

*Rapid Solarization can drive
Sustainable Economic Growth
while Preventing **Catastrophic
Climate Change***

David Schwartzman

Department of Biology, Howard University

dschwartzman@gmail.com

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(see Schwartzman, 2009, *Capitalism Nature Socialism* 20, No.1, 6-33)

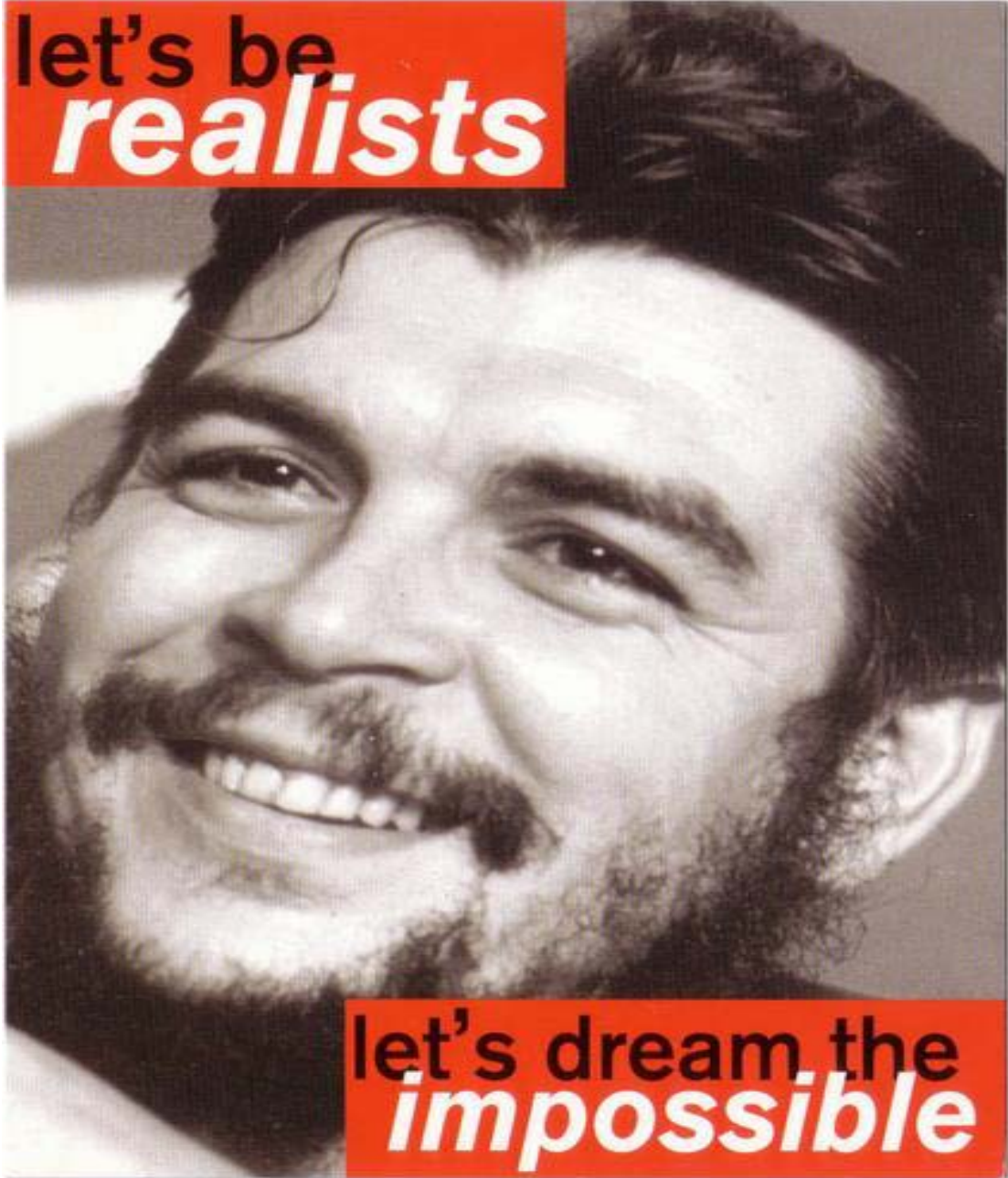
"More than at any other time in history, mankind faces a crossroads. One path leads to despair and utter hopelessness. The other, to total extinction. Let us pray we have the wisdom to choose correctly.

Woody Allen

“We can’t do anything to change the world until capitalism crumbles. In the meantime we should all go shopping to console ourselves.”

Banksy, 2006

let's be
realists



let's dream the
impossible

The threat of catastrophic climate change ("C3") now confronts all humanity. What are the biggest obstacles to prevention? And why is this challenge also an unprecedented opportunity to end the global rule of capital?

I will argue that

- 1) replacing Capitalism with **Ecosocialism** cannot be a prerequisite to begin taking effective preventative action to avoid C3, but rather, overcoming the obstacles to an effective prevention program will open up an unprecedented path for an **ecosocialist** transition out of capitalism.*
- 2) and **ecosocialist** theory and practice are essential to make C3 prevention possible.*

*James O'Connor has a succinct description of
red and green:*

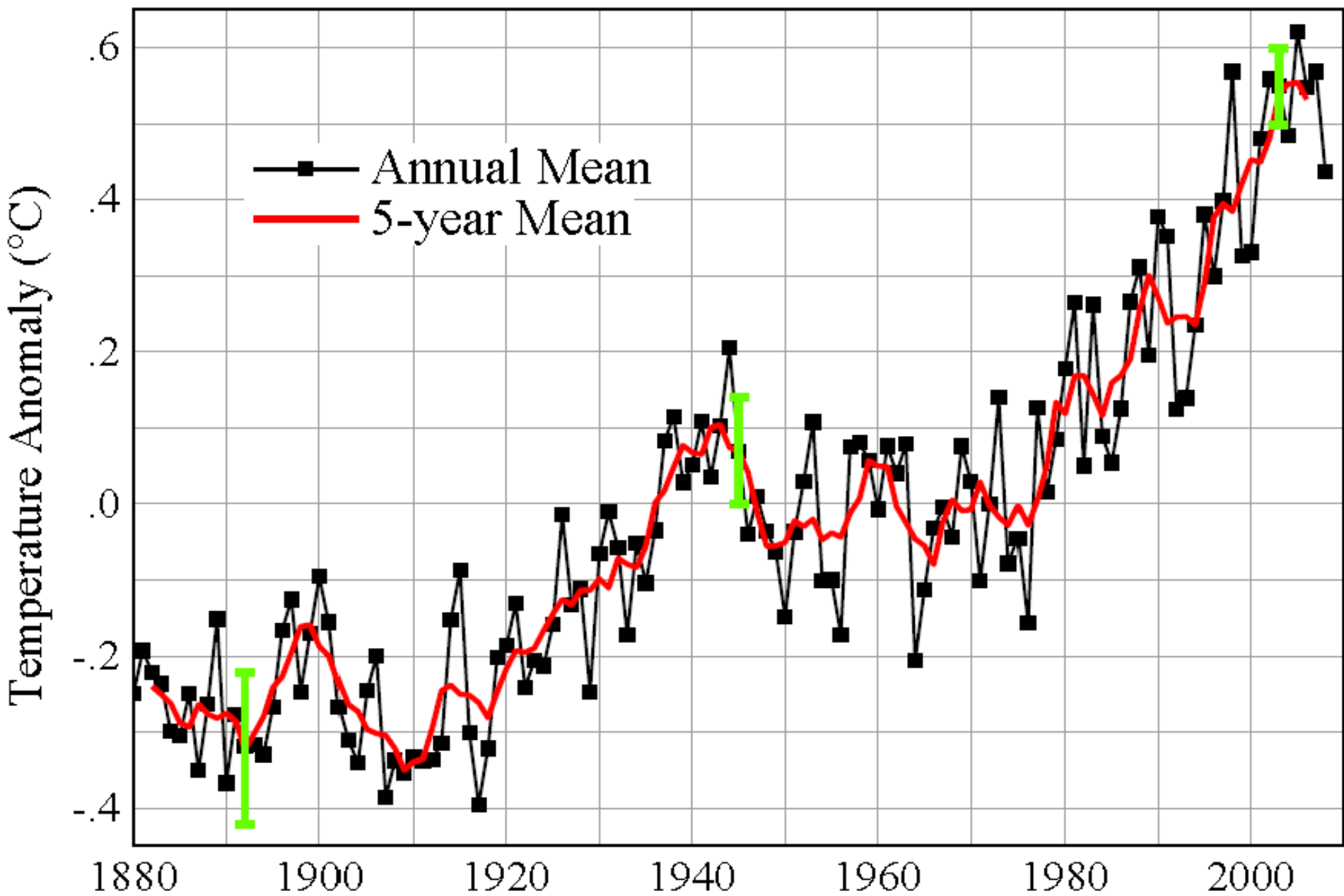
“Those who wish to abolish the wage form of labor and the commodity form of need satisfaction, to be done with global capital... deserve a color (**red**) as do those who seek to abolish the state as well (anarchist **black**).

Those who want to revolutionize the capitalist productive forces, to harmonize them with principles of ecological rationality and sensibility, revolutionize the capitalist production relations and productive forces, and to democratize material existence in every way possible, want their colors **red green** or **green red**.”

(Capitalism Nature Socialism June 2001, House Organ, p. 2.)

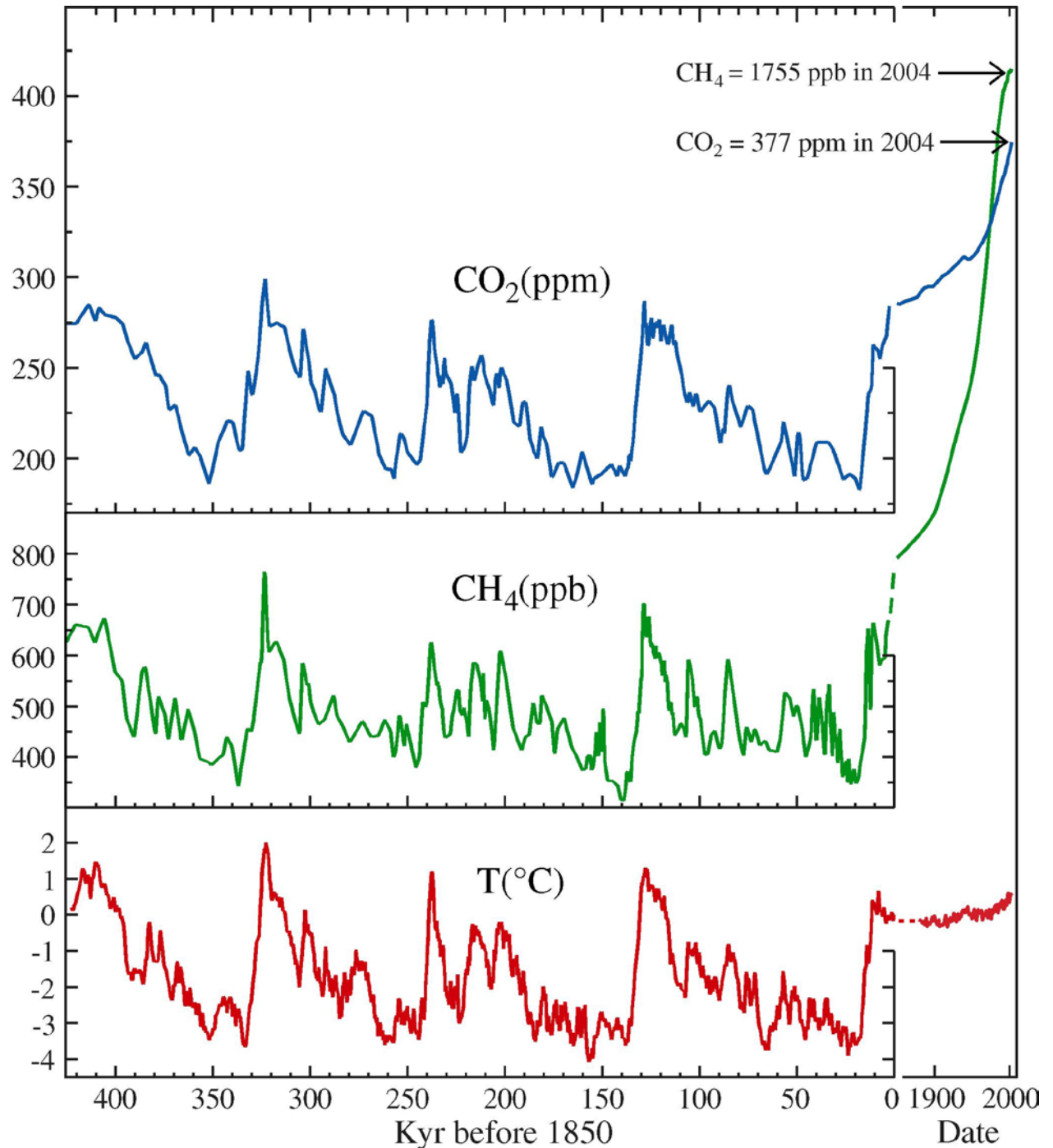
How far from catastrophe?

Global Land-Ocean Temperature Index



Giss analysis of global surface temperature change (Hansen, 2009)

CO₂, CH₄ and
estimated global
temperature
(Antarctic • T/2
in ice core era)
0 = 1880-1899
mean.



Source: Hansen, *Clim. Change*, **68**, 269, 2005.

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)

How much time left? Maybe 10 years at most!

James Hansen (NASA's Goddard Institute for Space Studies):

Catastrophic climate change prevention will require rapid reduction in greenhouse gas emissions, especially carbon dioxide from burning coal and carbon sequestration from the atmosphere starting now to reduce the level of atmospheric carbon dioxide from its present value of 385 ppm to 350 ppm or lower.

(Note that carbon sequestration, removal of carbon dioxide from the atmosphere, could be increasingly powered by a rapidly expanding solar energy infrastructure.)

Hansen et al., 2008, "Target Atmospheric CO₂: Where Should Humanity Aim?," The Open Atmospheric Science Journal, Vol. 2, pp. 217-131; go to: <http://www.columbia.edu/~jeh1>.

Assessment of Target CO₂

Phenomenon

Target CO₂ (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 CO₂ = 350* ppm (Now: 390 ppm)

***assumes CH₄, O₃, Black Soot decrease**

Reference: Hansen et al. Target Atmospheric CO₂, Open Atmos. Sci., 2008

Prevention, the material requirements:

First imperative:

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

Even 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 system, especially combined with greater energy efficiencies.

These solar technologies include:

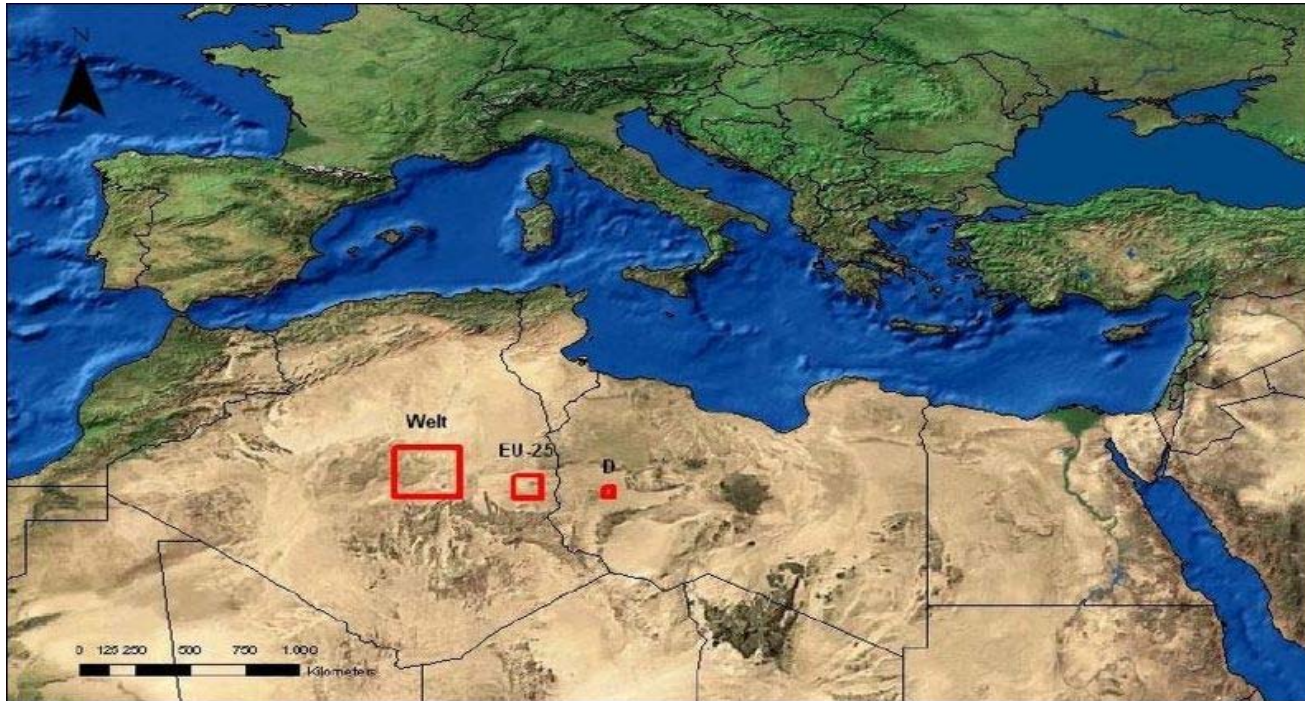
- 1) *Wind power*
- 2) *Solar thermal power (CSP)*
- 3) *Photovoltaics, including near future thin film high efficiency plastic technology*

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.

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

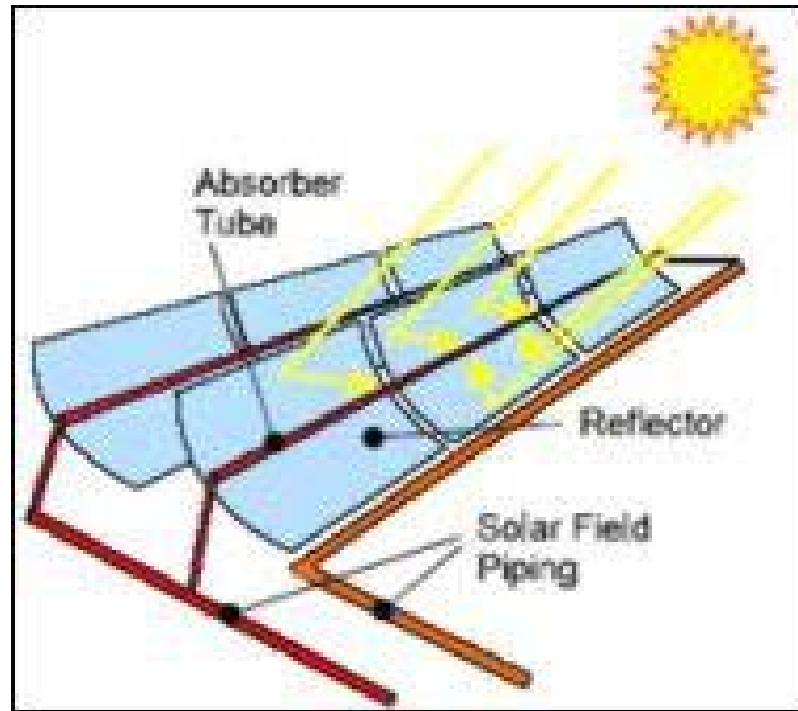
<http://www.trec-uk.org.uk/reports.htm>

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 3.8×10^{11} m²: Hashem Akbari, Surabi Menon, and Arthur Rosenfeld, “Global Cooling: Increasing World-wide Urban Albedos to Offset CO₂,” *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.)

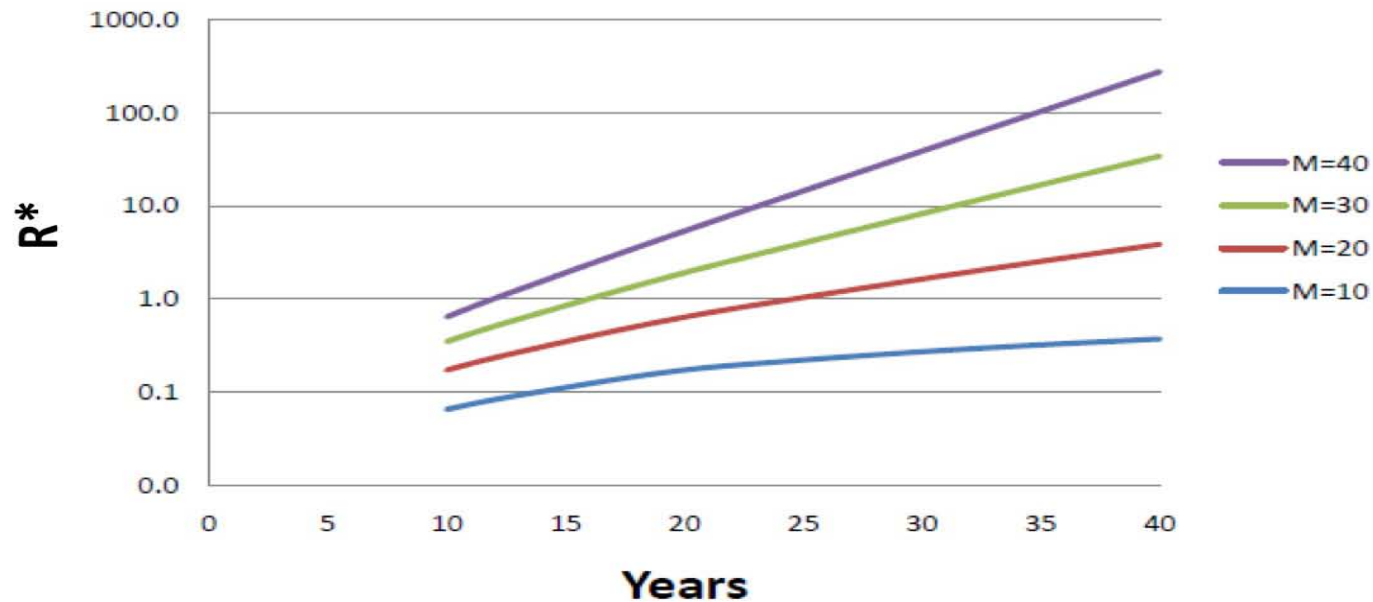
Concentrated Solar Power (CSP) in the Sahara could supply the current global electricity consumption on less than 6 percent of the Saharan land area (not that CSP should be only sited in the Sahara of course!).

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

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.



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

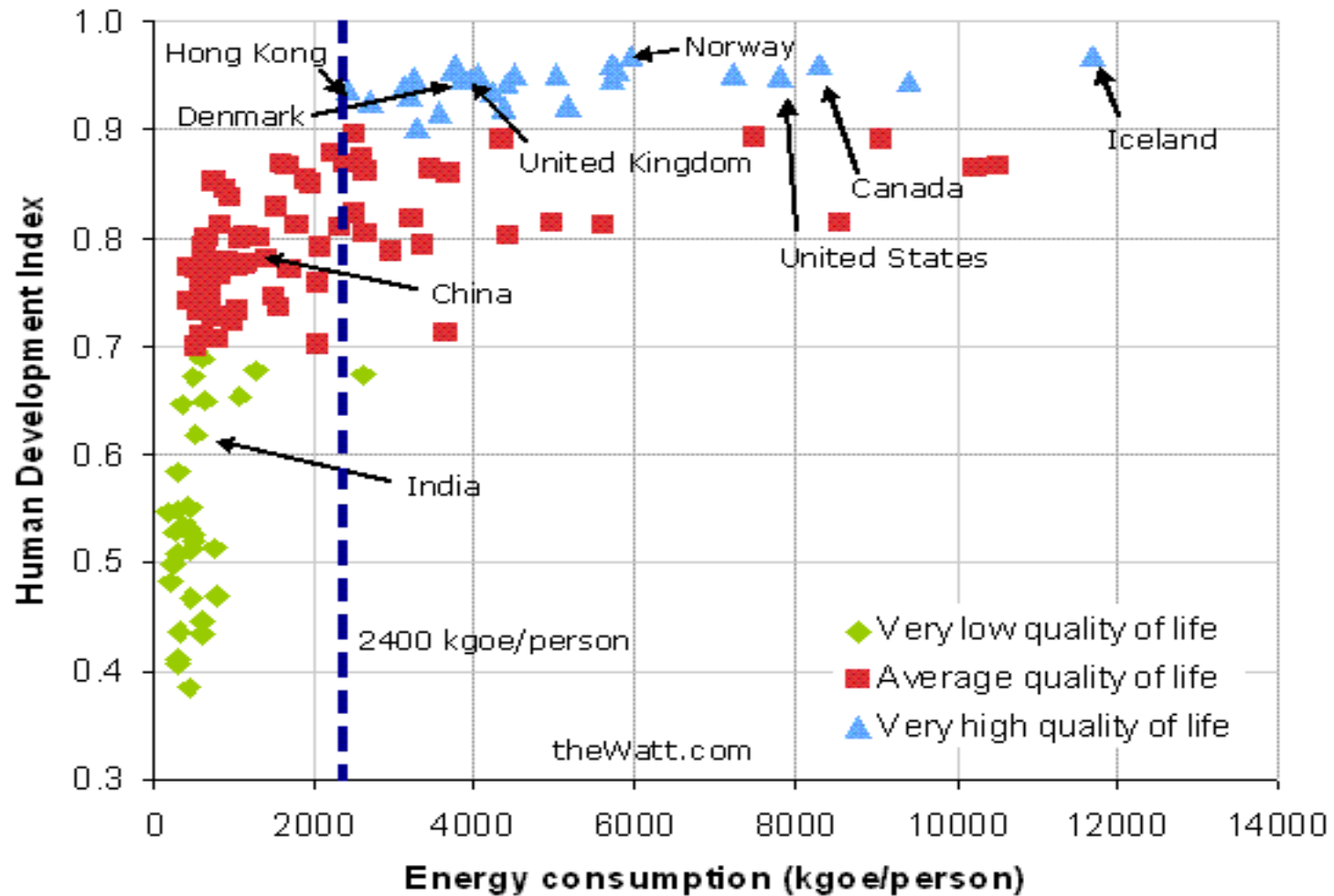
So what are the energy and material requirements for that "other world possible" ?

Material prerequisites include:

- 1) **A global high efficiency solar energy infrastructure**, replacing fossil fuels and nuclear energy
- 2) **Application of the containment and precautionary principles to environmental policy** (including industrial ecology, **organic agriculture** centered around and in **green** cities)
- 3) **Progressive dematerialization of technology, global availability of state-of-the-art information technology**
- 4) **Increase of human population density centered in green cities**, reduction of sprawl, protection of extensive biospheric reserves, managed to preserve biodiversity

Hence, Appropriate Technology from the local to the global scale!

Smil (2003, 2008) estimates a minimum requirement of 3.5 kilowatt per capita for high HDI, in comparison to 3.2 kilowatts per capita shown here (converted units):



Note: Energy consumption shown above is *per year*

How much energy does humanity really need?

Assuming a minimum of 3.2 kilowatt per capita necessary for highest achievable quality of life, then x 6.8 billion people would require a global power capacity of 21.8 TW or 1.4 x the present capacity of 15.8 TW. (1 Tera Watt (TW) = 10^{12} watts)

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 and create green cities globally....



Agroecology

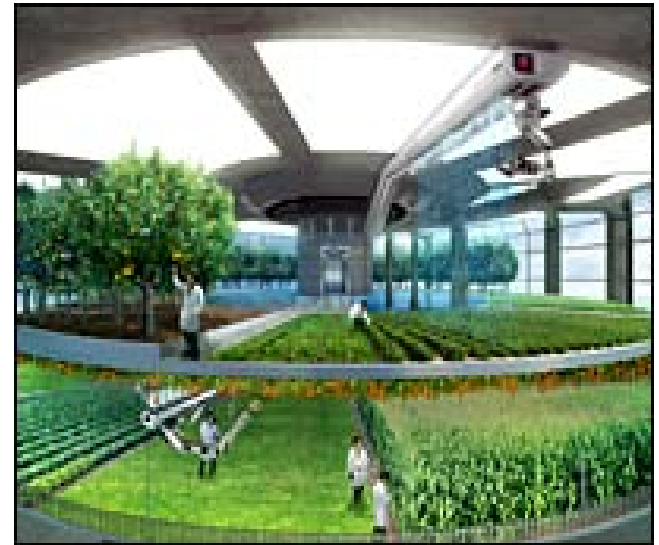


Cuban agroecology
in practice:

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

The Vertical Farm

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



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.

Sustainable Growth?

- 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
- *3 main components of this revolution:*
demilitarization, solarization, and agroecology

ReFocus on our challenge:

The most recent climate projections reinforce the urgency of **radically cutting carbon emissions by:**

1) rapidly implementing **energy conservation** in all areas and phasing out coal use, the most dangerous source of carbon emissions driving global warming,

2) replacing industrial agriculture with **organic farming**,

3) and pumping big investments in creating a **high efficiency solar infrastructure** now, both to replace the present unsustainable energy base and to create the base capable of **carbon sequestration**, the process of removing carbon dioxide from the atmosphere. (see <http://www.350.org> and the papers of Jim Hansen)

All of these measures have the potential to create millions of jobs and sharply reduce poverty in the U.S. and abroad, simultaneously creating a mass social base for rapid sustainable change in our national and global economy.

Some lessons from the BP/Gulf, Texaco/Ecuador, Shell/Nigeria and Natural Gas/New York

A global transition to high efficiency solar power must utilize the existing energy sources to completely replace them, but minimize carbon emissions in this process. Therefore the highest EROEI (energy return over energy invested) technologies such as wind turbines should be the first choice. While the fossil fuel of preference for a solar transition is petroleum (including natural gas), mainly because it yields significantly lower carbon emissions/energy generated than coal (and of course tar sands), the phaseout of all fossil fuels must be as rapid as possible. Bring peak oil on asap (if it hasn't already occurred) by radical energy conservation and solar power generation rapidly replacing fossil fuel.

All mining of coal, petroleum in the continental shelf, as well as deposits below rain forests and other very vulnerable ecosystems on land must end asap (our challenge)!

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.

“The hidden hand of the market will never work without a hidden fist,” “McDonald’s cannot flourish without McDonnell Douglas, the designer of the U.S. Air Force F-15. And the hidden fist that keeps the world safe for Silicon Valley’s technologies to flourish is called the U.S. Army, Air Force, Navy and Marine Corps.”

(Tom Friedman, 1999, “The Lexus and the Olive Tree”)

The huge role of MIC in the U.S. and global economy: military expenditure of over \$1.2 trillion in 2006, with the U.S. responsible for 46% of the total. The U.S. 2009 Fiscal Year military budget is actually \$1.449 trillion (the U.S. GNP in 2006 was \$11.5 trillion) (War Resisters League). The projected \$3 trillion for the Iraq War and Occupation is approximately equal to the estimated renewable energy investment of \$2.89 trillion needed by 2030 to insure a 50% reduction in carbon dioxide emissions by 2050 (July 2007, www.greenpeace.org/international/press/reports/future-investment).

Climate Catastrophe: Surviving the 21st Century
by **Ronnie Cummins and Will Allen**
Organic Consumers Association, February 10, 2010

“Climate Stabilization Requires a Cultural and Political Revolution”

“The only viable roadmap for survival-an 80-90% reduction in fossil fuel use and greenhouse gas (GHG) emissions by 2050-means we must force a drastic reduction in military spending (current wars and military spending are costing us almost one trillion dollars a year). We must tax the rich and the greenhouse gas polluters, and bring our out-of-control politicians, banks, Federal Reserve System, and corporations to heel.”

(http://www.organicconsumers.org/articles/article_20200.cfm)

“The budget of the United States is \$687 billion for defense. and for climate change, to save life, to save humanity, they only put up \$10 billion. This is shameful. The budget for the Iraq war, according to the figures we have, is \$2.6 trillion for the Iraq war, to go kill in Iraq. Trillions of dollars. But directed towards paying the climate debt, \$10 billion. This is completely unfair. These are our deep observations of what’s going on. That’s why—for the war, while trillions are going to the wars, on the other hand, to save humanity and the planet, they only want to direct \$10 billion.”

President Evo Morales, Interviewed by Amy Goodman, Dec. 16, 2009
http://www.democracynow.org/2009/12/16/bolivian_president_evo_morales_shameful_for

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

Some helpful dialectics:

Growth of solar power capacity and energy efficiency undermines the rationale and popular support for 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.

The WWF's *Living Planet Report 2006* assesses sustainable development using the United Nations Development Programme's (UNDP) Human Development Index (HDI) and the [ecological footprint](#). The index is calculated using life expectancy, literacy and education, and per capita GDP.

The UNDP considers an HDI value of more than 0.8 to be high human development. According to the [ecological footprint](#), a measure of human demand on the biosphere, 1.8 global hectares per person or less denotes sustainability.

The only country in the world that met both of the above criteria is Cuba.

(Viva La Revolución Energética, Laurie Guevara-Stone, *Solar Energy International*)

And if Cuba, a living example of
ecosocialist transition, could
accomplish so much, under such
difficult circumstances imposed
by U.S. Imperialism,

Just think of what is really
possible for our future!

Summing Up...

*No Climate Security without Peace,
No Peace without Climate Security*

*No Peace without the dissolution of MIC and its
Imperial Agenda, asap!*

*No Climate Security without the transfer of
the colossal resources now wasted by MIC
And only a Movement from below,
A Transnational Movement will make this happen..*

Think Globally, act Locally,

Think Locally act Globally

Supplementary material
follows...

Global potential for wind-generated electricity

Xi Lu, Michael B. McElroy, and Juha Kiviluoma

PNAS July 7, 2009 Vol. 106 No. 27, 10933–10938

Abstract

The potential of wind power as a global source of electricity is assessed by using winds derived through assimilation of data from a variety of meteorological sources.

The analysis indicates that a network of land-based 2.5-megawatt (MW) turbines restricted to non-forested, ice-free, nonurban areas operating at as little as 20% of their rated capacity could supply >40 times current worldwide consumption of electricity, >5 times total global use of energy in all forms.

Resources in the contiguous United States, specifically in the central plain states, could accommodate as much as 16 times total current demand for electricity in the United States. Estimates are given also for quantities of electricity that could be obtained by using a network of 3.6-MW turbines deployed in ocean waters with depths <200 m within 50 nautical miles (92.6 km) of closest coastlines.

*From Capitalism to
EcoSocialism
to Solar Communism*

Eco socialist transition to solar utopia

In addition to the material prerequisites, the necessary conditions arguably include:

- 1) Local/national/global *social governance of production/consumption* (self-management at all levels from global to local).
- 2) *Global equity*, full equality of women, elimination of North/South disparities in health, education; end of discrimination based on “race,” ethnicity, sexual preference, disability.
- 3) *Disarmament* (demilitarization of global society)
- 4) Expansion of and social management of the commons
- 5) The end of production of value based on labor time

A critical challenge: develop a full conceptualization of the technological basis of an ecosocialist transition to a future global society, the other world that is possible.

Marxist political economy cannot theorize this transition by itself.

The natural, physical and informational sciences, in particular, **climatology, ecology, biogeochemistry**, and **thermodynamics**, must be fully engaged, informing the technologies of renewable energy, green production and agroecologies, that must replace the present unsustainable mode. The creation of these sustainable infrastructures now and in an ecosocialist transition should organically include participation of both the exploited and oppressed, so that the social management and impacts of these technologies are emancipative.

This transformation itself is a challenge to Marxist theory.

Critical Research and Organizing Imperative:

The U.S. Military Industrial Complex (“MIC”)* and its Imperial Project as the biggest obstacle to Prevention of Climate Change Catastrophe

* More accurately the “Nuclear Fossil Fuel Military Industrial Complex”

Go to: <http://www.nowarnowarming.org/>

Further, we need concrete models that include:

The *transformation* of industrial/genetically modified agriculture to global agroecology, the creation of green cities, and industrial ecology in a world committed to rapid and progressive demilitarization and solarization, models that begin to demonstrate that another world is indeed not only possible but realizable in the 21st century.

Other considerations

The actual creation of sustainable infrastructures must always be contingent on a process that organically includes participation of both the exploited and oppressed so that the social management and impacts of these technologies are emancipatory.

Even in a radically democratized world, local autonomy must be limited by the character of its impacts on neighboring communities and the globe.

Another critical challenge is the theory and practice of a transnational ecosocialist movement and its interrelationships with local and national struggles.

Solar Capitalism?

“we can construct computer models of sustainable reproduction of capital in a globally dematerialized solar capitalism. However, the historical legacy of real capitalist development makes its realization virtually impossible. And most significantly, MIC, as the core of unsustainable capital reproduction, is the biggest obstacle standing in the way of an ecosocialist transition. *A global “solar capitalism” is an illusionary prospect, because the level of red and green struggle required to solarize global capitalism will itself likely result in ecosocialist transition.*

While individual capitalist economies may solarize, the dominant role of the military industrial complex in global capitalist reproduction makes its termination both an essential requirement for and likely a direct path to ecosocialist transition on a global scale.”

(Schwartzman, 2009, *Capitalism Nature Socialism* 20, No.1, p.25.)

Now for the relevancy of
thermodynamics to a revisioning
of (*Solar*) **Communism** in the 21st
Century

“From each according to her ability, to each according to her needs”, where "her" refers to humans and nature (ecosystems) (a red and green update)



I urge that concrete visions of utopia should now be discussed and represented by political movements that challenge the global rule of capital. This visioning should of course be a work in progress, continually revised with input from both the scientific/technological and political communities. If there is "another world possible" lets begin describing concretely how it will function and begin creating embryos of the future as global class struggle unfolds to achieve its full reality.

SOLAR COMMUNISM

http://www.redandgreen.org/Documents/Solar_Communism.htm

Science & Society, Vol. 60, No. 3, Fall 1996, 307-331

Solar Communism David Schwartzman

ABSTRACT: A global economy powered by non-solar energy sources is limited by global warming, finite reserves and concomitant insults to the Earth's biosphere, including our own species. Some of these impacts, such as loss of biodiversity, will be irreversible. Without constraints on the reproduction of capital, the global driver of the contemporary environmental crisis, these impacts will intensify. This is not a necessary outcome for an economy utilizing the high efficiency capture of solar energy, a conclusion informed by consideration of the heat budget of the Earth's surface and the laws of thermodynamics. Such a solar-based economy managed by containment of the socially modified environment is a necessary condition for a global civilization realizing the Marxian concept of communism.

Georgescu-Roegen



My paper Solar Communism critiqued fallacious arguments derived from the influential writings of Georgescu-Roegen regarding so-called entropy limitations to a solarized economy. *Georgescu-Roegen's fallacy was his conflation of isolated and closed systems: “A closed system (i.e., a system that cannot exchange matter with the environment) cannot perform work indefinitely at a constant rate”* (1989). **But the biosphere is essentially closed to transfer of matter, but not isolated with respect to energy flux, particularly solar energy.**

*The Limits to Entropy: the Continuing Misuse of
Thermodynamics in Environmental and Marxist theory*

(Science & Society, 2008, 72, No.1, 43-62,)

<http://www.redandgreen.org/Documents/Limits%20to%20entropy%20final.htm>

(In part a reply to Paul Burkett 2005 'Entropy in Ecological Economics: A Marxist Intervention', Historical Materialism, 13, 1: 117-52.)