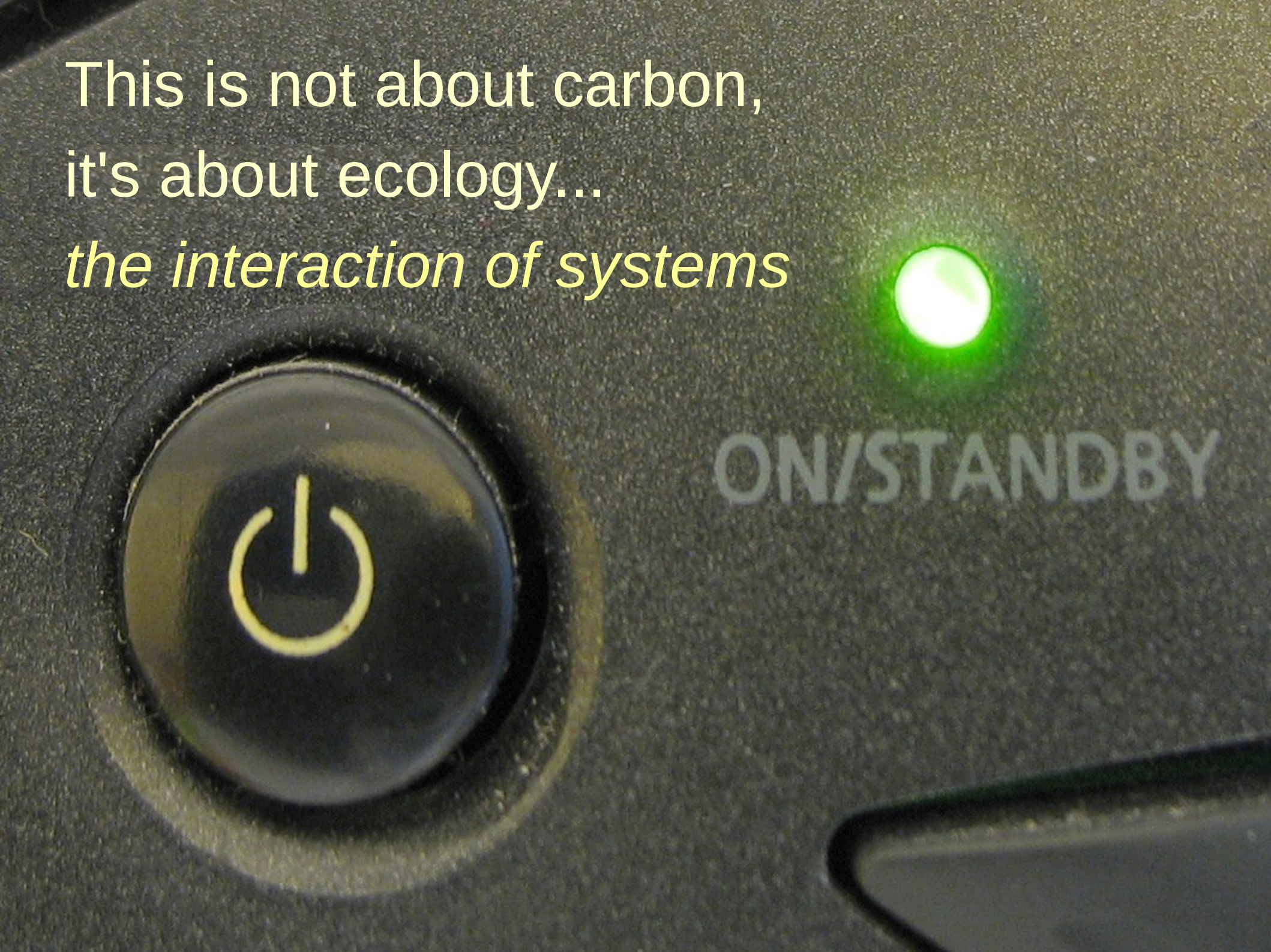
Limits to Technology

The Ecological Boundaries of the Information Age

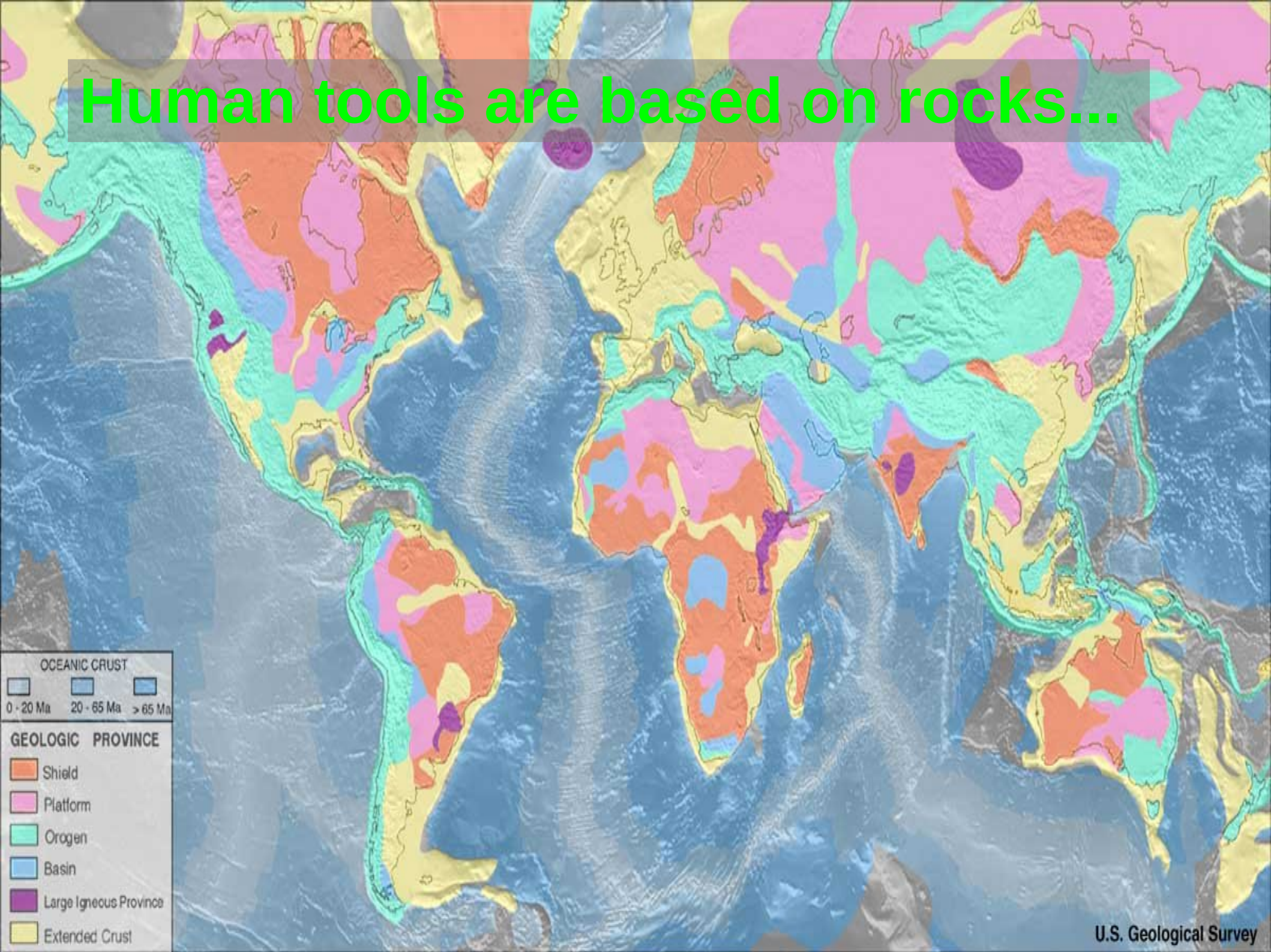
Group
Location
Date

The Free Range
Salvage Server
Project

http://www.fraw.org.uk/workshops/limits_to_technology/


This is not about carbon,
it's about ecology...
the interaction of systems
ON/STANDBY

Human tools are based on rocks...



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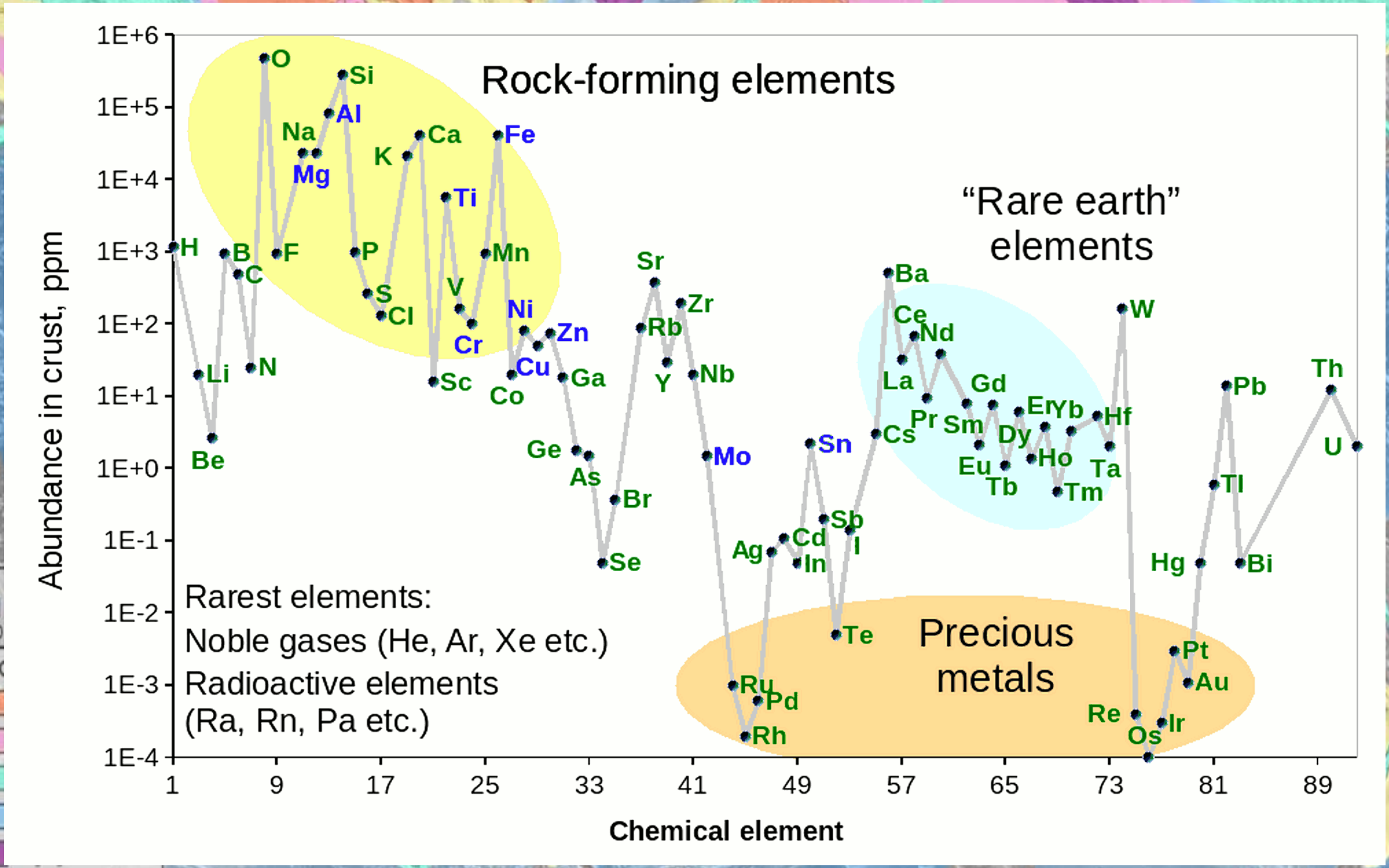

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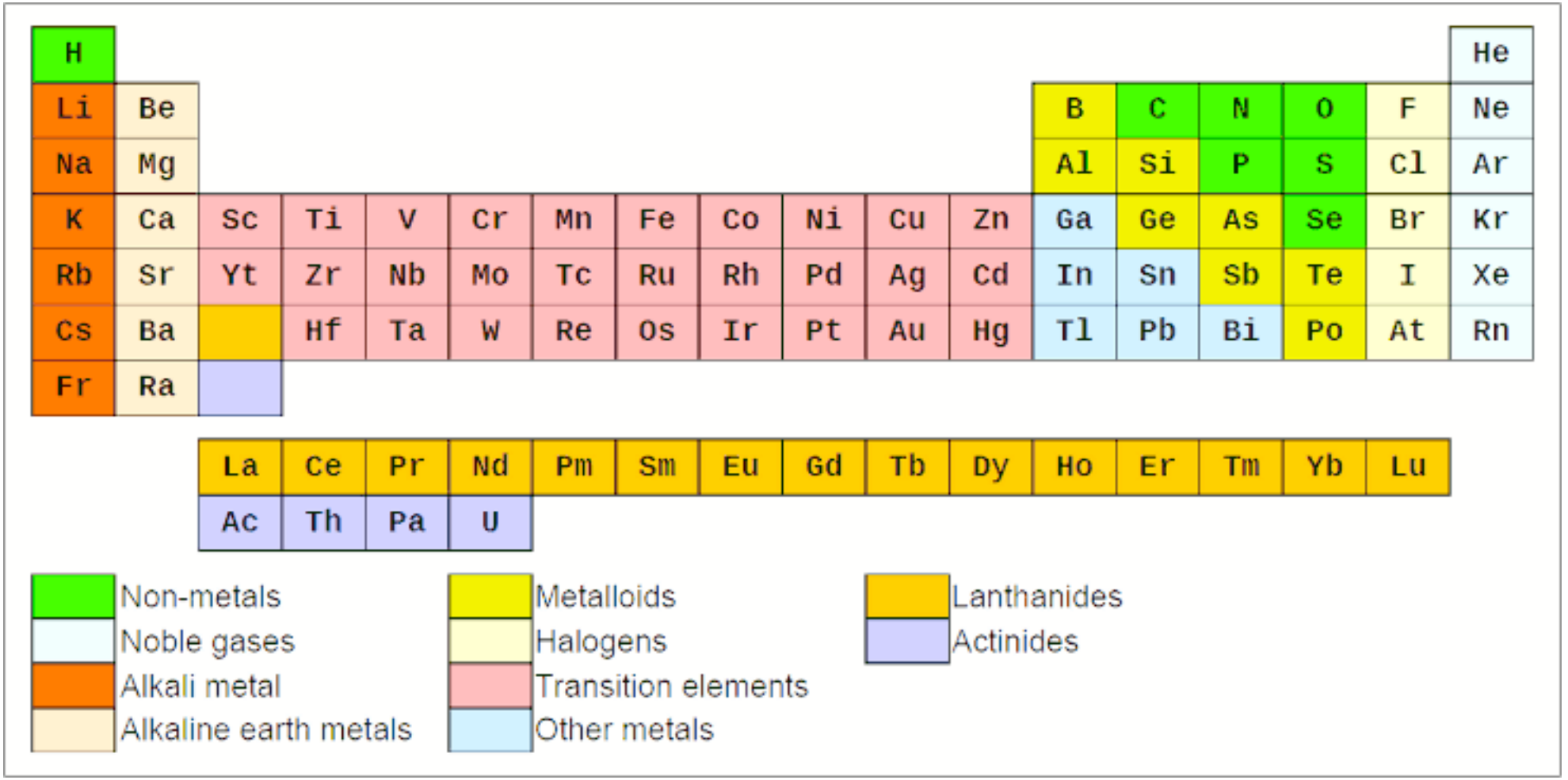

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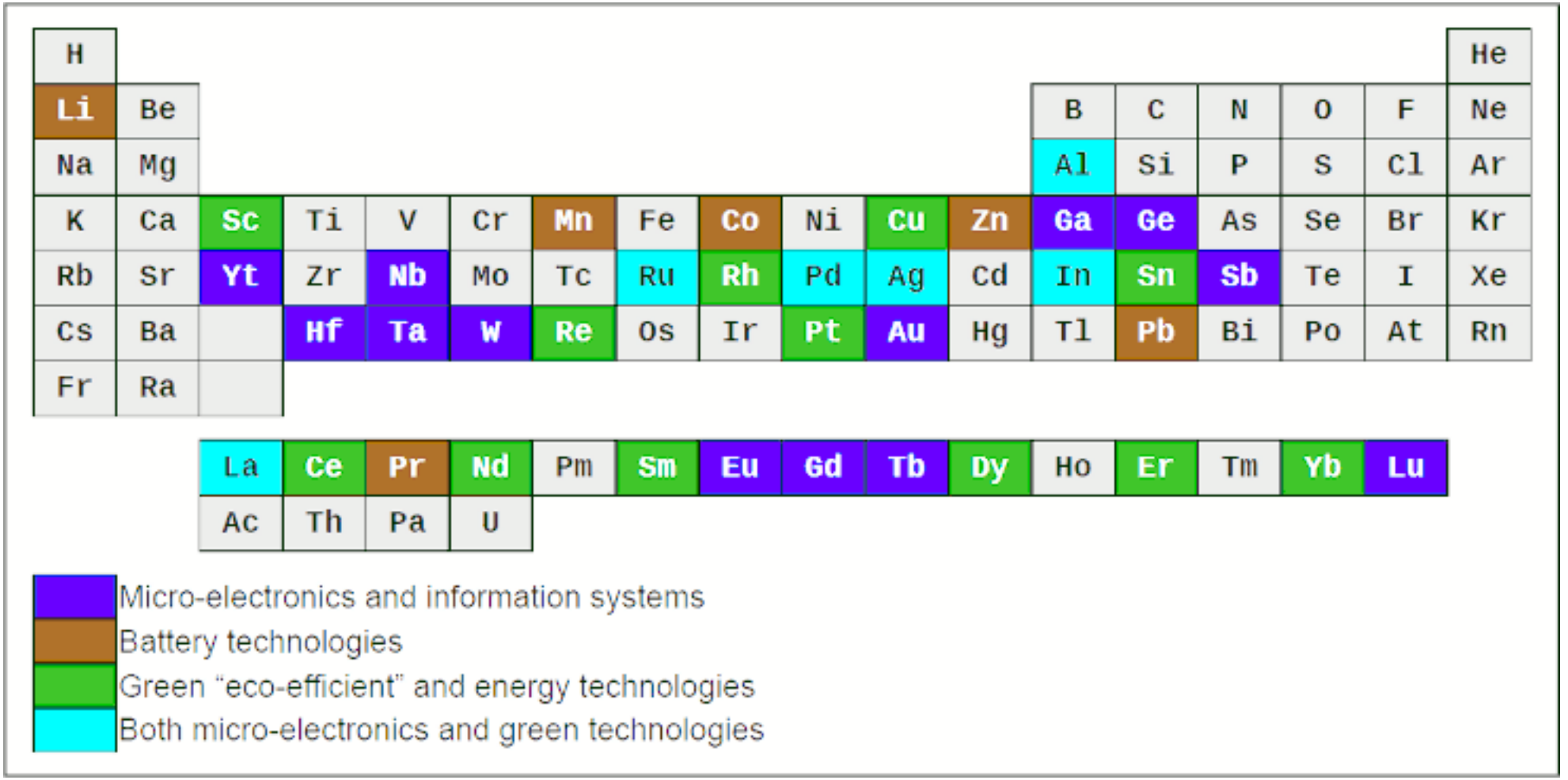

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Human tools are based on rocks...
and those rocks are finite!

El Chino copper mine, New Mexico, USA

Minera Escondida

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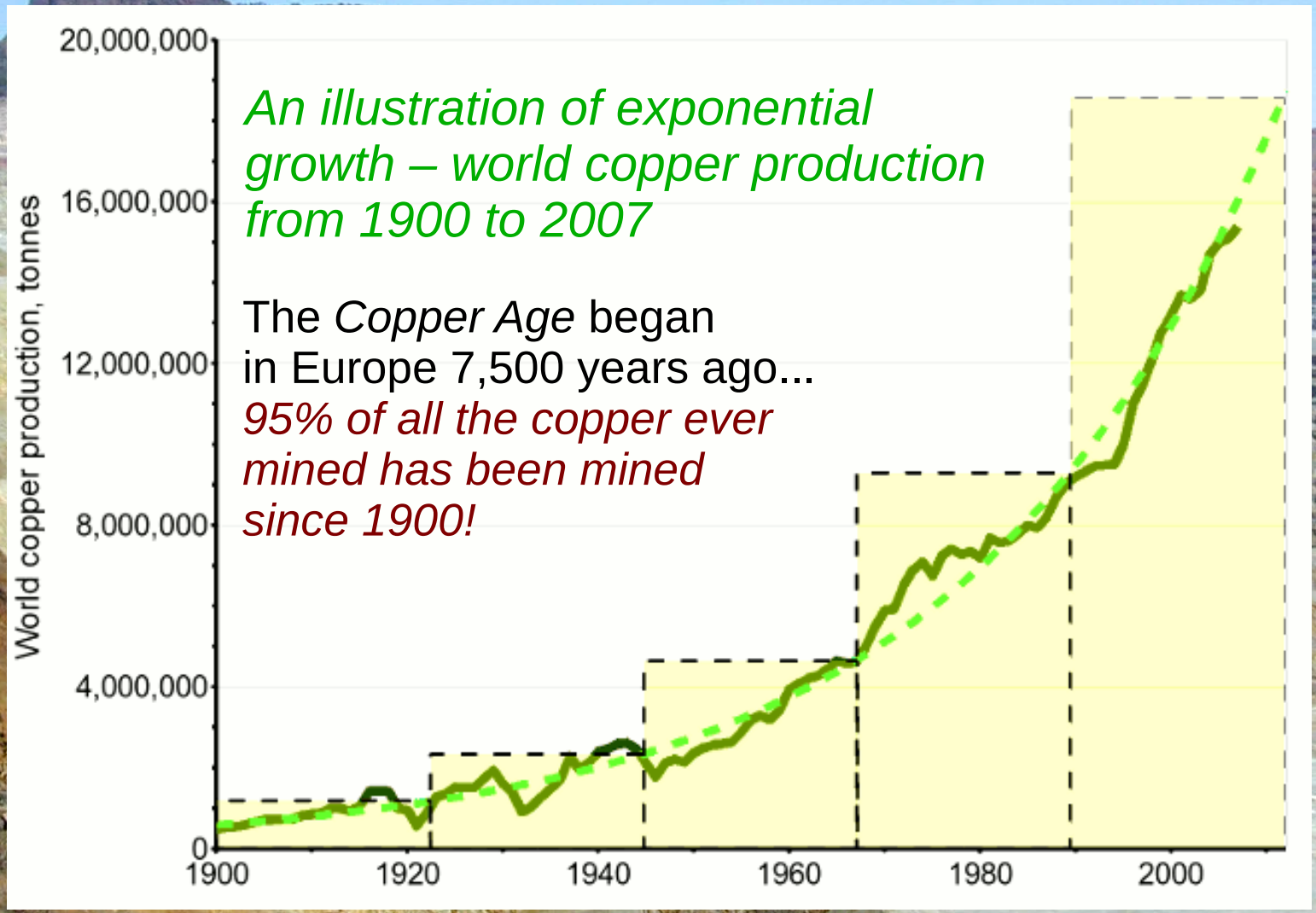

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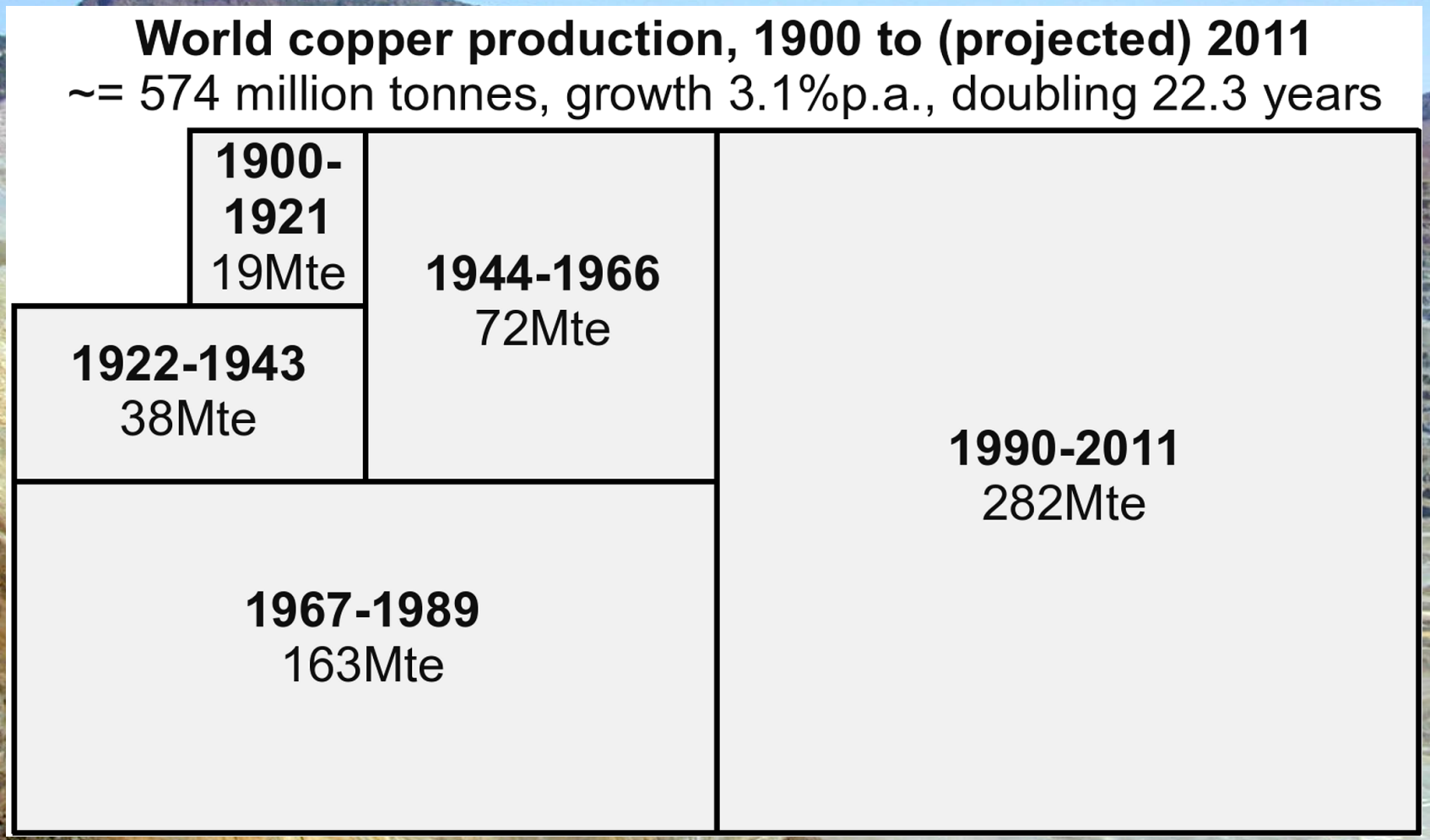
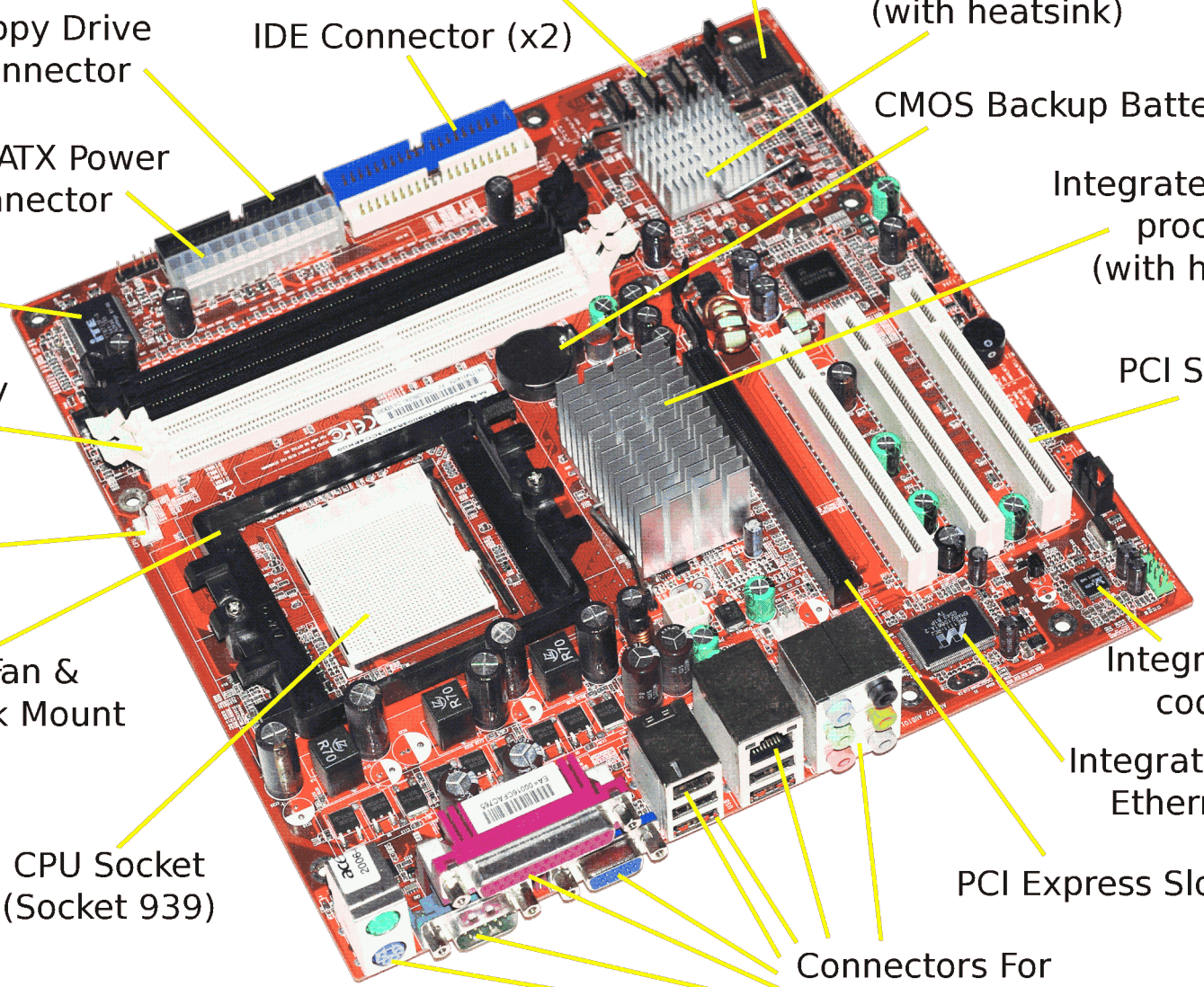
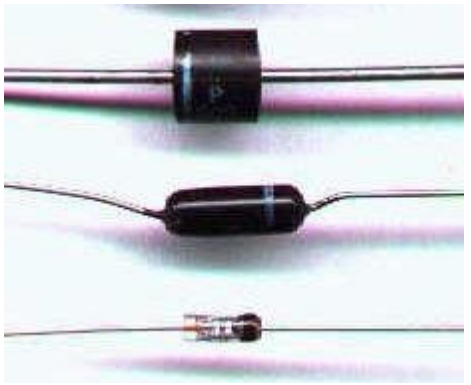


High tech. = high purity and rare



High tech. = high purity and rare

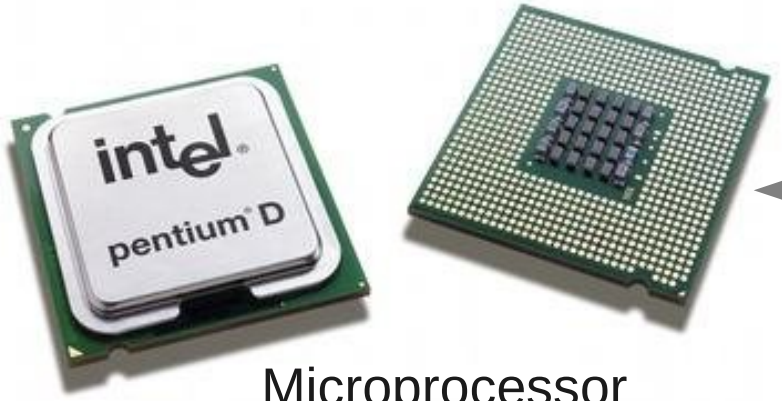
Thermionic valve



Junction diode

Junction transistor

Integrated circuit



Microprocessor

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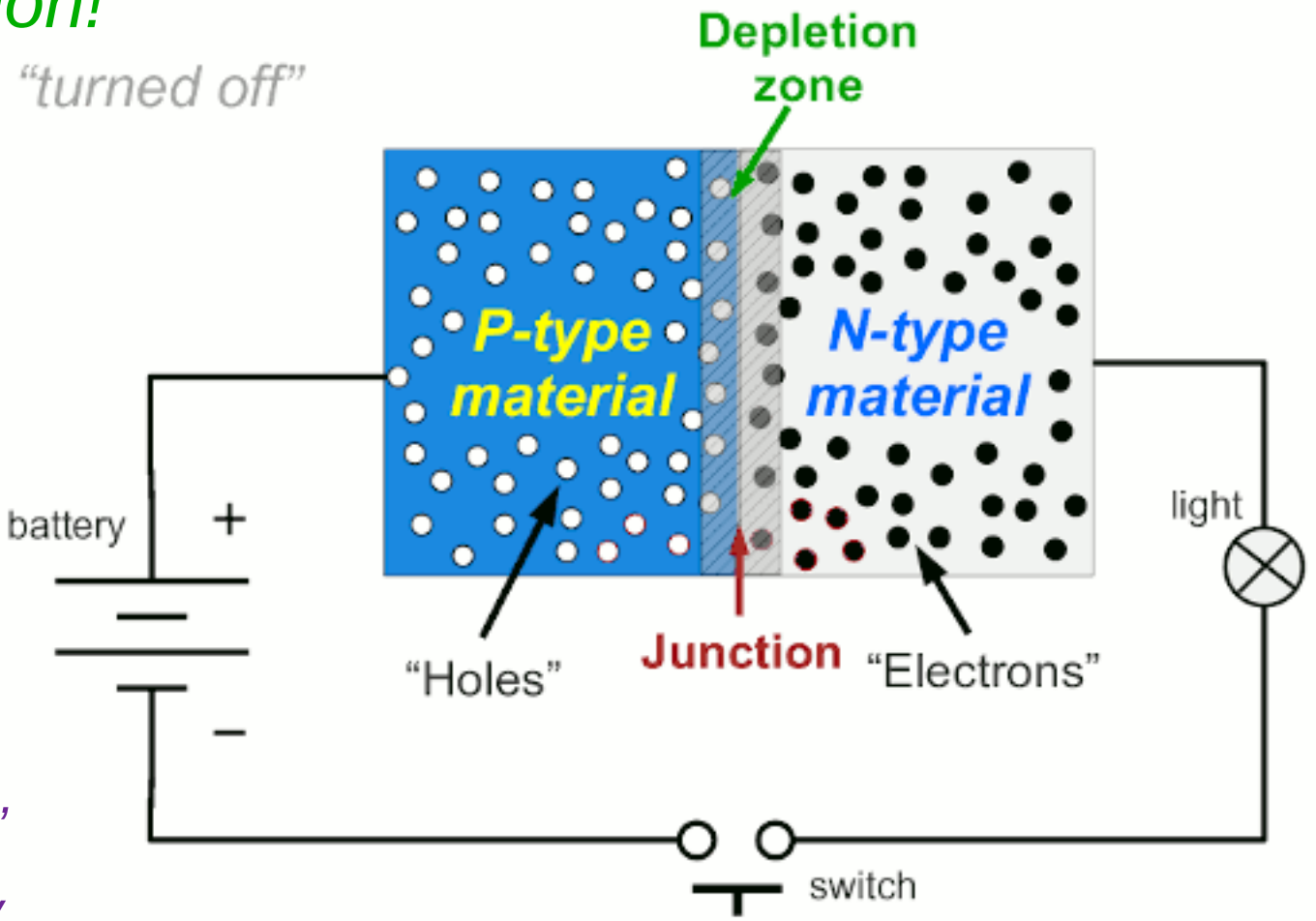
High tech. = high purity and rare

All modern electronics owe their operation to the *P-N junction!*

P and N-type materials are made from the same element (usually 99.9999% purity silicon or germanium), but are "doped" with 10-100 parts per billion of various metals to create different characteristics – e.g. aluminium, boron, gallium, indium, arsenic, antimony, cadmium, zinc, selenium, mercury, tin, tellurium, copper or lead.



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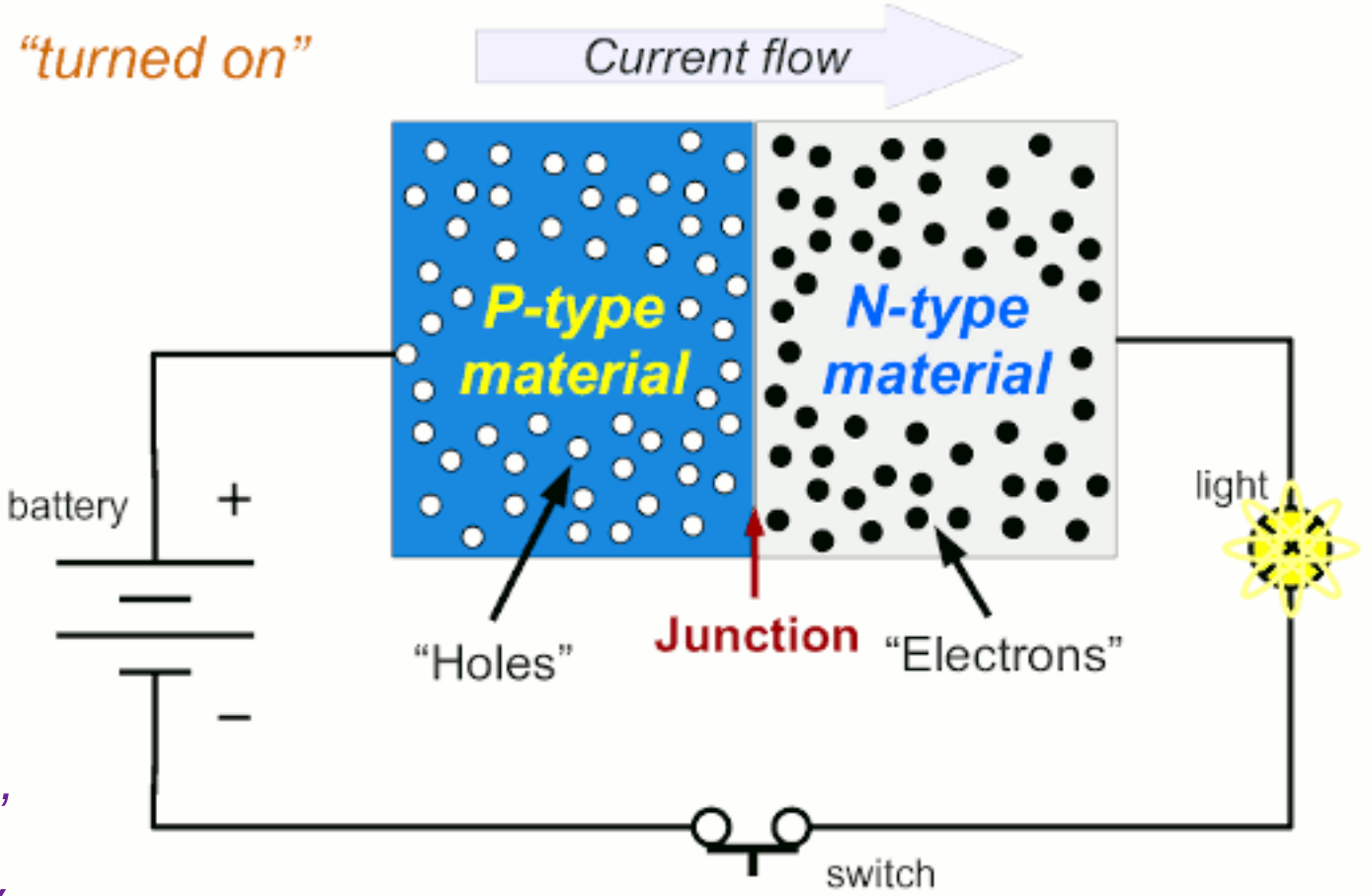

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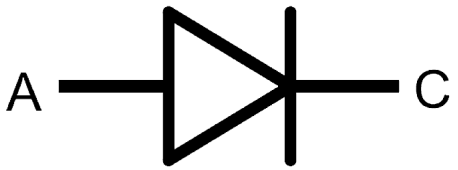
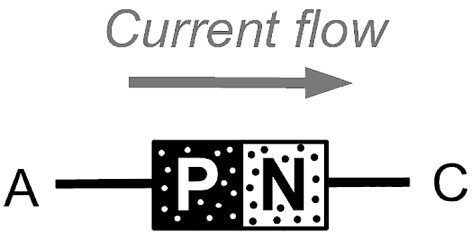
High tech. = high purity and rare

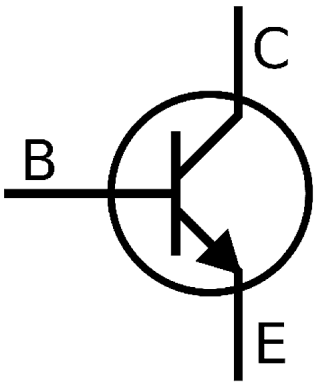
A diode

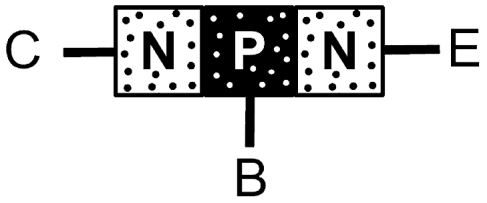




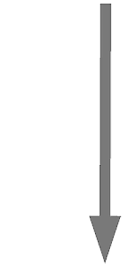
P-N junction

A 'bipolar' transistor

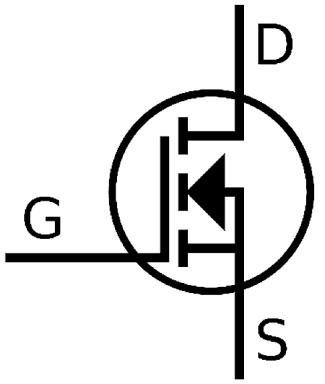


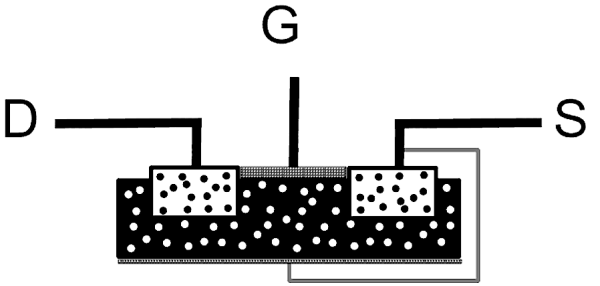


Current flow



A 'field effect' transistor





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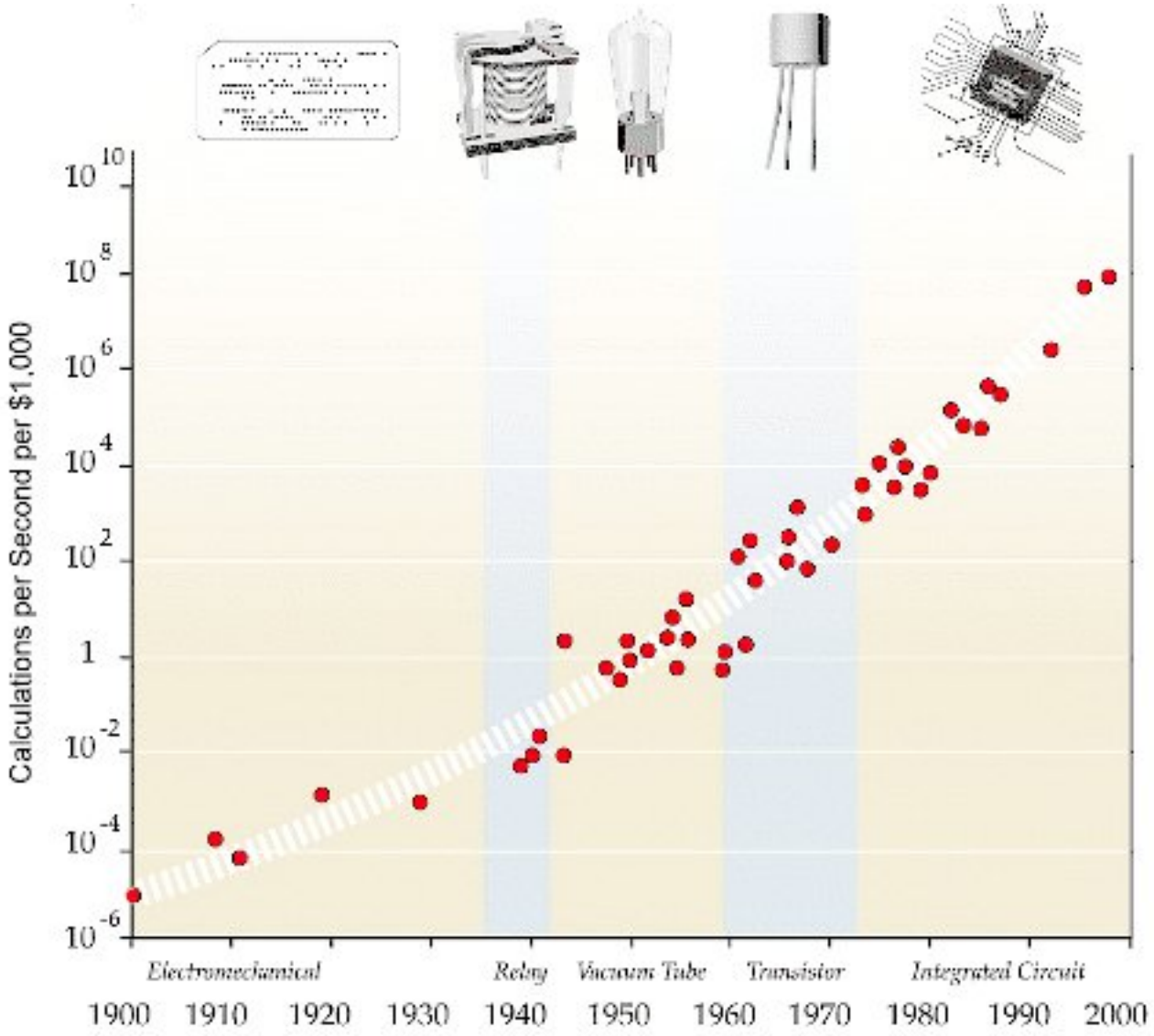
High tech. = high purity and rare



The basis of future projections in ICT is “Moore's Law” – a trend that dictates the computing power of processors will double every 2 years.

It's debatable if this trend can be main-tained if the rare elements required for high speed chips can no longer be produced in sufficient quantities.

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High tech. = high purity and rare

The thermodynamics of digital electronics means that they will always be high energy systems in order to create the low entropy materials they contain.

E.g., a (rather old) study of a 32MB memory chip found that the 2 gram chip required 1,600g of fuel, 72g of chemicals, 32 litres of water, and 700g of gases to make it; the silicon for memory chips takes 160 times more energy to produce than standard silicon metal. ***A laptop memory chip takes more energy to make than using the laptop for it's 3 year lifespan.*** ***Four-fifths of the lifecycle energy of a computer (2,000kWh or 145 litres of petrol) is expended in production.***

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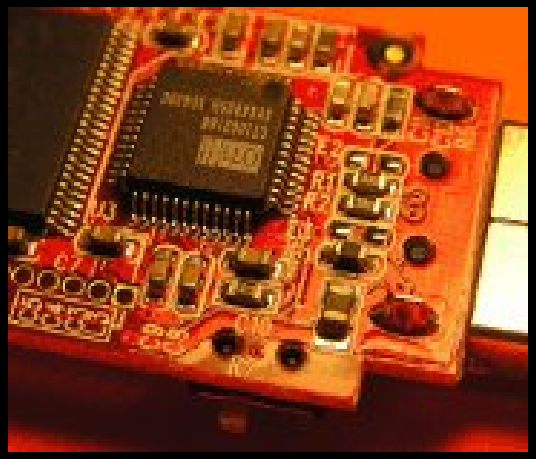
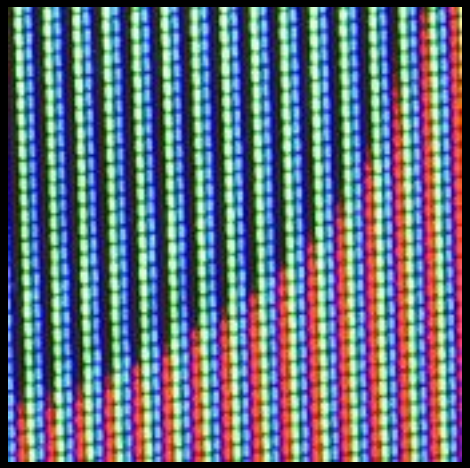
Not enough!

No rare metals, no high/green tech.



Digital gadgets:
In, Ha, Ga, Cu, Au, Nb, Ta, Ag, Lu, Tb, Ru

Fluorescent lighting:
Ba, Eu, Ce, Tb, La



Plasma/ LCD screens:
In, Yt, La, Tb, Eu, Gd

LEDs:
In, Ga

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~~Not enough!~~

No rare metals, no high/green tech.

Magnets/ motors:
Nd, Sm, Ce, Co

Batteries:
Ni, Li, La, Ce, Nd, Pr, Mn, Sb

Catalysts:
Pt, Pd, Ce, Rh

Engineering:
Everything!

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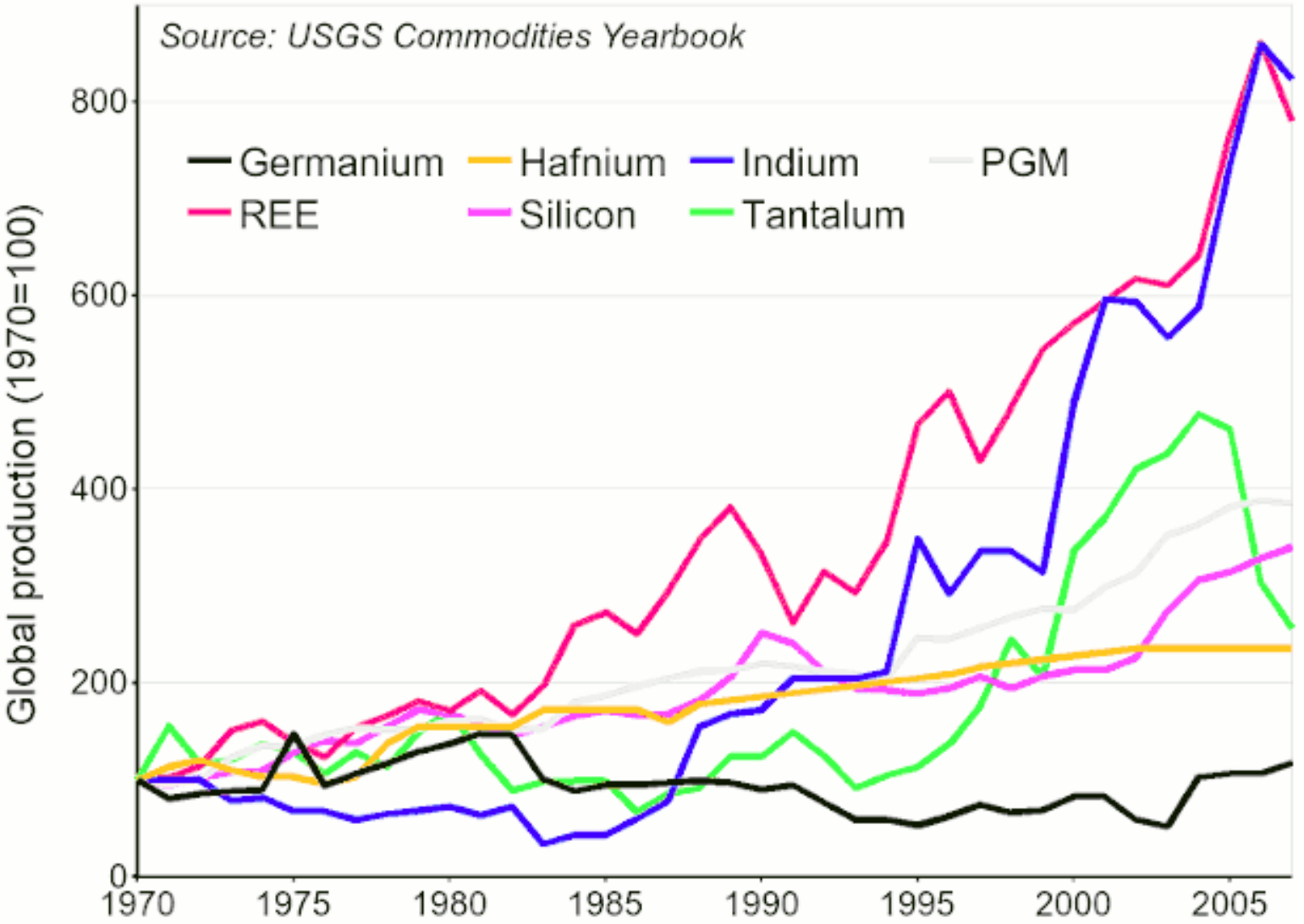
You can't grow a finite resource



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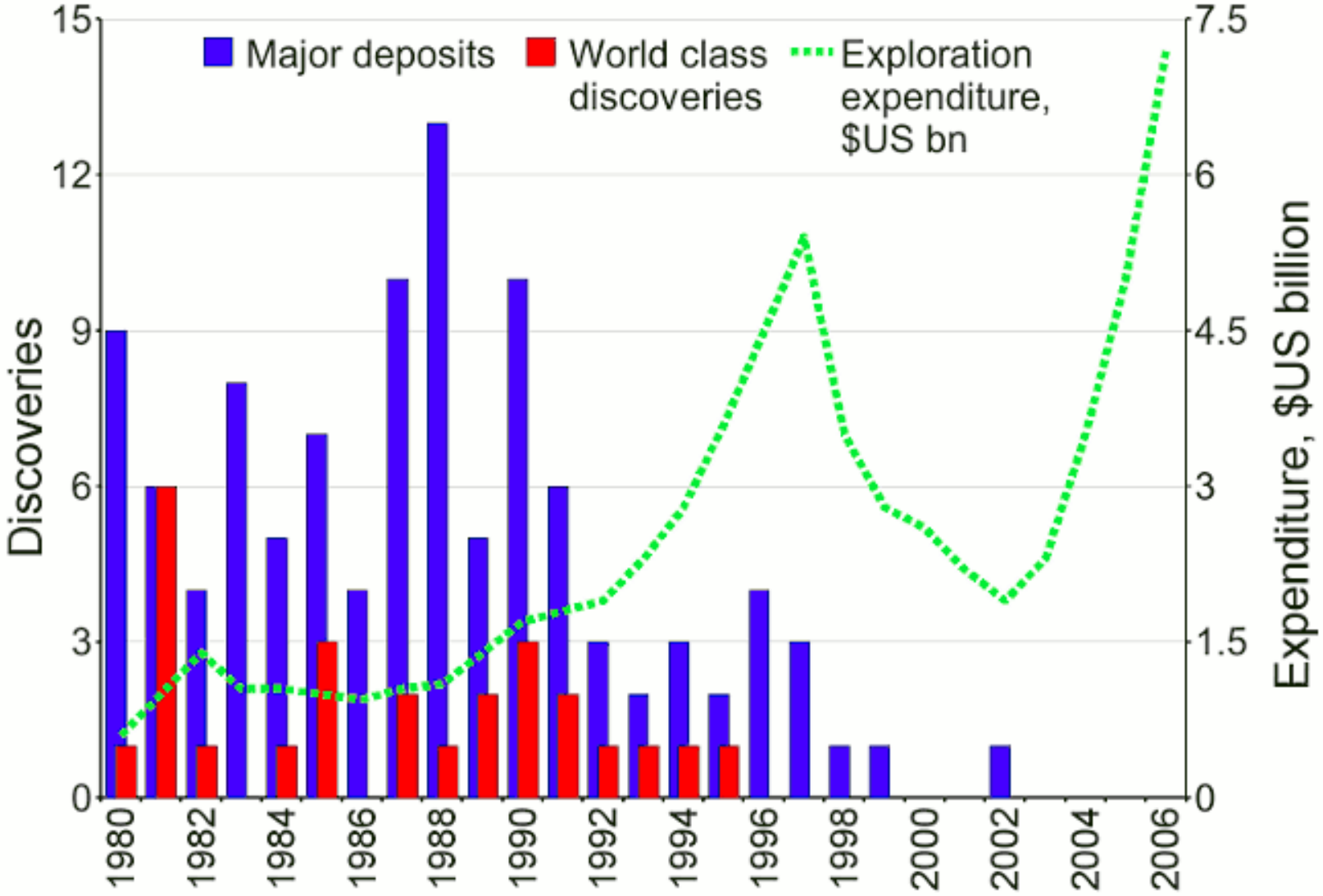

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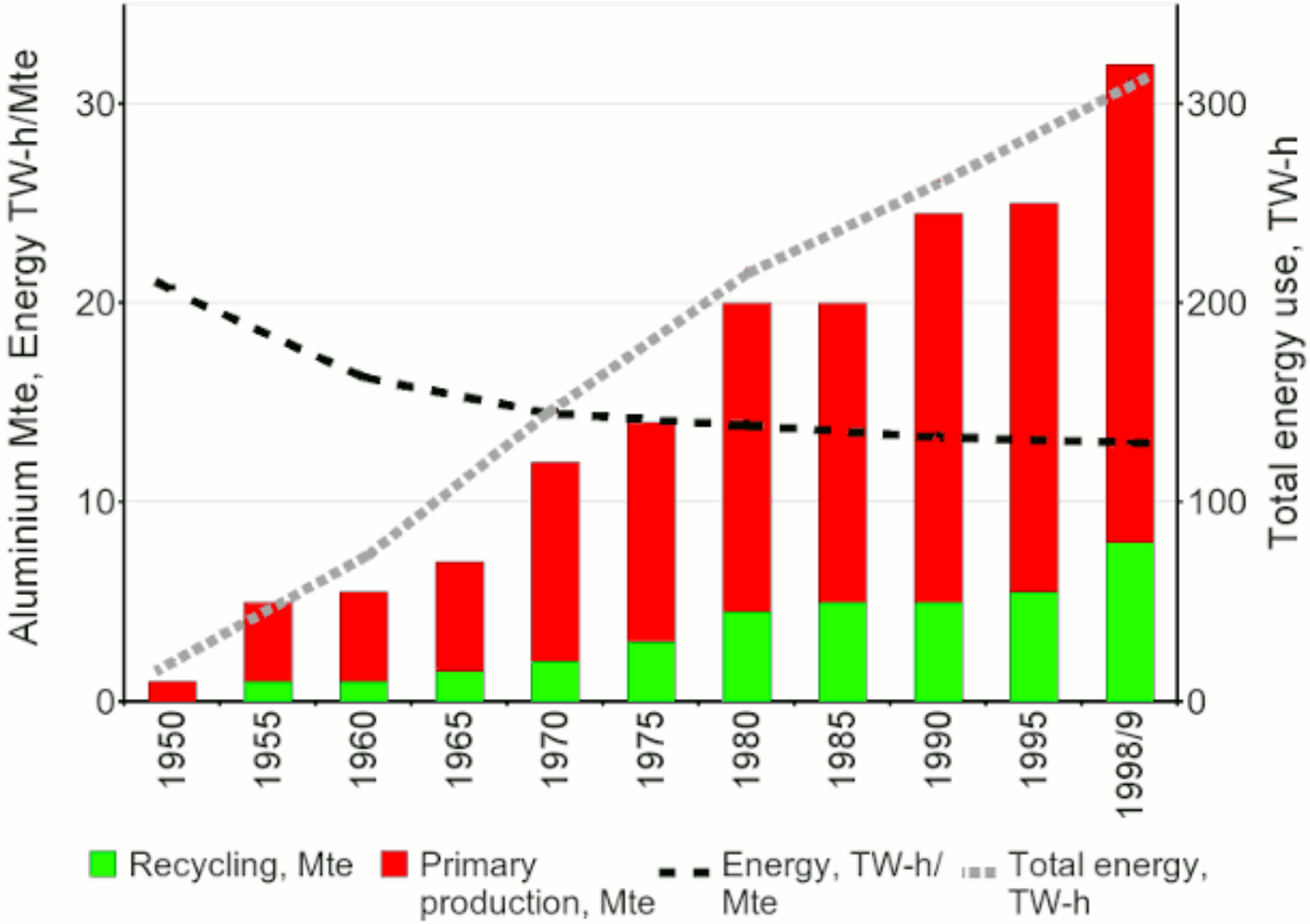

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Depletion and geo-politics

Recent studies of remaining metal reserves,
at current rates of use:

Copper	**25-61**	Chile 36% (peak soon?)
Gallium	by-product	(peaked 2002)
Gold	**15-36**	(peak now?)
Hafnium	20-100	(zirconium peaked 1994)
Indium	**7-25**	China 58%
Niobium	40->100	Brazil 95%
Silver	**12-25**	
Tantalum	20-116	Australia 53%
Tin	**17-50**	Chile 45%/India 30%
Yttrium	40->100	97% in China
Platinum group	40->360	SA 57%/Russia 28%
Rare earth group	>70	**97% in China**

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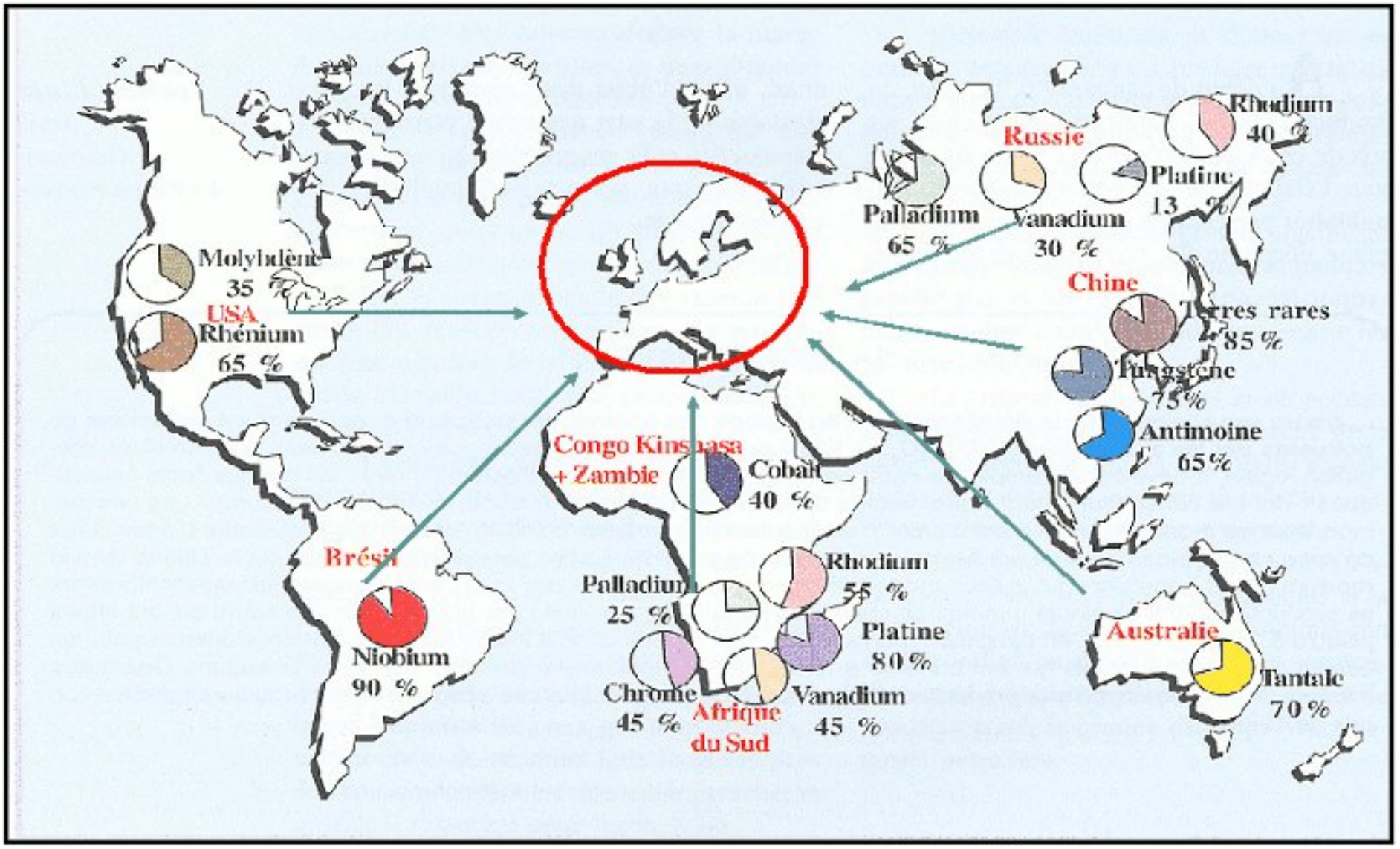
Depletion and geo-politics



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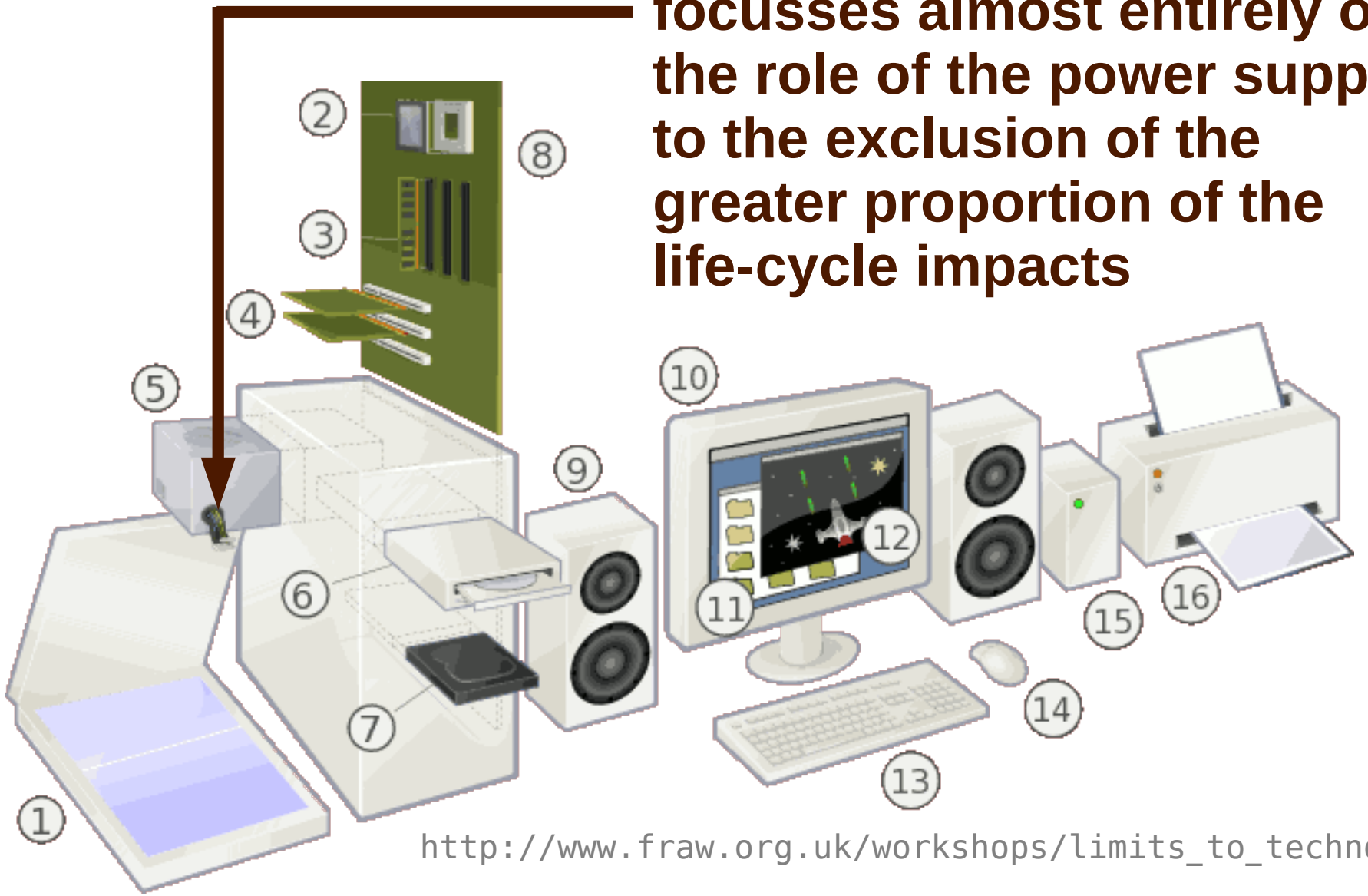
Depletion and geo-politics

From:
Global Witness
Basel Action Network

The carbon fixation

The issue of ICT and carbon focusses almost entirely on the role of the power supply, to the exclusion of the greater proportion of the life-cycle impacts



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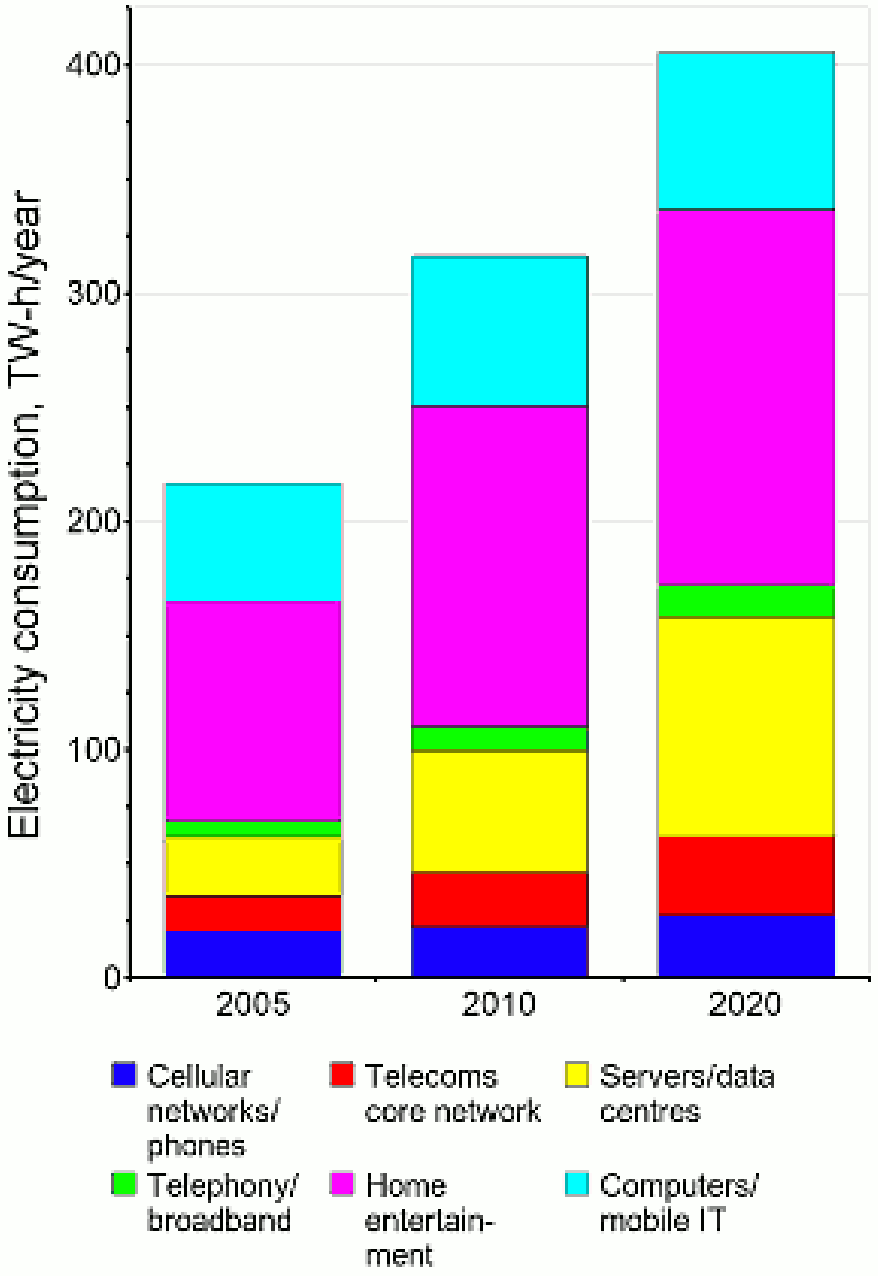
The carbon fixation



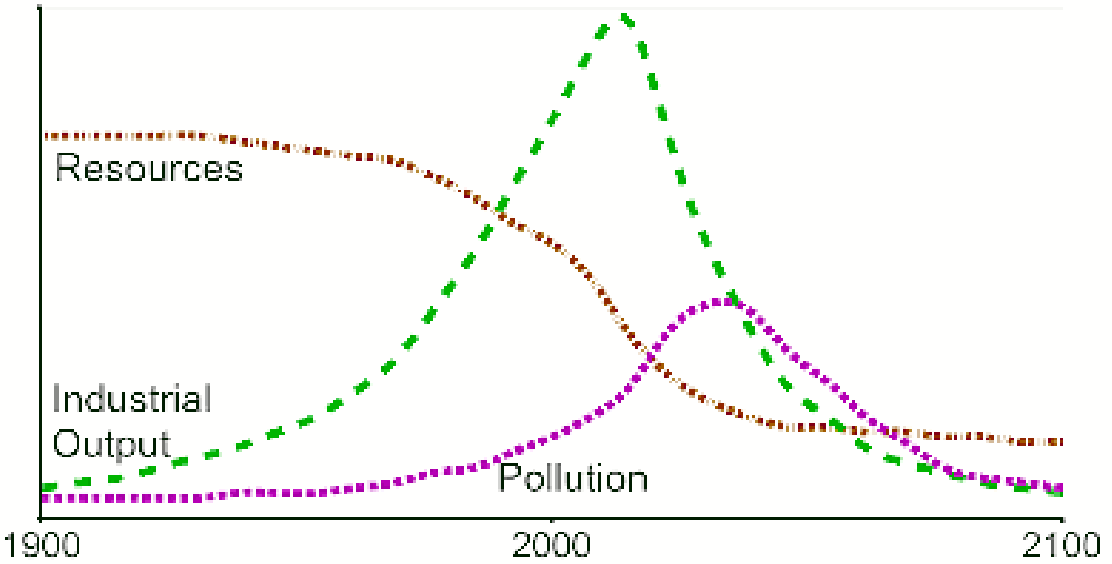
Irrespective of the trend for individual devices to use less power, the growth in the number of ICT-related electrical devices/gadgets means that their total power consumption is forecast to rise until 2020.

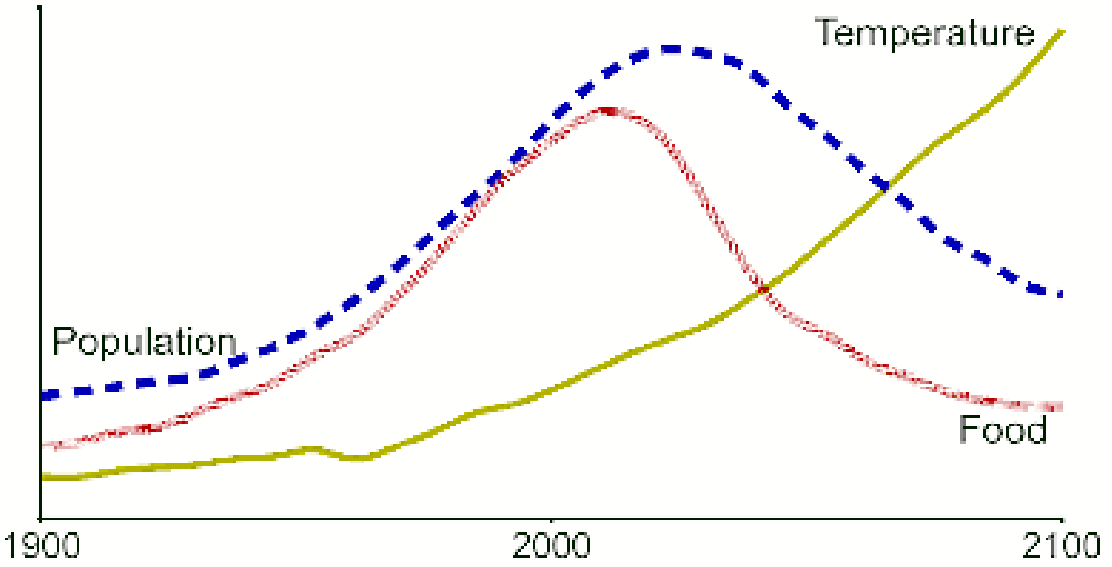
Whilst “green energy” might theoretically reduce direct emissions, their higher pro-duction footprint means that emissions will be higher (the “rebound” effect).

The future...

This is not a “new” issue – it's an old issue that the environment move-ment has been too embarrassed to talk about recently.

The first “Limits to Growth” report in 1972 highlighted the resource depletion issue; re-examinations of the data in 2004 and 2009 show no significant change in the prognosis.





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The future...

The assumption in government policy is that we'll “innovate” our way out of the problem, as we have done in the past. That's an extrapolation from past trends (which we've been doing for the past 400 years).

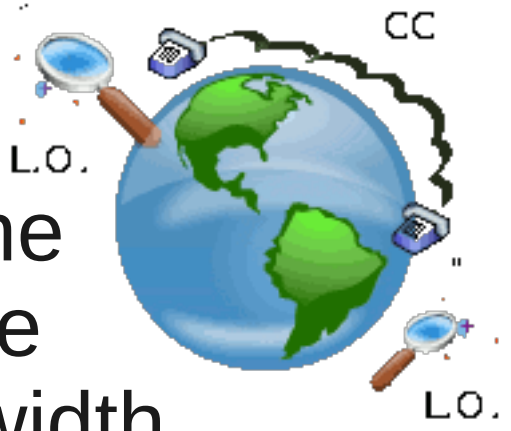
Resource depletion invalidates the basis of the growth economy; it's not “the end of civilisation”, just the end of growth for the sake of economic growth.

There is a very elegant and simple solution, but it involves a little reading, personal study and reflection on what to do with your life:

CONSUME LESS!

(I'd explain the detail but that's another gig in itself!)

The future...



We can still have digital electronics/the Internet in the future but they will have to work more slowly/with lower bandwidth.

At present more powerful computers are not deliverying significantly more capacity because each generational improvement results in a greater level of data/software bloat (*Wirth's Law*).

Resource depletion will make the price of all goods greater, but the trade-off will be the ability to make them last longer and perform more useful functions – *we must value them more!*

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In conclusion:

- The changes ahead necessitate a change of lifestyle/outlook, not a change of brand;
- If you only think of carbon you're going to make some pretty stupid decisions – think of the totality of impacts, and how to reduce them by combining or sharing activities;
- **You can't solve a problem of consumption with more consumption.**

This problem requires us to work on the content of the space between our ears, not the space in our homes or work!

The end of now... *sometime!*

A “crisis” is a “problem” that's been ignored for too long; don't ignore these issues, but don't panic either – *learn, prepare and change!*

For more information see the Free Range Salvage Server Project's “Limits to Tech.” site:

http://www.fraw.org.uk/workshops/limits_to_technology/