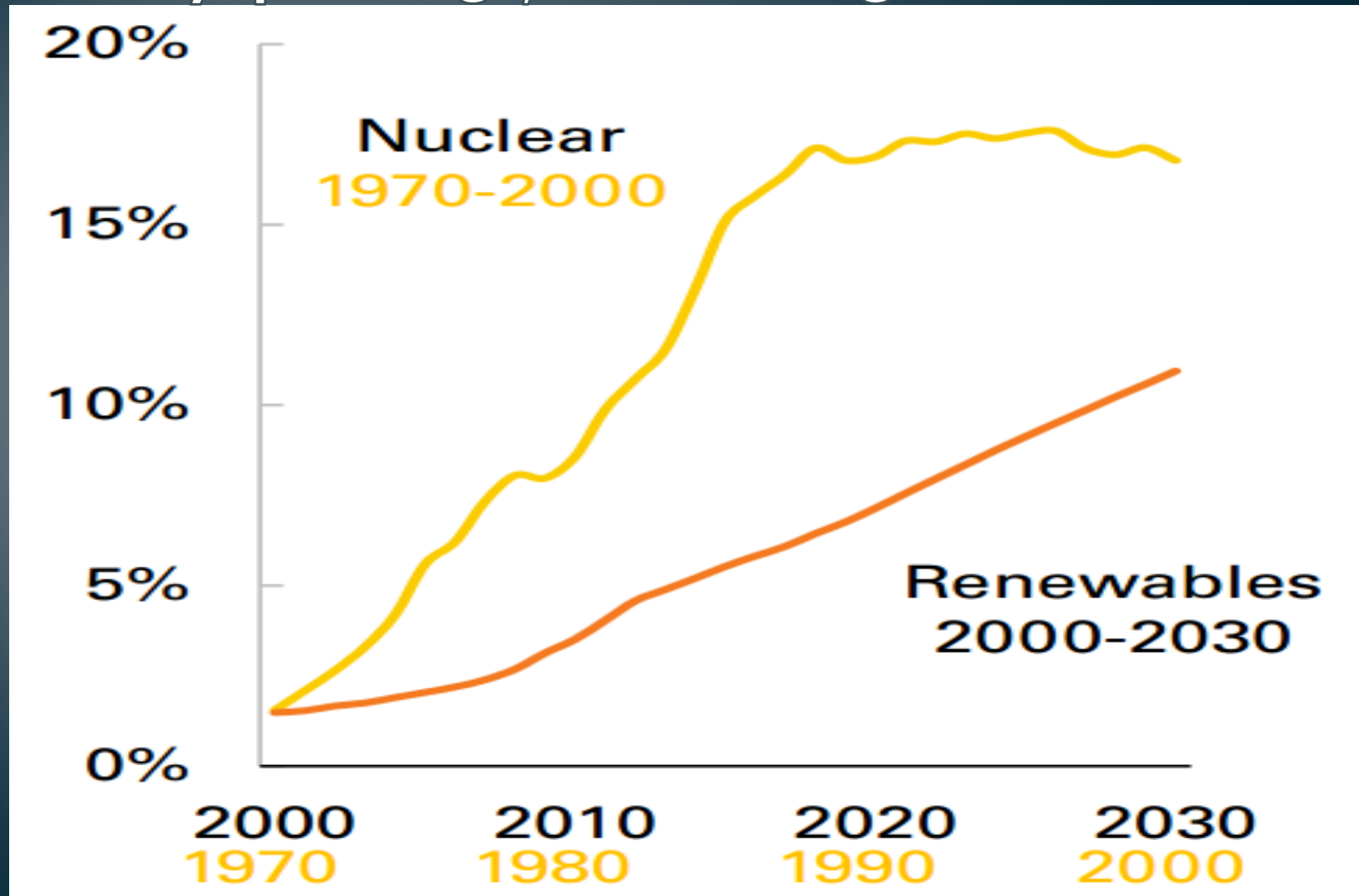


Can Renewables even run non-growth Business as Usual?

- The answer is:

- No

Cherry-picking / Dinishing Returns



MONEY

Evolved first to track bartering inequalities

Is only a proxy

An expectation that it can be exchanged for goods/services

Good/services are produced by the doing of work

Work requires the use of energy

Thus ENERGY UNDERWRITES MONEY

Needed to grow exponentially, to track the exponential growth in trading

Fiat finance; always needs the next round to be bigger than the last

Overshoot/debt issue

SUSTAINABILITY

Using renewable resources at a non-depleting rate

Recycling/reusing finite resources, in a non-polluting manner

Requires a massive reduction in physical consumption, pollution.

Brundtland Definition

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

"What is needed now is a new era of economic growth - growth that is forceful and at the same time socially and environmentally sustainable". (p. xii)
(the oxymoron of all time)

Our RMA waters *that* down further with:

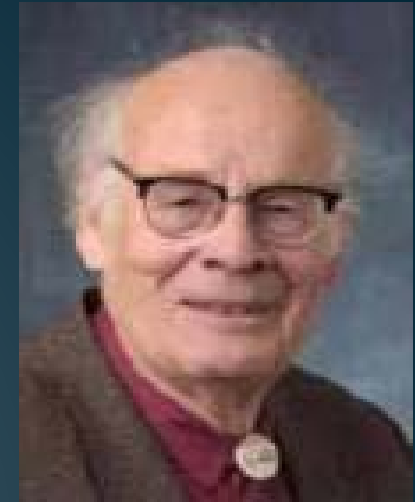
"for their [current-generation] social, **economic**, and cultural wellbeing"

'Economic' implies 'profit'; profit expects to buy 'more'.

This definition was deficient, before the RMA made it more so.

Defining Sustainability:

We need to rephrase the Brundtland definition as follows:



Sustainable development is development that does not compromise the ability of future generations to meet their own needs.

Prof Albert

Bartlett

The Tragedy of the Commons

- Garrett Hardin essay, 1968



The Jevons Paradox

- William Stanley Jevons (1835-1882)



In 1865, observed that technological improvements that increased the efficiency of coal use led to increased consumption of coal in a wide range of industries.

He argued that, contrary to common intuition, technological improvements could not be relied upon to reduce fuel consumption

CRANIAL CURTAILMENTS

Relativity – grasp of time-scales,
- grasp of the exponential function.

Discounting the future

DNA – drive to reproduce, optimise mating, store fat, co-operate or fight.

Placing the 'wish' ahead of 'addressing reality'.

Cognitive dissonance.

Denial

Blame-shift

.

Addressing Energy

- We will end up with solar energy
- Current stores of fossil fuels are too precious to burn.
- (feedstock potential)
- We don't have the spare energy to address fossil-fuel pollution (climate change etc)
- Need to use the present system, to build the next
- (triage required)

Addressing Population

- When asked (here at the University Staff Club) “how many people can the planet support?”, Professor Ellen Moseley-Thompson replied:

“That’s not the question”

“The question is – at what level of consumption do you want to live?”

“You tell me that, and I’ll tell you how many”

Estimates vary from 2 billion, down!



Addressing Consumption

- Trainer states:
 - “If we have a 3% increase in output,
 - then by 2070 we will be producing
 - 8 times as much”.
-
- “If all the expected 9 billion had risen to that living standard, we would be looking at 60 times as much”
-
- “Yet the present level is unsustainable”



Addressing Money

- Has to be 'Steady State'
- Cannot support Profit, Dividend, Interest
- (If they are charged, it will be by displacing something else)
- Expect Inflation *and* Deflation
- And Systemic Collapse

Addressing Overshoot

- Global war(s) – over scarce resources/energy
- Pandemic(s) – taking advantage of stressed populace
- Controlled descent
- “It is interesting to note that
- one probably gets more reduction per
- dollar spent if you spend that dollar on
- family planning”..... Al Bartlett



THINKING IN SYSTEMS

- (Putting it all in context)
- Population **WILL** reduce, one way or another
- Growth (physical) will slow, then cease
- Growth-based finance cannot survive
- Environmentalism alone, cannot solve the dilemma

Social Options

- Altruism vs Selfishness (sorry, free-marketeering!)
- Local vs Global
- Morphing old to new (leadership, rules, structures)
- The Simpler Way (Trainer)
- (which is what I was meant to be talking about!)

A final thought

“When asked if we have enough time to prevent catastrophe, she’d always say that we have exactly enough time – starting now”

(Amory Lovins eulogising Limits to Growth co-author Donella Meadows, 2001)

Malthus would have replied: “But she might easily, and with perfect certainty, name a point in time at which it will be too late”.