

# *Prospect of a bottom-up solar revolution igniting an ecosocialist transition*

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**Science for the People: The 1970s and Today Umass, Amherst**  
**Climate change and energy technology and policy**

**April 13, 2014**

*Global biodiversity and civilization are in peril from the threat of catastrophic climate change (C3).*

*But this threat is also an immense, unprecedented opportunity to end the rule of capital on this planet.*

## *Two Triggers for **Ecosocialist** Revolution:*

**1) The contradictions in 21st century capitalism ripen to produce a political revolution that finally utilizes already-existing conventional solar technologies to their full potential.**

**2) Revolutionary new renewable energy (wind/solar) technologies *directly precede and make inevitable* a revolution in global political economy, analogous to the steam engine and the industrial revolution/capitalism.**

**Between 2015 and 2020, large-scale implementation of high-efficiency thin film photovoltaics, low-cost capture of ocean currents, and high-elevation tapping of wind energy begins to rapidly decarbonize global energy supplies, radically undermining the Military Industrial Complex (MIC) because of the growing availability of very low-cost clean energy, which requires virtually no rare strategic metals.**

**Corporate-instigated attempts to block this rapid process of solarization are undermined by decentralized grassroots initiatives around the globe.** Massive civil disobedience and resistance within the armed forces and police prevent any effective repression of a now global peace and justice movement fighting for survival in the continuing Global Slump. As a result, public support for the MIC plunges, governments are elected around the world, including in the United States, with anti-capitalist agendas, promising a 21st century ecosocialist transition to *Solar Communism*.

**The dreams of Marx and W. Warren Wagar are realized, in spite of the fact that in 2014 few anticipated this could ever happen in our lifetime.**

(This is “scenario 2” in my 2013 paper, 4 Scenarios for 2050.

*Capitalism Nature Socialism* 24 (1): 49-53)

***I will make the case that this science fiction scenario is not completely delusional, rather a distinct possibility – not to be taken too literally!- for which we should be prepared to make real.***

*How far are we from  
Irreversible Catastrophic  
Climate Change (C3)?*

<http://www.guardian.co.uk/environment/2011/nov/09/fossil-fuel-infrastructure-climate-change>

# ***World headed for irreversible climate change in five years, IEA warns***

If fossil fuel infrastructure is not rapidly changed, the world will 'lose for ever' the chance to avoid dangerous climate change.

**Fiona Harvey**, environment correspondent  
guardian.co.uk, November 9, 2011

***Specifically, the peak of global C emissions to the atmosphere must come by 2016-17, and then progressively decline...***

# *Is a 2 deg C rise from the pre-industrial climate now inevitable?*

**A 2 deg C rise is a “*prescription for disaster*”  
(Hansen et al., 2011)**

**“scenarios with 2 °C or more global warming [are] far more dangerous; so dangerous, we suggest, that aiming for the 2 °C pathway would be foolhardy.” (Hansen et al., 2013)**



# *Requirements for a 1 deg C rise*

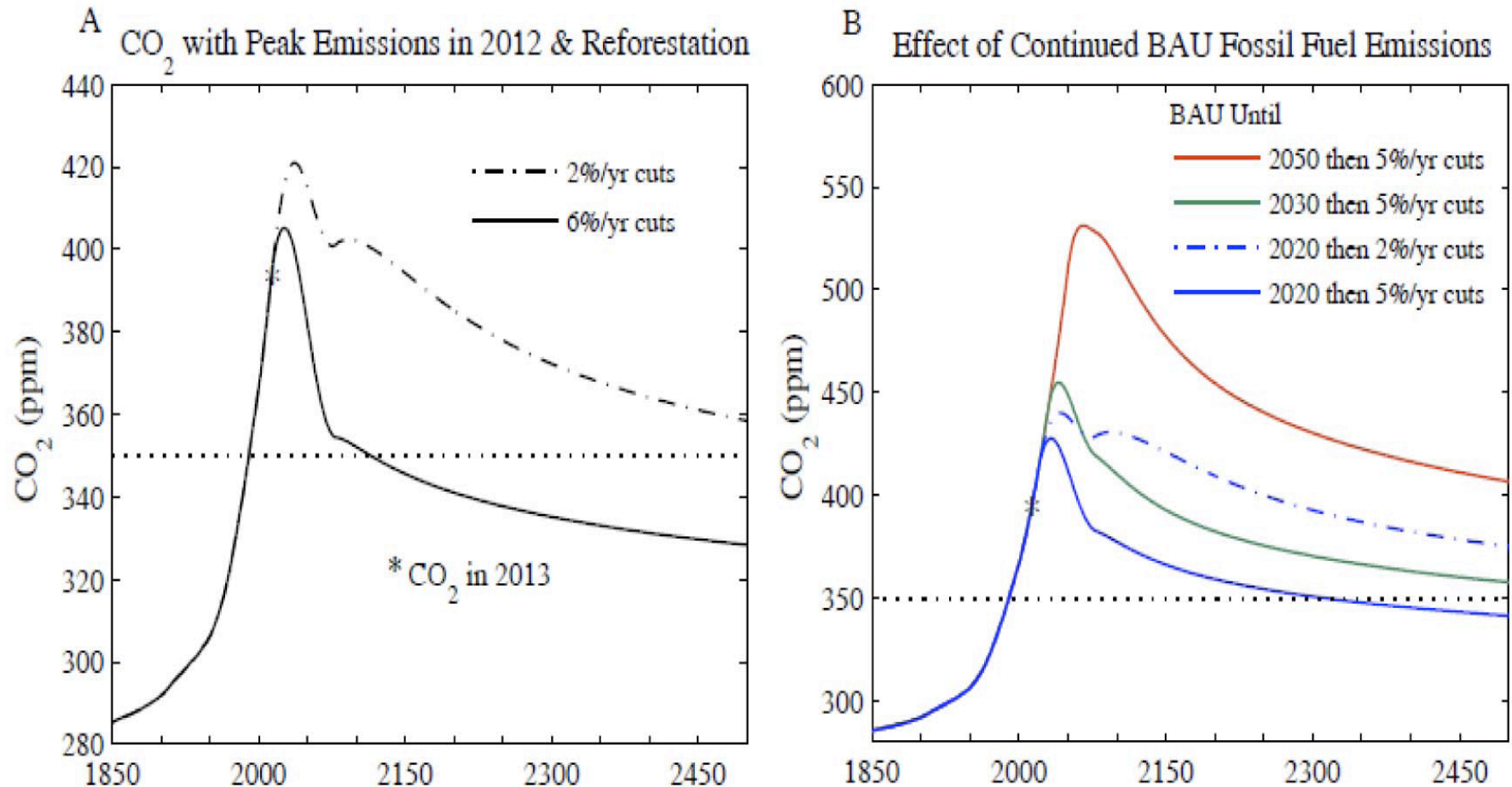


Figure 5. Atmospheric CO<sub>2</sub> if fossil fuel emissions reduced. (A) 6% or 2% annual cut begins in 2013 and 100 GtC reforestation drawdown occurs in 2031–2080, (B) effect of delaying onset of emission reduction.

**Hansen et al., 2013, Assessing “Dangerous Climate Change”: Required Reduction of Carbon Emissions to Protect Young People, Future Generations and Nature. PLOS ONE)**

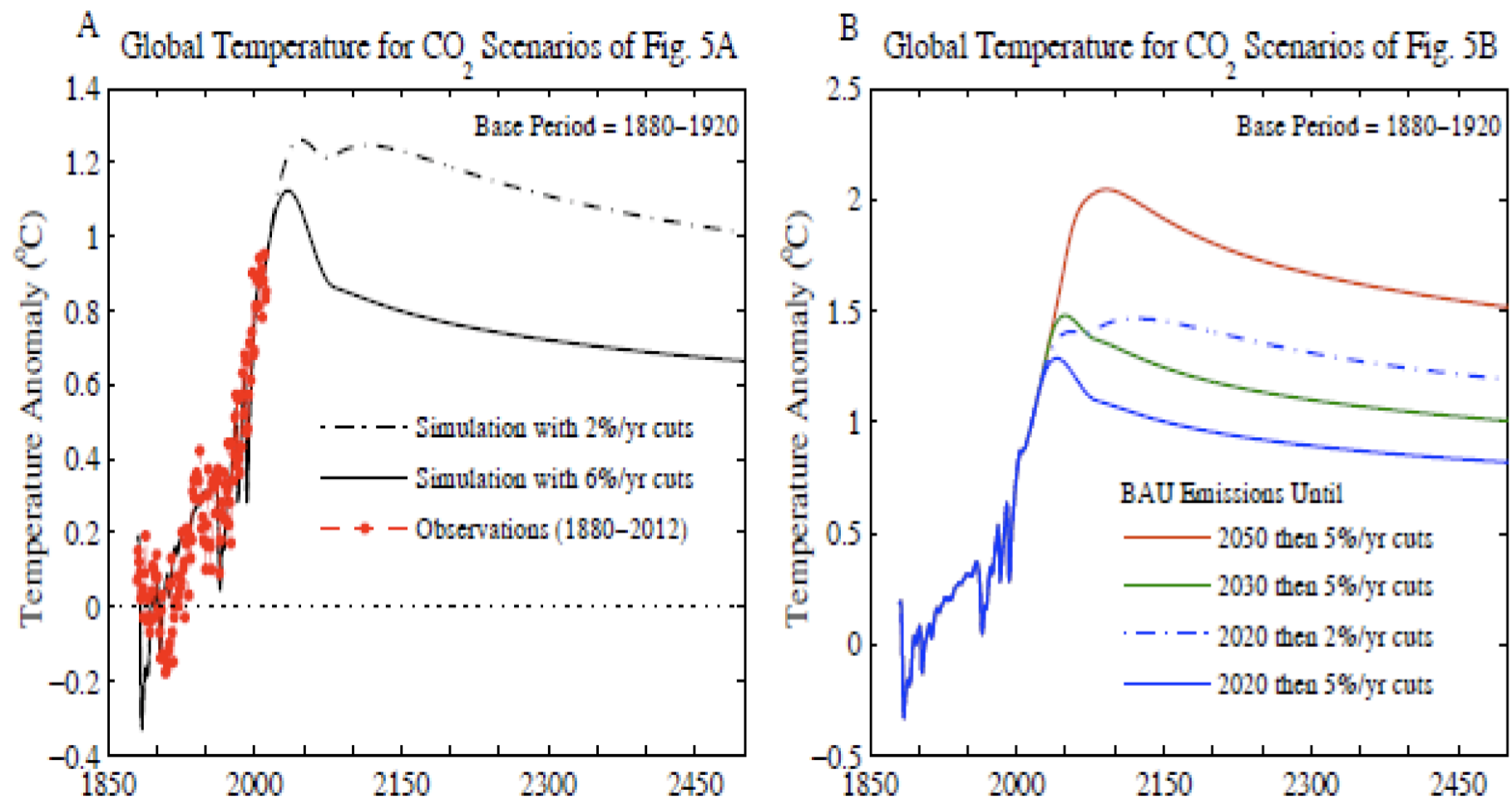


Figure 9. Simulated global temperature relative to 1880–1920 mean for CO<sub>2</sub> scenarios of Figure 5.  
 doi:10.1371/journal.pone.0081648.g009

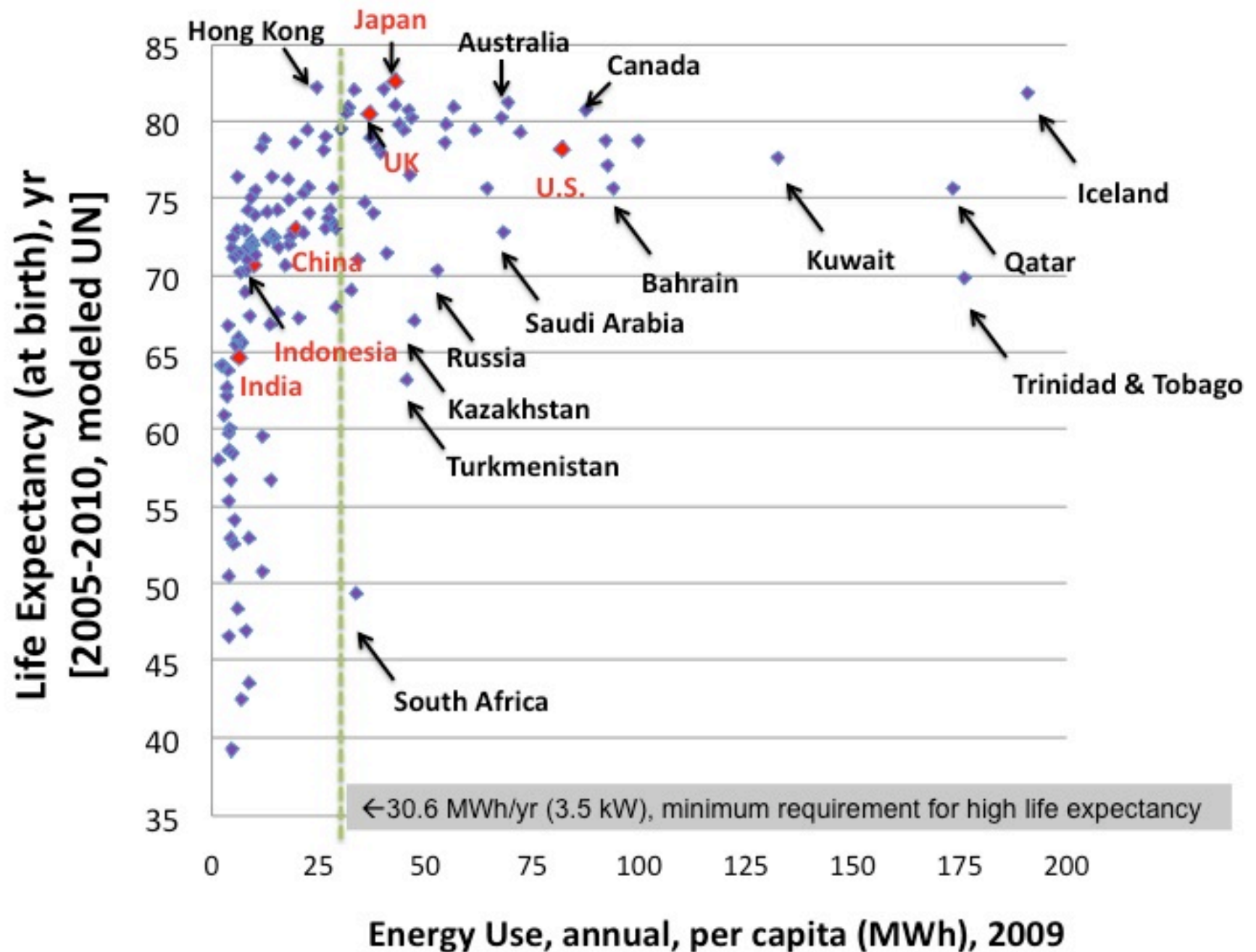
# *The Imperatives for C3 Prevention and Ecosocialist Transition*

Rapid replacement of fossil fuels (starting with phase out of coal and non-conventional petroleum such as fracked gas and tar sands) by global wind and solar energy power sufficient for:

- 1) Carbon-sequestration from the atmosphere to bring atmospheric level of CO<sub>2</sub> below 350 ppm (it is now 400 ppm)
- 2) Termination of energy poverty now afflicting the great majority of humanity.

**How much energy does  
humanity really need?**

Smil (2003, 2008) estimates a minimum requirement of 3.5 kilowatt per capita for high HDI



***3.5 kilowatt/person***  
***Necessary but not sufficient***

**Income Inequality drives bad health!**

Wilkinson R & Pickett K (2009) *The Spirit Level  
Why Equality is Better for Everyone*.  
Penguin Books. London.

Kawachi I & Kennedy BP (2006) *The Health of  
Nations: Why Inequality Is Harmful to Your Health*.  
The New Press. New York.

## *Energy Poverty in Africa*

	<b>Life Expectancy</b> (years)	<b>kilowatt/person</b> <b>consumption</b>	<b>Gini</b> <b>index</b>
Libya	74	4.3	0.36
South Africa	49.3	3.9	0.65
Nigeria	46.9	0.9	0.44
Ethiopia	52.9	0.6	0.30
Mozambique	39.2	0.6	0.46

For comparison:

<b>Cuba</b>	<b>78.3</b>	<b>1.4</b>	<b>0.30</b>
<b>United States</b>	<b>78.2</b>	<b>9.4</b>	<b>0.45</b>

## *So, how much energy does humanity need?*

Approximately 3.5 kilowatt/person

or for 7 billion people, 25 Tera Watts

(Now humanity consumes the equivalent of 18 Tera Watts.

7 billion people x 3.5 kilowatt/person = 25 Tera Watts;

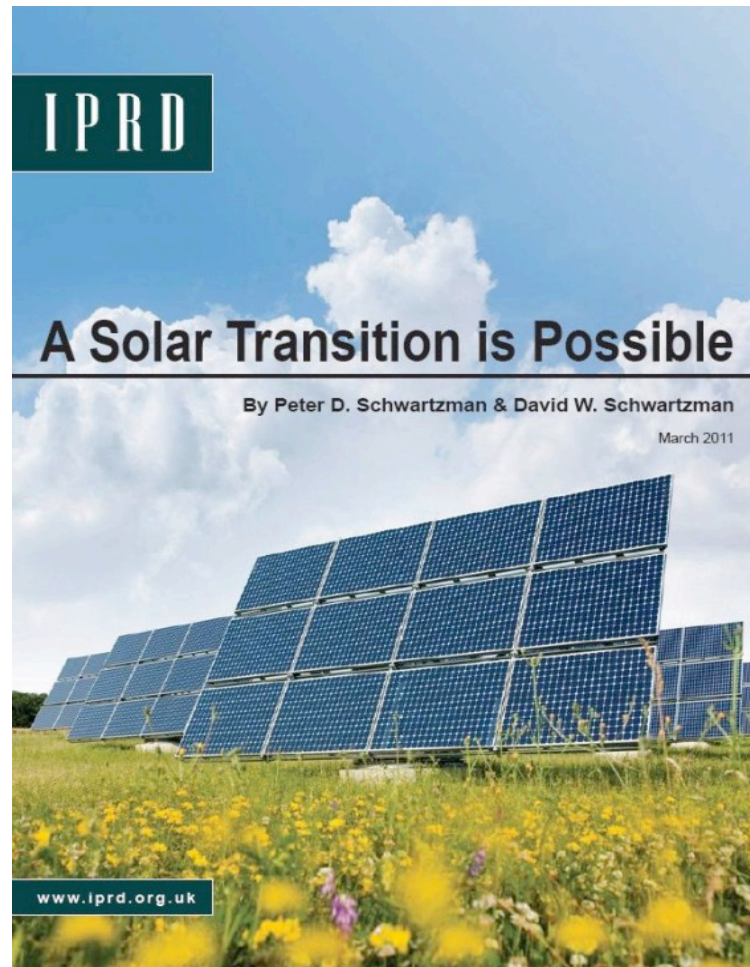
remember that Power = Energy/Time, watt is a unit of power.)

## *Degrowth in the global North?*

**We must confront the global North's historic responsibility for the threat of C3. Hence, the global North must create the solar energy infrastructure sufficient for carbon-sequestration from the atmosphere and a massive cleanup of the biosphere.**



*Does the **technology** now exist for  
robust **Solar Energy Transition**  
accompanied by a rapid and radical  
reduction of carbon emissions ?*



Peer-reviewed, Initially posted at: <http://iprd.org.uk>  
(Institute for Policy Research & Development)

*This Report and more at: [SOLARUTOPIA.ORG](http://SOLARUTOPIA.ORG)*

# Modeling Results

**Assuming *present* wind/solar technological capacities, using 1 to 2% of current annual consumption of energy (85% derived from fossil fuels) for wind/solar power creation per year:**

**A global-scale transition can be achieved in no more than 30 years, ending with zero anthropogenic carbon emissions, providing the rough minimum of 3.5 kilowatt/person energy consumption for all**

*Improvements in wind/solar technologies will make this transition easier and faster, specifically boosts in the Energy Return/Energy Invested Ratio ( “EROEI” ), requiring less fossil fuel input*

*Revolutionary breakthroughs in  
Renewable Energy  
Technologies ?*

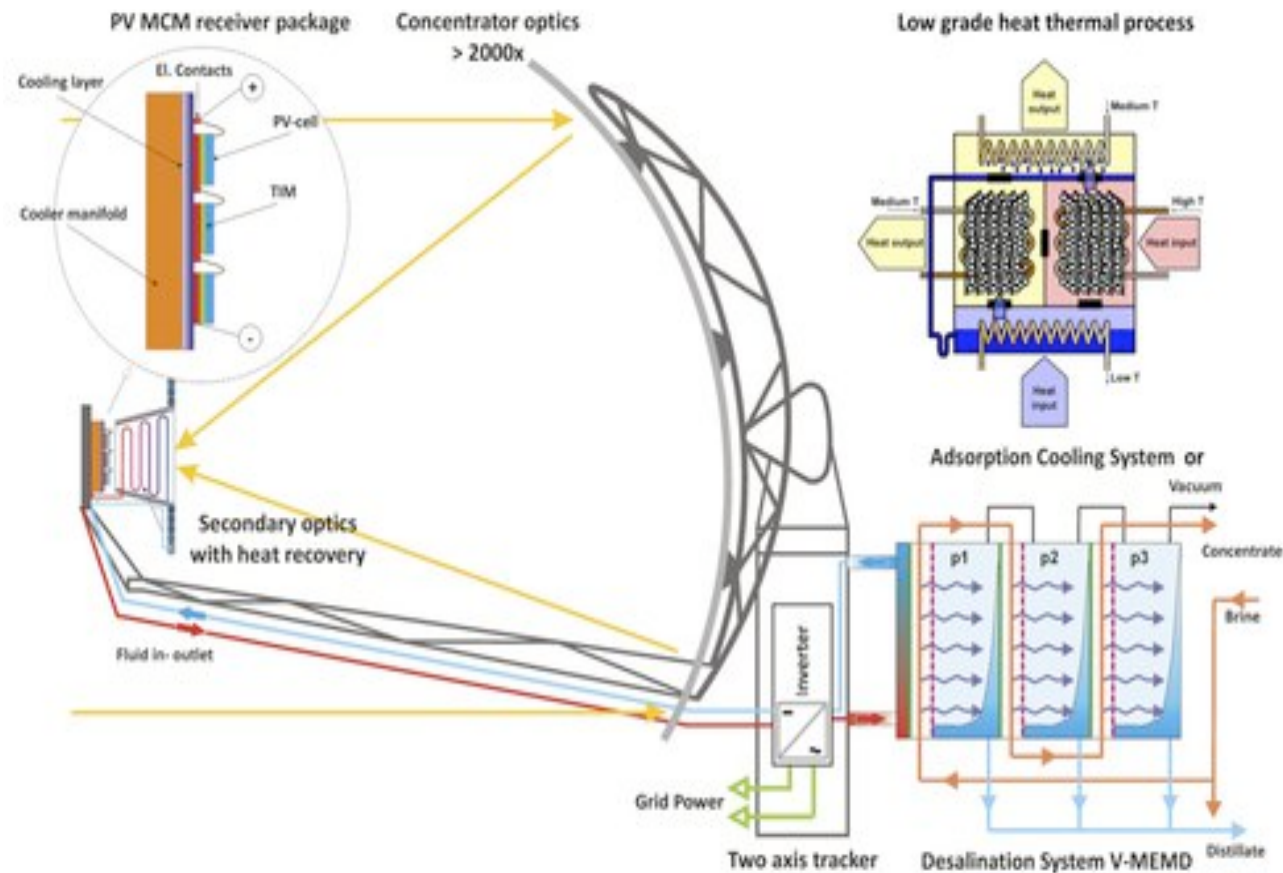
<http://arstechnica.com/science/2013/04/ibms-solar-tech-is-80-efficient-thanks-to-supercomputer-know-how/>

## **IBM's solar tech is 80% efficient thanks to supercomputer know-how**

Water that cools photovoltaics gets used for other purposes, upping efficiency. by **James Holloway** - Apr 23 2013, 3:58pm BST



IBM Research's prototype HCPVT system in Zurich.



© IBM

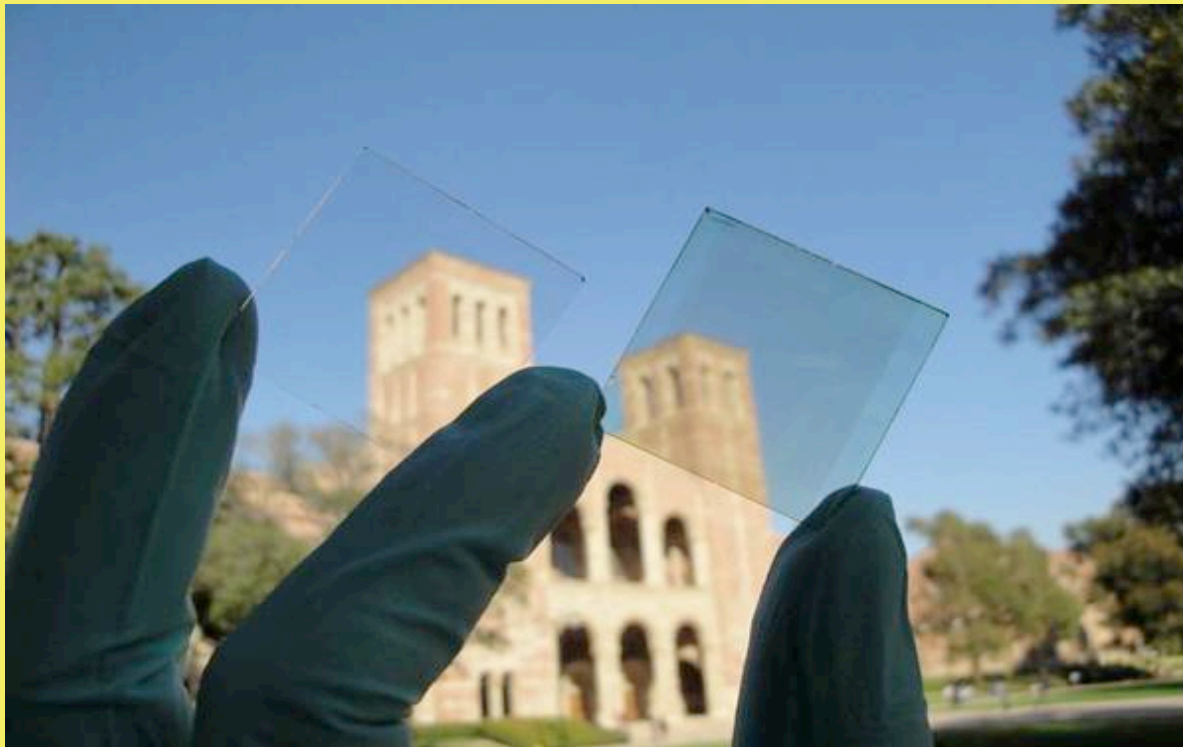
<http://www.treehugger.com/renewable-energy/ibm-solar-collector-magnifies-sun-2000x-without-cooking-itself.html>

They are targeting a cost below \$250 per square meter, which would be three-times lower than comparable systems and bring "levelized cost of energy" to less than 10 cents per kilowatt hour (KWh). At this price, it would be a good fit for Southern Europe, Africa, the Arabic peninsula, the southwestern United States, South America, and Australia.



<http://www.newscientist.com/blogs/onepercent/2012/08/green-machine-transparent-sola.html>

*Green Machine: Transparent solar cells could come cheap*





<http://www.skywindpower.com/ww/home.htm>

## **A Technology Key to Energy Independence and Arresting Global Warming**



Wake up, world!

Why look down, not up, to meet the world's there is far more than enough energy in high altitude winds, miles above the earth's surface, to supply all the world's power needs. And just average wind conditions high above the earth in the temperate zones of the Northern and Southern Hemispheres are sufficient to supply all the world's energy needs.

## *Solar Coops, Off-Grid Solar Power*

Sovacool, B.K. (2012) Deploying Off-Grid Technology to Eradicate Energy Poverty. *Science* 338: 47-48.

Local Clean Energy Alliance, Oakland CA  
[www.localcleanenergy.org](http://www.localcleanenergy.org)

*Engineers without Borders, Howard University*  
*Chapter: PVs in Senegal; Bunker Roy: Barefoot*  
*Approach in Africa*

(see: *Proceedings Spring 2010 Howard University Appropriate Technology Symposium*)

# Will **Green** Capitalism deliver this revolution?

“Several years ago, Tony Seba, an energy expert from Stanford University, published a book called *Solar Trillions*, predicting how solar technologies would redefine the world’s energy markets and create an investment opportunity worth tens of trillions of dollars.... His new prediction is that **by 2030, solar will make the fossil fuel industry more or less redundant**. Even more striking is his forecast That electric vehicles will do the same thing to the oil industry by around the same date.”

<http://reneweconomy.com.au/2013/how-solar-and-evs-will-kill-the-last-of-the-industry-dinosaurs-86893>

**How solar and EVs will kill the last of the industry dinosaurs**

By Giles Parkinson on 23 August 2013

*But is a market-driven “business as usual” scenario with a more aggressive investment in renewable energy infrastructure sufficient for C3 prevention, given the fact that global carbon emissions continue to climb?*

*Rather,  
multidimensional/transnational  
class struggle has the capacity to  
make this revolution in both the  
physical and political economies,  
especially as wind/solar technologies  
grow more efficient!*

***This struggle should include alliances, albeit temporary, with so-called green capital, undermining the “MIC” (i.e., the Military Industrial Fossil Fuel Nuclear State Terror and Surveillance Complex), the main obstacle to C3 Prevention....***

“Some of the more far-sighted corporations without significant investments in fossil fuels will see the way the wind is blowing and that money can be made from investing in alternative energies, as is already the case. This will create tension and splits among ruling elites and between conflicting corporate interests, which will open up space for social and labor movements to demand swifter and more coordinated action.” (Chris William, 2010, Ecology and socialism. Chicago: Haymarket Books. p.166, cited in my 2011 CNS paper)

***Reload Lenin! (i.e., utilize the divisions within capital)***

# *Multidimensional class struggle*

*On every scale,  
from the bedroom and the classroom to the globe  
(transnational)*

*At every intersection of the oppressed and the  
exploited, “race”, gender, sexual orientation, ethnicity,  
citizenship status, (a)religion, age, degree of  
able-bodiedness etc.*

*Transnational, multidimensional class struggle for social governance of production and consumption on all scales, neighborhood to global:*

- **Publicly owned and accountable banks, following the example of N. Dakota**
- **Municipalization of electric and water supplies**
- Reconversion of MIC to the new Green Clean Energy physical economy
- Nationalization of the energy, rail, and telecommunications industries
- **Compulsory licensing** of state-of-the-science wind/solar and information technologies, making them freely available globally
- **Creation of decentralized solar power, food, energy and farming cooperatives and worker-owned factories (solidarity economy)**
- Strengthening the regime for environmental, ecological and health protection for workers and communities, particularly for the industries supplying the new renewable energy technologies
- **Replacement of industrial and GMO agriculture with agroecologies**
- **Creation of green cities**
- Organizing the unorganized in all sectors, especially Global New Deal workers.  
**Terminate the prison-industrial complex and the Drug War.**



**Compulsory licensing** of state-of-the science wind/  
solar and information technologies, making them  
freely available globally, following the precedent of  
the Clean Air Act (US):

The Clean Air Act states that if technology exists  
that is vital to preventing and controlling air  
pollution or vital for the industry to meet the  
goals of the act (as determined by a government  
official), a court order could be sought that  
requires a patentee to license it under reasonable  
terms (after a hearing determines).

(Jane Zara, Left Forum, 2012)

***C3 is a Global Emergency***

# *Our papers*

**Schwartzman, D,**

1996. Solar Communism. *Science & Society*, Vol. 60 (3): 307-331. Online at:

[http://www.redandgreen.org/Documents/Solar\\_Communism.htm](http://www.redandgreen.org/Documents/Solar_Communism.htm).

2008, The Limits to Entropy: Continuing misuse of thermodynamics in environmental and Marxist theory. *Science & Society* 72 (1): 43-62. Online at: [http://www.redandgreen.org/Documents/Limits to entropy final.htm](http://www.redandgreen.org/Documents/Limits_to_entropy_final.htm)

2009a, Ecosocialism or Ecocatastrophe? *Capitalism Nature Socialism* 20 (1): 6-33.

2009b, Response to Naess and Hoyer. *Capitalism Nature Socialism* 20 (4): 93-97.

2011, Green New Deal: An Ecosocialist Perspective. *Capitalism Nature Socialism* 22 (3): 49-56.

2012a, A Critique of Degrowth and its Politics. *Capitalism Nature Socialism* 23 (1): 119-125.

2012b, “McKibben’s Climate Math is too Narrow and too Broad.” <http://climateandcapitalism.com/2012/07/24/mckibbens-climate-math-is-too-narrow-and-too-broad/>.

2013. “4 Scenarios for 2050.” *Capitalism Nature Socialism* 24 (1): 49–53.

2013, The great bifurcation and prospects for solar communism in the twenty-first century. *International Critical Thought* 3 (4): 480–495.

2014, Is zero economic growth necessary to prevent climate catastrophe? *Science & Society* 78 (2): 235-240.

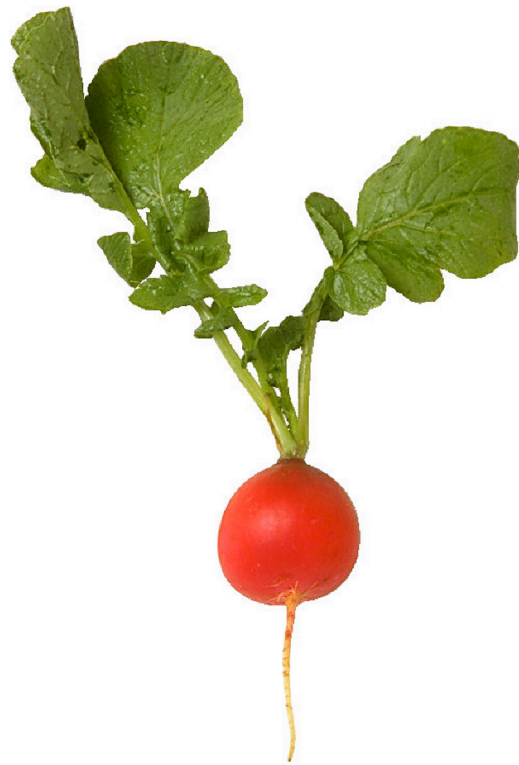
2014, Ted Trainer and the Simpler Way: a somewhat less sympathetic critique. *Capitalism Nature Socialism*, in press.

Schwartzman, D. and P. Schwartzman, 2013, A rapid solar transition is not only possible, it is imperative! *African Journal of Science, Technology, Innovation and Development* 5 (4): 297-302.

Schwartzman, P. and D. Schwartzman, 2011, A solar transition is possible. Online at: <http://solarUtopia.org> and <http://iprd.org.uk/>

(pdfs available upon request: [dschwartzman@gmail.com](mailto:dschwartzman@gmail.com))

*Radical and Radish have the Same Root*



*Be as Radical as Reality Itself, Be **Red** and **Green**!*

# Supplementary Material

*Wind/Solar must replace  
Fossil Fuels*

**Existing solar technologies** can now be the basis of a high efficiency infrastructure capable of replacing the present unsustainable fossil fuels/nuclear power/big hydropower energy/biofuels system, especially combined with greater energy efficiencies.

**These solar technologies include:**

*1) Wind power*

*2) Solar thermal power (CSP)*

*3) Photovoltaics, including near future thin film high efficiency technology*

Expansion of nuclear energy, specifically a reincarnation of fission-powered reactors with new technology, will not significantly mitigate global warming, nor will it plausibly avoid the well-known negative environmental and health impacts of this energy source.

A global mix of these three solar technologies coupled with a sophisticated grid and energy storage capacity can replace the current unsustainable energy infrastructure

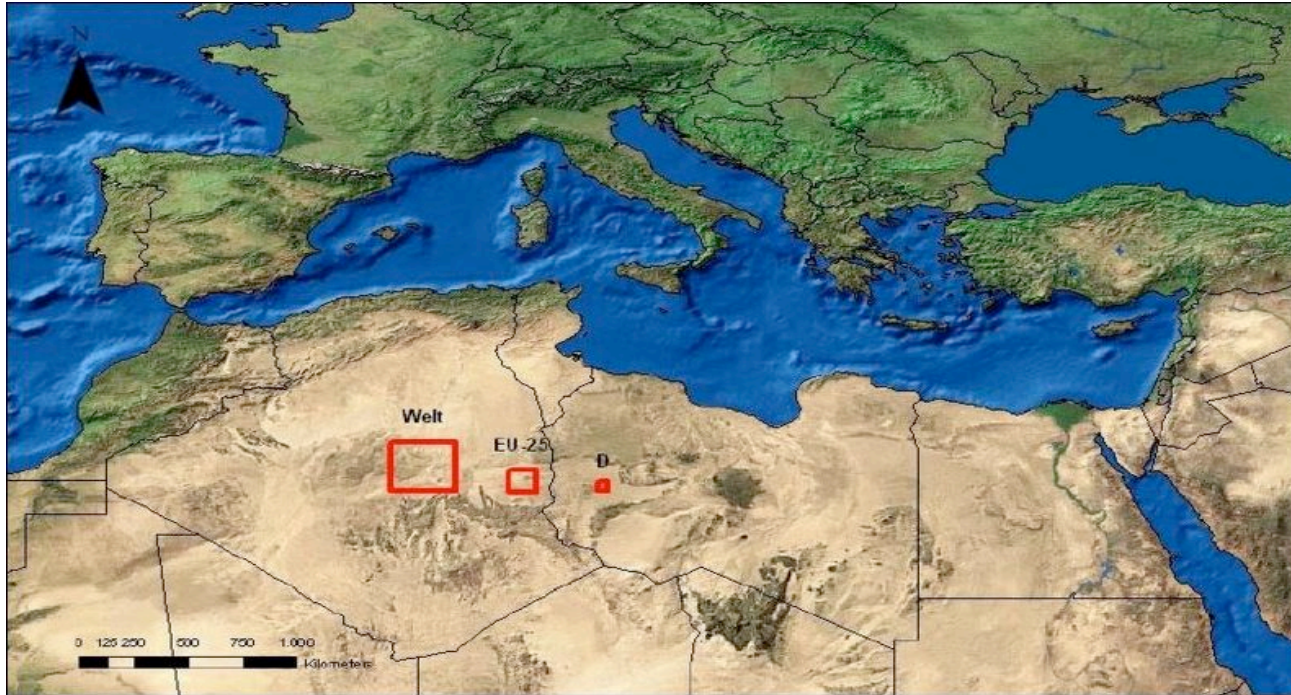
*if*

sufficient transnational political power can be generated to make this transition possible in a time frame sufficient to prevent C3.

<http://www.trecers.org/>

<http://www.trec-uk.org.uk/reports.htm>

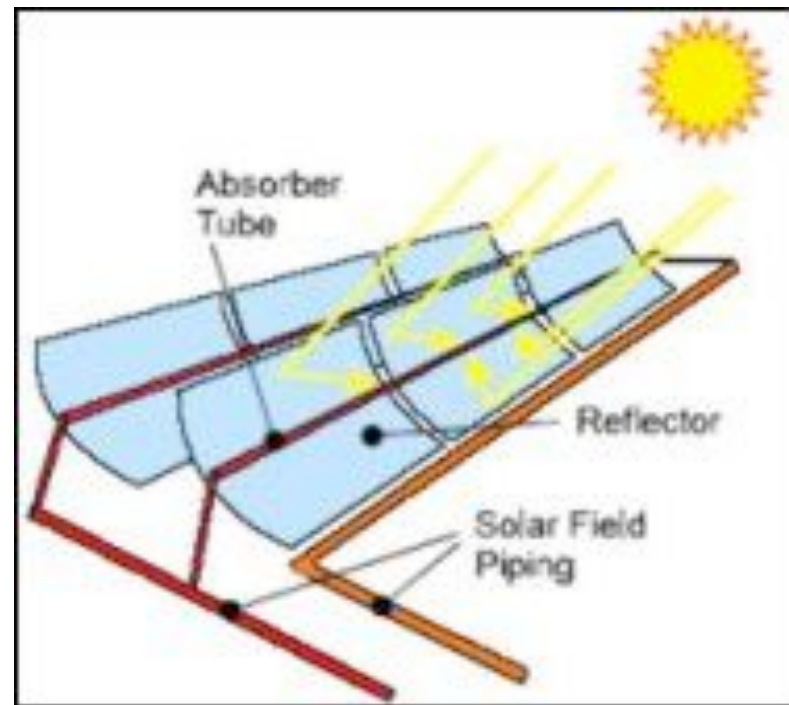
## Trans-Mediterranean Renewable Energy Cooperation



- For illustration: Areas of the size as indicated by the red squares would be sufficient for [Solar Thermal Power Plants](#) to generate as much electricity as is currently consumed by the World, by Europe (EU-25) and by Germany respectively. (Data provided by the German Aerospace Center (DLR), 2005) (Data provided by the [German Aerospace Center \(DLR\)](#), 2005)



# Sketch of a parabolic trough collector (CSP)



## *The material resources and land area needed for global solarization are already within reach.....*

If 15 percent of present **world rooftop area** were to be used to site *photovoltaics* with an assumed conversion efficiency of 20 percent, the current global electricity power capacity would be created.

(An estimate of global rooftop area is  $3.8 \times 10^{11} \text{ m}^2$ : Hashem Akbari, Surabi Menon, and Arthur Rosenfeld, “Global Cooling: Increasing World-wide Urban Albedos to Offset CO<sub>2</sub>,” *Climatic Change*, Vol. 94, 2009, pp. 275-286. )

*A global wind turbine infrastructure* could deliver several times the present global energy consumption while not closing off most of the land where it is sited to other uses (e.g., farming).

(Xi Lu, Michael B. McElroy, and Juha Kiviluoma, “Global Potential for Wind-generated Electricity,” *Proceedings of the National Academy of Sciences*, Vol. 106, No. 27, 2009, pp. 10933–10938.)

*Concentrated Solar Power (CSP)* in the Sahara could supply the current global electricity consumption on less than 6 percent of the Saharan land area (not that CSP should be only sited in the Sahara of course!).

(The Trans-Mediterranean Renewable Energy Cooperation (TREC) Project, published online at: <http://www.trecers.net/index.html>.)

## ***Our global climate is nearing tipping points.***

“Changes are beginning to appear, and there is a potential for explosive changes with effects that would be irreversible – if we do not ***rapidly*** slow fossil fuel emissions over the next few decades. Tipping points are fed by amplifying feedbacks. *As Arctic sea ice melts, the darker ocean absorbs more sunlight and speeds melting. As tundra melts, methane a strong greenhouse gas, is released, causing more warming. As species are pressured and exterminated by shifting climate zones, ecosystems can collapse, destroying more species.*”

(Jim Hansen, Feb. 15, 2009: The Sword of Damocles, op-ed submitted to The Observer)

<http://www.guardian.co.uk/environment/2012/sep/17/arctic-collapse-sea-ice>

# **Arctic expert predicts final collapse of sea ice within four years**

As sea ice shrinks to record lows, Prof Peter Wadhams warns a 'global disaster' is now unfolding in northern latitudes

John Vidal, Arctic Sunrise, 81N

guardian.co.uk, Monday 17 September 2012 11.14 BST

**More alarming signs of the worse case scenario being most likely:  
Warmer still: Extreme climate predictions appear most accurate,  
report says** (Brian Vastag, Washington Post, Nov. 8, 2012, reporting  
On Fasullo and Trenberth (2012) Science 338: 792-794)

### *C3 Prevention, the material requirements:*

*Radical and rapid reduction in carbon emissions to the atmosphere (especially carbon dioxide, methane and soot),*

*coupled with aggressive energy conservation and buildup of global wind/solar power, sufficient to sequester carbon from the atmosphere below the “safe” limit of 350 ppm (carbon dioxide level).*

# Assessment of Target CO<sub>2</sub>

## Phenomenon

## Target CO<sub>2</sub> (ppm)

- |                              |         |
|------------------------------|---------|
| 1. Arctic Sea Ice            | 300-325 |
| 2. Ice Sheets/Sea Level      | 300-350 |
| 3. Shifting Climatic Zones   | 300-350 |
| 4. Alpine Water Supplies     | 300-350 |
| 5. Avoid Ocean Acidification | 300-350 |

→ Initial Target CO<sub>2</sub> = 350\* ppm

\*assumes CH<sub>4</sub>, O<sub>3</sub>, Black Soot decrease

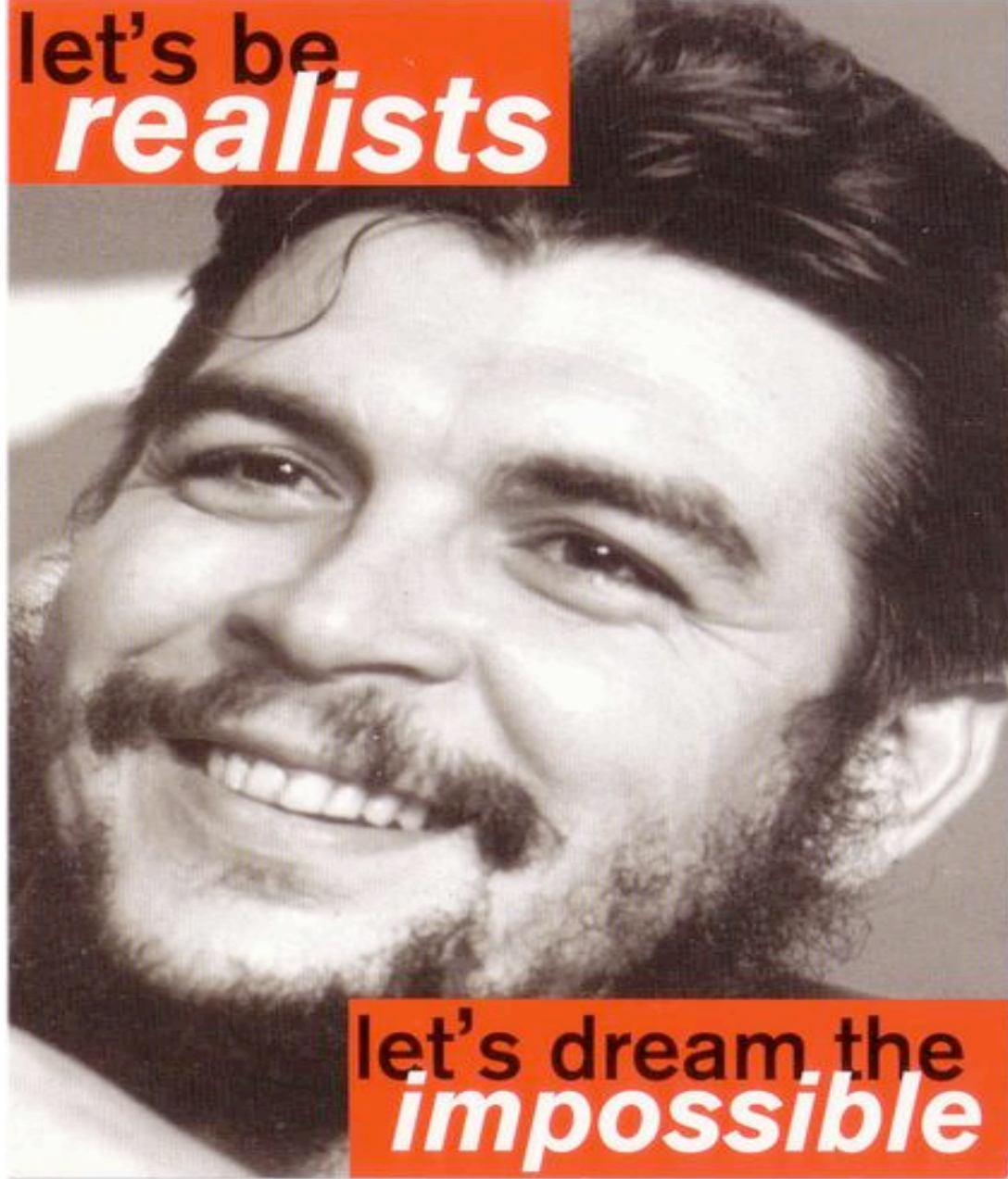
Reference: Hansen et al. Target Atmospheric CO<sub>2</sub>, Open Atmos. Sci., 2008

*The C3 Prevention Program must include  
Carbon Sequestration from the Atmosphere  
to bring the atmospheric CO<sub>2</sub> level  
below 350 ppm (it is now 395 ppm)*

**(NOT the same as “Clean” Coal or other  
Geoengineering Technofixes!)**

*Two technologies to achieve this objective:  
Agroecologies increasing soil carbon and  
Solar-powered industrial C-sequestration*

let's be  
*realists*



let's dream the  
*impossible*



*Threat of **Catastrophic Climate Change (C3)**  
and Nuclear War pose an **unprecedented  
opportunity** to end the rule of capital on our  
planet,*

*because the main obstacle to elimination of these threats is  
the “**MIC**”, aka the **Military Industrial (Fossil Fuel,  
Nuclear, State Terror) Complex** at the core of real existing  
Capitalism*

*Ecosocialist transition can only  
be achieved by  
multidimensional, transnational  
Class Struggle*

*Mass struggle for radical reforms provide the school  
for radicalization, to end the rule of capital.*

*Is capitalism now in terminal crisis?*

*Let's make this possibility a  
reality by terminating it, before  
it terminates us!*

*Ecosocialist strategy:  
Global Green New Deal confronts  
converging multiple crises;  
C3 prevention must begin now!*

# So, just how much energy does humanity really need?

Assuming a minimum of **3.5 kilowatt per capita** necessary for highest achievable quality of life, then **x 7 billion people** would require a global power capacity of 24.5 TW or 1.5 x the present delivery of 16 TW.  
(1 Tera Watt (TW) =  $10^{12}$  watts). **Recall that Energy = Power x Time**

**Hence, while the U.S. and several other countries need to reduce their energy consumption, most of the Global South requires a significant increase to achieve “state of the art/science” quality of life.**

**But a shift to wind and solar-generated electricity as an energy source could reduce the required power level by 30% once a global system is created...** (Jacobson and Delucchi, “A Path to Sustainable Energy by 2030”, November 2009, Scientific American: “For example, only 17 to 20 percent of the energy in gasoline is used to move a vehicle (the rest is wasted as heat), whereas 75 to 86 percent of the electricity delivered to an electric vehicle goes into motion.” )

Future progress in increased energy efficiency, such as dematerialization of information technology, will likely reduce the required minimum per capita consumption.

A shift to solar power would likely increase quality of life for the same level of present energy consumption by reducing/eliminating the negative externalities of fossil fuels and nuclear power (e.g., the impact of air and water pollution on health).

On the other hand, in the transition to that “other world that is possible” additional energy will likely be required to clean up the “mess” left by the historic dependency on fossil fuels and nuclear power, and in addition to repair the physical infrastructure, create green cities globally, and to sequester  $\text{CO}_2$  out of the atmosphere (using solar power and agroecologies such as permaculture).

*Is Degrowth the Solution?*

# **“Self-Evident Truths [sic] A no-nonsense declaration”**

**by Derrick Jensen\***

**“We demand the immediate, explicit, and legally binding recognition that perpetual growth is incompatible with life on a finite planet. Economic growth must stop, and economies must begin to contract. We demand acknowledgment that if we don’t begin this contraction voluntarily, it will take place against our will, and will cause untold misery.**

We demand an immediate and permanent halt to all extractive and destructive activities: fracking, mountaintop removal, tar sands production, nuclear power, and offshore drilling chief among them. **The list of activities to be halted must also include the manufacture of photovoltaic panels, windmills, hybrid cars, and so on.** We must find nondestructive ways of becoming a sustainable society.” \*([July/August 2012](http://www.orionmagazine.org/index.php/articles/article/6916) issue of *Orion* magazine, <http://www.orionmagazine.org/index.php/articles/article/6916>



# Richard Heinberg, “The End of Growth”, 2011

**“there is no credible scenario in which alternative energy sources can entirely make up for fossil fuels as the latter deplete. The overwhelming likelihood is that, by 2100, global society will have less energy available for economic purposes, not more....**

A full replacement of energy currently derived from fossil fuels with energy from alternative sources is probably impossible over the short term; it may be unrealistic to expect it even over longer time frames. . . . It is highly unlikely that the entire world will ever reach an American or even a European level of energy consumption, and even the maintenance of current energy consumption levels will require massive investment. . . . **Fossil fuel supplies will almost surely decline faster than alternatives can be developed to replace them.** New sources of energy will in many cases have lower net energy profiles than conventional fossil fuels have historically had, and they will require expensive new infrastructure to overcome problems of intermittency ...**we believe that the world has reached immediate, non-negotiable energy limits to growth.”**

*Au contraire*, we show that a complete global transition to wind/solar energy is possible using current technology in 20-30 years, **IF** we start now rapidly replacing our unsustainable energy supply (85% fossil fuel)!

Richard Heinberg's prescription would doom most of humanity to a future of living hell (for those who survive).

(for details go to: [www.solarUtopia.org](http://www.solarUtopia.org))

# *How much Petroleum is needed for this Solar Transition?*

**Conventional Petroleum (oil and natural gas)** is the preferred energy source for transition to a fully wind/solar global energy supply because of its lower carbon footprint with respect to global warming compared to **coal or non-conventional hydrocarbons (tar sands, oil shale, fracked natural gas)**.

**We estimate that a maximum of 40% of the estimated global conventional proven petroleum reserves (oil and natural gas) are needed for a full solar transition in 25 years.** (for details go to: [www.solarUtopia.org](http://www.solarUtopia.org))

*New wind and solar technologies  
with higher EROEI values will  
make this solar transition faster,  
requiring even less conventional  
petroleum*

# Meeting the needs of humanity and nature

**Deconstructing economic growth: qualitative versus quantitative aspects**  
(e.g., culture, information, dematerialization of technology)

The Energy Base of an economy is critical: global solar power will pay its "entropic debt" to space as non-incremental **waste heat**

**Green sustainable growth** in transition to a steady-state global solar economy: Clean air and clean water, organic food, meaningful employment and more free creative time for all on this planet

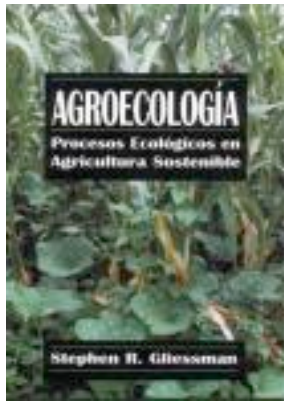
**Demilitarization, Solarization, Agroecology**

*Struggles for radical reforms must begin under capitalism,  
opening up a path to **Ecosocialist** transition*

## *Benefits of Implementing this Solar Transition*

Rapid replacement of current unsustainable energy supplies with *Wind/Solar* providing the state-of-the-science requirements for everyone on our planet asap (a minimum of 3.5 kilowatt/person).

Rapid decarbonation of energy supplies (with phaseout of coal first) and a chance to bring down the atmospheric CO<sub>2</sub> level below 350 ppm confronting the challenge of C3.



# Agroecology



**Cuban agroecology**  
in practice:

Funes et al., 2002,  
Sustainable Agriculture  
and Resistance. Food  
First Books.

But can agroecology still feed the world's population without the well-known negative impacts of industrial agriculture? There is a very good case that it can, even in preferred synchronicity with the process of solarization

Reference: Badgley et al., 2007, Organic Agriculture and the Global Food Supply. *Renewable Agriculture and Food Systems* 22, 86-108.



# What is the main obstacle to C3 prevention?



## *The critical challenge of demilitarization*

"Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed, those who are cold and are not clothed. This world in arms is not spending money alone. It is spending the sweat of its laborers, the genius of its scientists, the hopes of its children... This is not a way of life at all, in any true sense. Under the cloud of threatening war, it is humanity hanging from a cross of iron."

Dwight Eisenhower (1953)

*The avoidance of catastrophic climate change (C3) requires the end of coal and fossil fuel addiction, giving up the nuclear option and a rapid conversion to a high efficiency solar energy infrastructure.*

*MIC is likely the biggest single obstacle to preventing C3:*

- 1) MIC is the present core of global capital reproduction with its colossal waste of energy and material resources.
- 2) The integration of fossil fuel/nuclear industry in MIC.
- 3) MIC's dominant role in setting the domestic/foreign policy agenda of the United States, with no evidence of weakening in the present administration.
- 4) **Pentagon as the “global oil-protection service”** for the U.S. imperial agenda (Klare), or even for the transnational capital class itself (e.g., Robinson).
- 5) The **Imperial Agenda** blocks the global cooperation and equity required to prevent C3.

# *Climbing MIC*

***Falling to oblivion:*** Contemplating the challenge of overcoming the greatest State Terror Apparatus in the history of the world understandably generates the same fear as imaging oneself in the position of this climber who is using not ropes, only his hands and feet. But when millions collaborate, including those who work for MIC, climbing together, we will succeed... Once on top, MIC will be dissolved and its resources converted to serve humans and nature.



A global solar transition replacing the present unsustainable energy supplies must be parasitic on these supplies, just as the industrial fossil fuel revolution was parasitic on biomass energy, so-called plant power, until it replaced the former supply with sufficient capacity.

Mainly because of its lower carbon emission footprint compared to coal, **the preferred fossil fuel to make a solar transition is conventional petroleum (oil and natural gas, but *excluding* tar sands, fracked natural gas, and dangerous drilling on deep water continental shelves).**

**Oil rich countries in the Mid-East and South America (e.g., Venezuela) will be valuable partners in this solar transition by providing the needed petroleum.**

***But a global regime of equity and cooperation is required!***

*The path to **climate  
security** passes through  
Gaza...*

Available at:

*JNF eBook Vol 4 - JNF eBook Series*

*[www.jnfebook.net/JNFeBookVol4.pdf](http://www.jnfebook.net/JNFeBookVol4.pdf)*

**Real climate security** will only come with the radical reduction of The MIC and its servant the Pentagon. Without this challenge to the MIC and its Imperial Agenda, we can anticipate at best pathetic curbs on carbon emission (note the outcome of Copenhagen and Durban), insufficient to avoid C3, combined with the expanded military agent of the MIC.

*Some helpful dialectics:*

*Growth of solar power capacity and energy efficiency undermines the rationale and popular support for the MIC, and the struggle against the Imperial Agenda and for global demilitarization promotes a more peaceful and cooperative world thereby freeing up both resources and labor for the creation of a global solar energy infrastructure.*



Degrow the Military Industrial Complex,  
Grow the New Green Economy!

Creating the social and material base for  
EcoSocialist transition out of capitalism  
while still having a chance to prevent  
catastrophic climate change

Political requirement: transnational,  
multidimensional class struggle



# Urban farming

For example, Common Good City Farm, V St. NW, DC





Photos source: <http://commongoodcityfarm.org/>

# *McKibben's climate math is too narrow and too broad*

**by David Schwartzman**

<http://climateandcapitalism.com/2012/07/24/mckibbens-climate-math-is-too-narrow-and-too-broad/> (Posted on July 24, 2012)

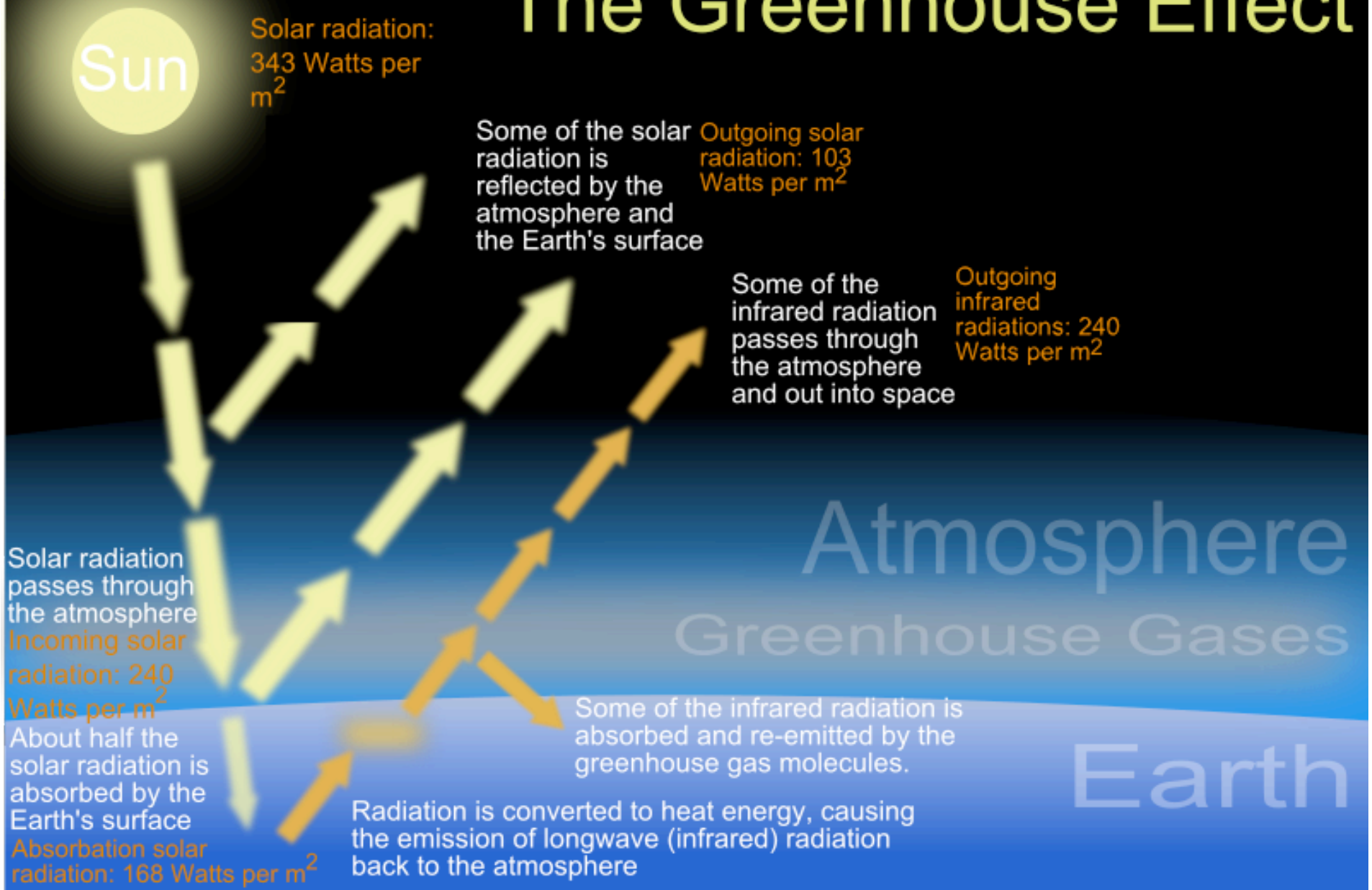
A response to Bill McKibben's

**Global Warming's Terrifying New Math,**

<http://www.rollingstone.com/politics/news/global-warmings-terrifying-new-math-20120719> (Posted on July 19, 2012)



# The Greenhouse Effect



*Is the rise of atmospheric CO<sub>2</sub> from pre-industrial (280 ppm) to the present level of 400 ppm anthropogenic (i.e., produced by human technological activity)?*

**YES!**

**Evidence:**

1) Dilution of C<sup>14</sup> level in atmosphere by introduction of “dead” carbon from burning fossil fuels (tree ring record).

2) Inventory of fossil fuel consumption since 1880s: roughly 40% released remains in atmosphere (see Tyler Volk, “CO<sub>2</sub> Rising”, 2008, MIT Press)

(More on this subject: <http://www.realclimate.org/index.php/archives/2004/12/how-do-we-know-that-recent-co2-increases-are-due-to-human-activities-updated> )

*From [www.solarUtopia.org](http://www.solarUtopia.org)*

## *Modeling the Global Solar Transition*

$$d(P_{RE})/dt = [(M/L)(f)(P_{RE})] + [(M/L)(f_{FF})(P_{FF})]$$

$P_{RE}$  : Renewable Power (“RE”);  $t$ : time in years;

$P_{FF}$  : Current power delivery (85% Fossil fuels)

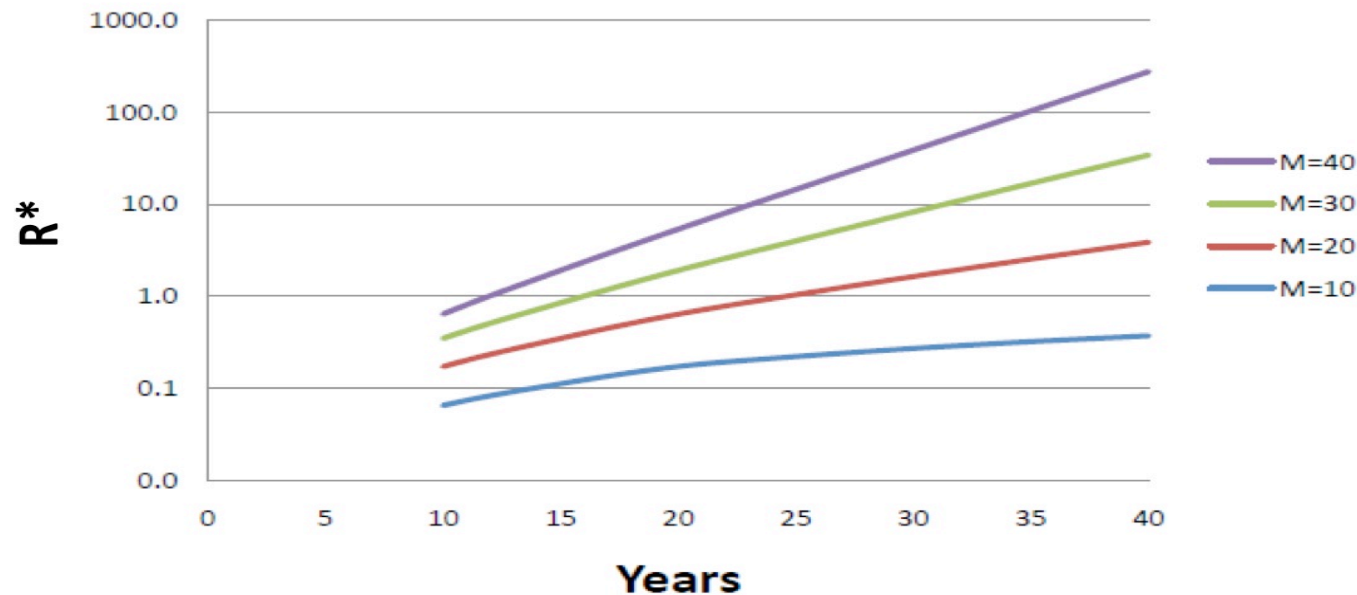
$f$  : fraction of  $P_{RE}$  used to make more  $P_{RE}$

$f_{FF}$  : fraction of  $P_{FF}$  used to make more  $P_{RE}$

$L$ : lifespan of any RE source

$M$  (= EROI or EROEI): Energy return over energy invested for RE

$(M/L)$  x instantaneous energy invested = instantaneous RE created



## Future Renewable Energy Capacity with different assumed *Energy Return Over Energy Invested* values (“EROEI”) = M for wind/solar technologies

(Modeling Study of Solar Transition, Peter and David Schwartzman)

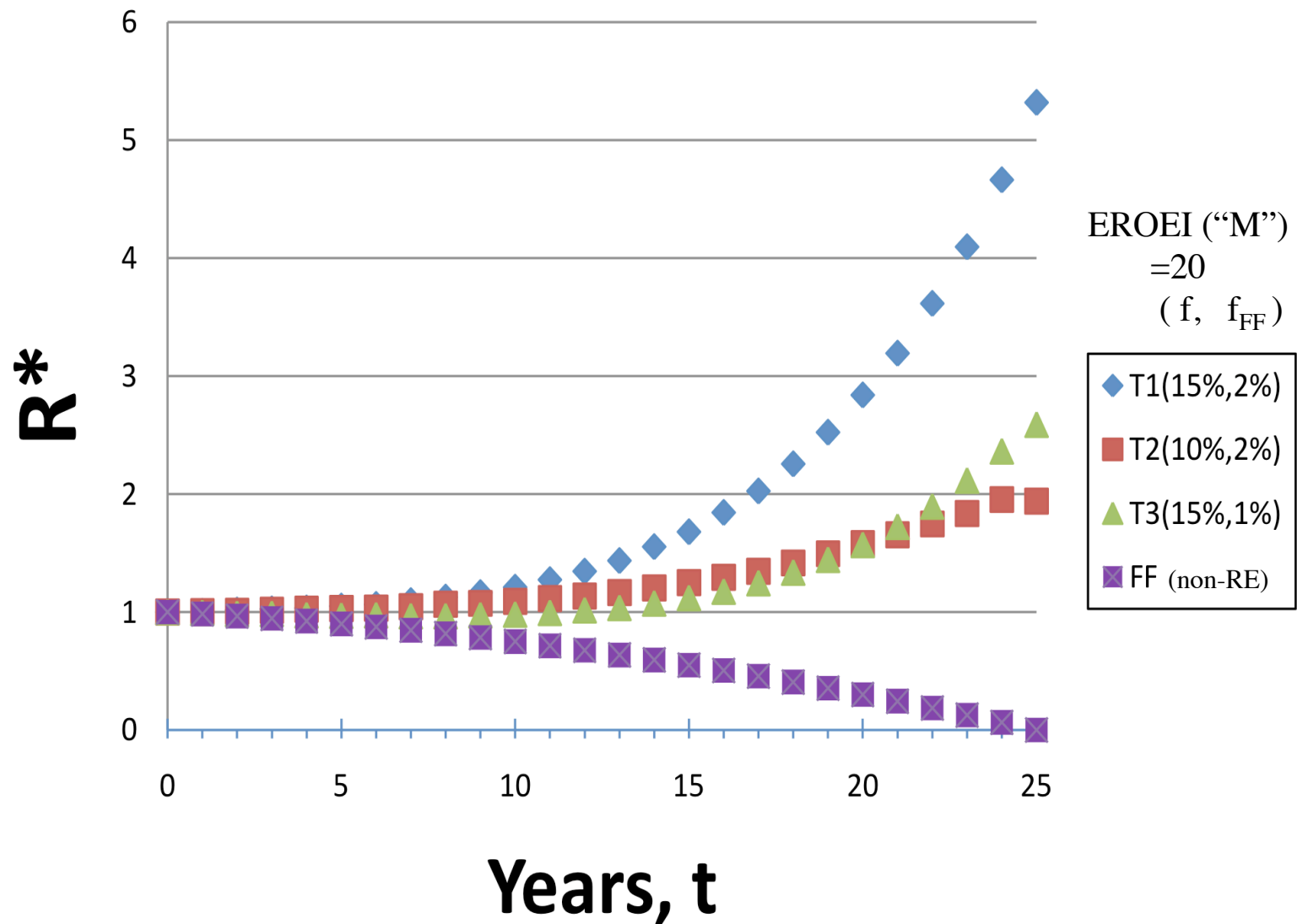
$R^*$  is the ratio of future global renewable power capacity to existing fossil fuel power generation, thus represents the energy capacity available relative to the current fossil fuel demand.

Assumed *Lifetime* of installed wind/solar = 20 yrs, with 10% of wind/solar energy produced being reinvested in making more of the same, and with 1% of fossil fuel energy being used to continuously create wind/solar power (this fossil fuel energy consumption is assumed in this model calculation to be equal to the present rate).

**State of the Science values of EROEI:** Wind turbines: 20 to 75; Photovoltaics: 6-10; CSP: 2-7



# Figure 1: Energy Production in Transition



# *How much Petroleum is needed for this Solar Transition?*

Here is the function used for progressive phase out of non-RE energy sources over the assumed 25 year transition period, with  $t$  being the time in years:

$FF = 1 - 0.015t - 0.001t^2$  ;  $\int FF dt$  from  $t = 0$  to 25, gives a total FF consumption equal to 15.1 times the present annual global energy consumption level (0.47 ZJ)\* or 7.1 ZJ,

which is **43% of the estimated global 16.7 ZJ remaining in conventional petroleum reserves (oil and natural gas)**. Of course coal, nuclear power, as well as hydropower and biofuels with significant carbon footprints, can contribute to RE creation before being phased out completely in 25 years, and thus **this computed fraction of petroleum reserves needed as a backup is a maximum.**

***(Note: the “proven” reserves cited do not include Tar Sands, Oil Shale or Fracked Natural Gas)***

(In 2008, total worldwide energy consumption was 474 exajoules ( $474 \times 10^{18}$  J = 132,000 TWh). (en.wikipedia.org/wiki/World\_energy\_consumption). Smil (2008), footnote 49 in our report, cites Ahlbrandt et al. (2006) Global Resource Estimates from Total Petroleum Systems. Tulsa, Okla. AAPG.: remaining natural gas = 415 T cubic meters of which 31% is remaining reserves with eventual growth amounting to 24%. This gives a proven reserve of ( $0.55 \times 415$ ) = 228 T cubic meters (= 8.50 ZJ) giving a total Petroleum proven reserve of 16.7 ZJ. )

# *The role of energy conservation in solar transition*

Many countries in the global North can reduce their energy consumption per capita levels with **aggressive energy conservation**, improving their quality of life, as well as reducing the extraction of fossil fuel reserves thereby *freeing up additional FF for RE creation, especially for the global South bearing the brunt of energy poverty. This potential and highly desirable transfer from the global North to the global South would translate into a positive contribution to both with respect to quality of life.*

Likewise energy conservation in the global South can free up FF for RE creation as well as increase its dedicated use without increasing carbon emission in order to reach the 3.5 kilowatt per capita level during the solar transition.

## *C-sequestration from the atmosphere in a Solar Transition*

Lal (2010) estimates 2-4 Pg per year of carbon from the atmosphere could be sequestered globally as soil carbon from the atmosphere using agroecological approaches. Assuming a rate of 2 Pg/year, in 50 years 100 Pg of carbon could be sequestered from the atmosphere. A likely complementary approach is solar-powered industrial carbon sequestration from the atmosphere. Assuming a minimum energy requirement of 442 KJ/mole CO<sub>2</sub> (Zeman, 2007; House et al., 2011), 100 Pg of carbon could be sequestered from the atmosphere using 3.7 ZJ, equivalent to 7.3 years of the present global energy delivery (16 TW). **In a robust solar transition, assuming 7 ZJ of conventional petroleum are consumed in 25 years, with EROEI of wind/solar equal to 25 (same as their lifetime in years), then a total of 51 ZJ is generated, with industrial carbon sequestration energy being 7% of the total. This requirement would of course be reduced by the use of agriculturally-driven carbon sequestration into the soil.**

### References

Lal, R., 2010, Managing soils and ecosystems for mitigating anthropogenic carbon emissions and advancing global food security. *BioScience* 60: 708-721; House, K.Z., Baclig, A.C., Ranjan, M., van Nierop, E.A., Wilcox, J., and H.J. Herzog, 2011, Economic and energetic analysis of capturing CO<sub>2</sub> from ambient air. *PNAS* 108, No. 51: 20428-20433; Zeman, F., 2007, Energy and material balance of CO<sub>2</sub> capture from ambient air. *Environ. Sci. Technol.* 41: 7558-7563.

## **Hansen's C3 Prevention Program:**

**6%/year reduction in fossil fuel consumption starting now, with 100 Pg of carbon sequestered from the atmosphere by reforestation from 2031-2080 leaving 350 ppm CO<sub>2</sub> in the atmosphere by 2100.**

**The current official goal of a 2 deg C global temperature increase over pre-industrial (about 1 deg C warmer than now) roughly equivalent to 450 ppm CO<sub>2</sub> is a “prescription for disaster” (Hansen et al., 2011)**

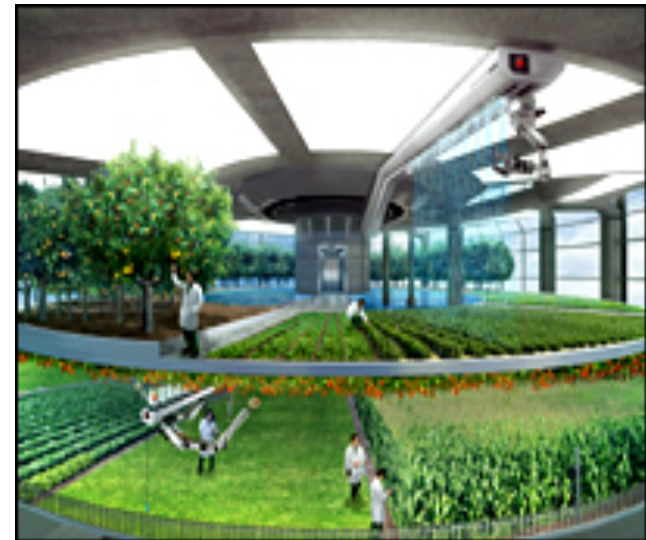
**BAU (Business As Usual) carbon emissions projected to 2100 will likely result in several meter sea level rise, owing to non-linear melting of the ice-caps (Hansen and Sato, 2012)**

Hansen et al., 2011, The Case for Young People and Nature: A Path to a Healthy, Natural, Prosperous Future. <http://www.columbia.edu/~jeh1/mailings/>.

Hansen, J.E. and M.Sato, 2012, Paleoclimate implications for human-made climate change. arXiv:1105.0968v3 [physics.ao-ph]

# The Vertical Farm

<http://www.verticalfarm.com/>



“...*Capital*, I, chapters 6 and 7.

**Labor power is, always and necessarily, a special commodity, never subject to full valorization like other commodities. Its value is always the outcome of the balance of class forces** (“balance” here in the sense of “relationship” or “correlation,” with no implication of “equilibrium” or any sort of inherent equality or consistency). For present purposes, this means that reforms — all of the proposals emanating from the Reformists as enumerated above\*, plus undoubtedly many more — are not only “good things” from the standpoint of the 99%; they represent changes in the balance of forces. They are *empowering*. Empowerment of the exploited is inherently problematic: capitalism must vigorously oppose it, even when it is entirely warranted in terms of general productive development or some superior social–philosophical ethic.”

\* “...reforms: fair taxation, government (public) responsibility for job creation in the last instance, full funding for health care, education, child and elder care, ecological sustainability.”

(Laibman, 2012, Editorial Comment, *Science & Society*)

## *Class struggle redux*

“So does the declaration by radical bourgeois feminists, eco-feminists, deep ecologists, libertarian ecologists, communitarians, etc. that Marxism is dead. ...it is possible to point out that **in ecological Marxist theory, the struggle over production conditions has redefined the class struggle** beyond any self-recognition as such, at least until now. This means that the capitalist threats to the reproduction of production conditions are not only threats to profits and accumulation, but also to the viability of the social and “natural” environment as a means of life.”

[red and bold added]

James O'Connor, 1986, CNS 1(1): 11-38.



# *Roots of the Degrowth Movement*

Georgescu-Roegen's (mis)take on entropy

Limits to Growth (Club of Rome)

Neo-Malthusian revival

Peak Oil Prophets, notably Richard Heinberg;

link to Transition City movement, Int'l Forum on  
Globalization/Post Carbon Institute

*Degrowth in Europe:*

*Latouche, "Farewell to Growth"*