

The Technical and Spiritual Challenges of Sustainable Energy

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Outline

- 1 Energy and its Sources
 - 2 Technology and its limitations
 - 3 Christian Perspectives and Resources
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I am not aiming to be controversial, but I will be direct — perhaps provocative.

It is helpful to separate

a dispassionate assessment of the facts of the situation from
a passionate advocacy of what we think is ethically right action.

Please save the passion for part 3.

Outline

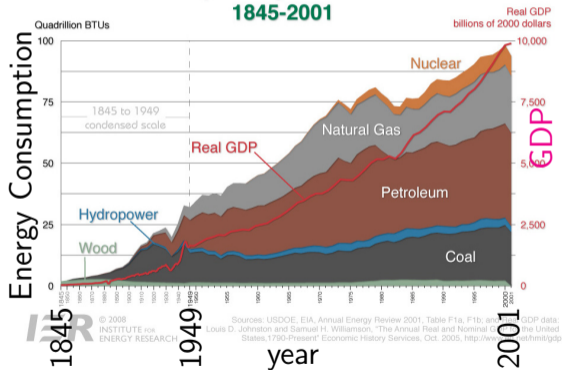
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Energy Intensity and Financial Prosperity go together

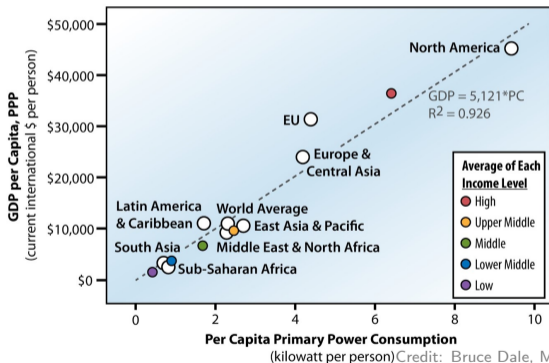
Not with perfect correlation, or causation, but as a remarkably robust general trend

Over the history of one nation (US)

**US Consumption by Source v. Real GDP
1845-2001**



And between nations/regions at one time

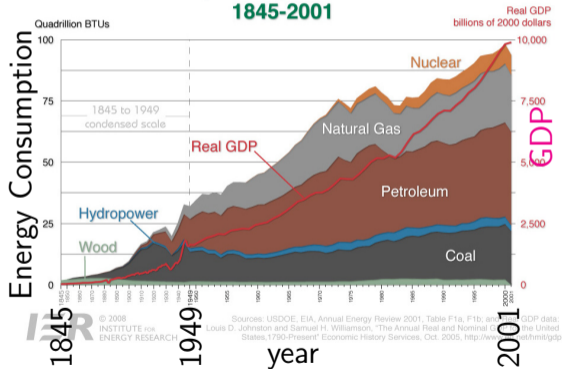


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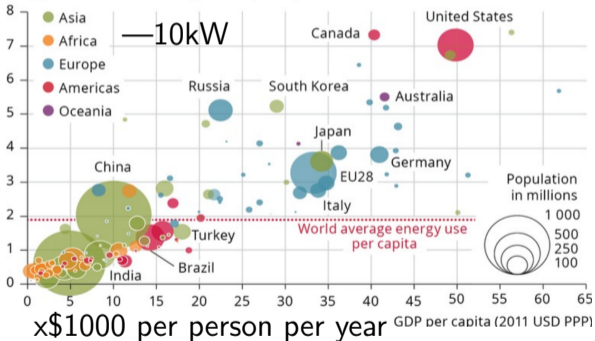
Over the history of one nation (US)

US Consumption by Source v. Real GDP 1845-2001



And between nations/regions at one time

Energy use in tonnes of oil equivalent per capita



European Environment Agency

A Broader Assessment of Prosperity and Development

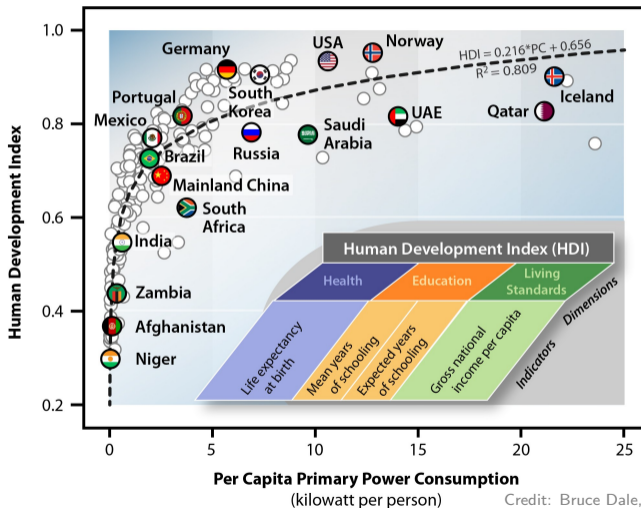
Still shows strong correlation, but also decoupling (saturated prosperity) at higher consumption

Human Development Index (HDI)

Based on Health, Education, and Income.

Approximately 4kW/person is the curve's knee ($< \frac{1}{2} \times \text{US}$)

Much above does not improve life.
Much below: steep fall.



Credit: Bruce Dale, MSU

US Energy Sectors, typical of industrialized world

Sector (2008)	% of total	% fossil
Electricity	40%	69%
Transportation	28%	97%
Industry	21%	90%
Buildings	11%	99%

https://en.wikipedia.org/wiki/Energy_in_the_United_States

Electricity is the largest sector, and the only one not totally dominated by fossil fuel.

Transportation is 95% petroleum.

Industry uses direct fossil energy/feedstocks.

Residential and commercial building heating.

Merely electrifying (e.g. transport) would do little to reduce fossil fuel dependence.

However, electricity is “smart” energy and is most able to use sustainable sources.

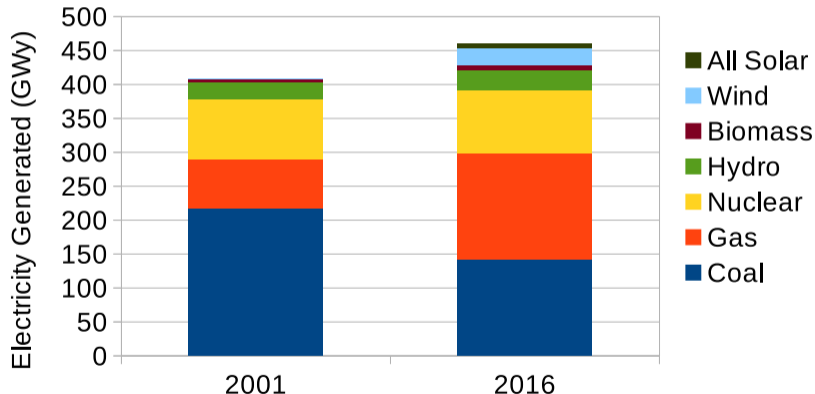
We can lower electricity’s 69% fossil and raise its 40% of total.

US Electricity Generation from different sources

shows some evolution, but the changes are slow and are not reducing fossil dependence.

- Total is increasing.
- 'Conservation' is losing.
- Solar is tiny/growing
- Wind becomes significant
- Nuclear/Hydro are steady
- Despite drop in coal use, total fossil is increasing.

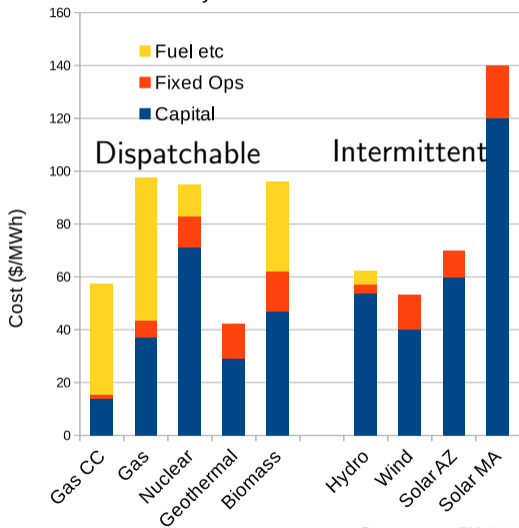
US Electricity Sources



Data source: EIA 2017 review

Economics: generation levelized cost dictates investment

Levelized Electricity Generation Costs. New in 2022.



Data source: EIA 2017

No new coal plants, high costs, air pollution.

Gas has 2 types: base-load (CC, 80+% capacity factor) or top-up (Conventional, 30% cf).

Fuel dominates its costs; gas currently cheap.

Nuclear (and sustainable): capital dominates.

Hydro (Geothermal) can't much be expanded.

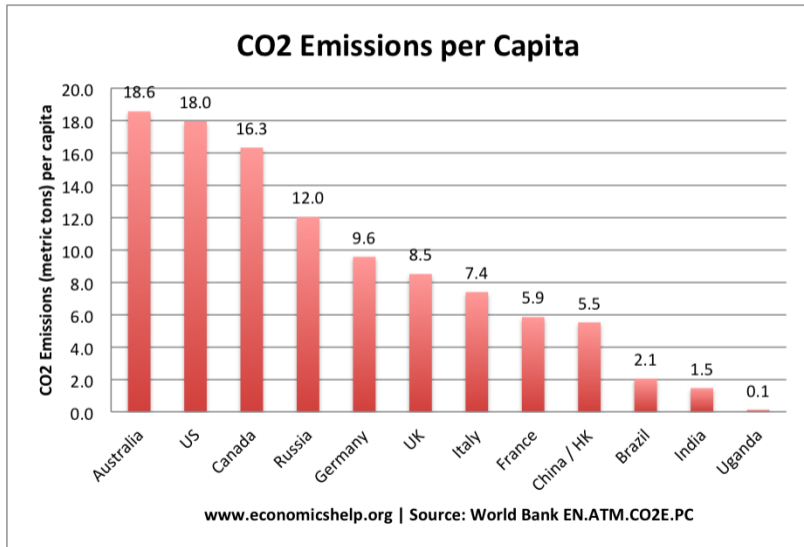
Intermittent sources, e.g. solar, wind, require backup dispatchables. (Batteries ~\$400/MWh.)

Solar PV competitive in sunny south (25% cf), not in north (12% cf); incentives help it.

Per-person emissions: Developed World Dominates

Europe shows that modern living standard is possible at half north-american per-capita emission rate.

But there is no example of industrialized economy at significantly lower rate than europe.



Modelled future source balance under carbon-constraining tax.

With CO₂ priced to 2° global temp^r rise economics predicts nuclear-dominated energy late this century

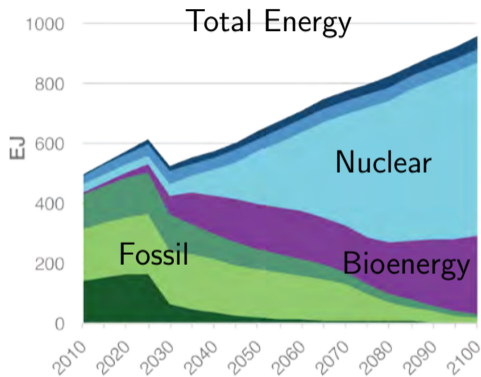


Figure 27. Global Primary Energy (exajoules) under the 2°C scenario with median assumptions about technology costs & median climate response

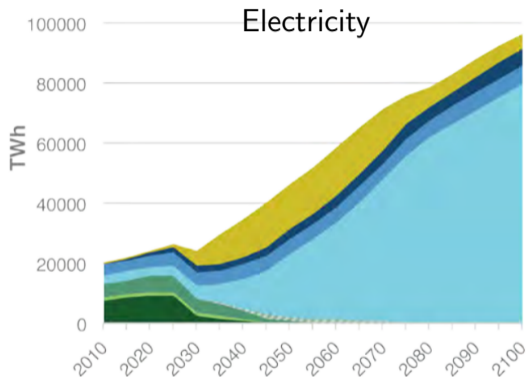


Figure 28. Global Electricity Production (TWh) under the 2°C scenario with median assumptions about technology costs & median climate response



IEA median prices

Source: MIT Joint Program on the Science and Policy of Global Change. 2016 Food, Water, Energy, and Climate Outlook.

Nuclear-Priced-Out 2° rise Scenario

Bioenergy is predicted to take over if nuclear is artificially priced out or constrained.

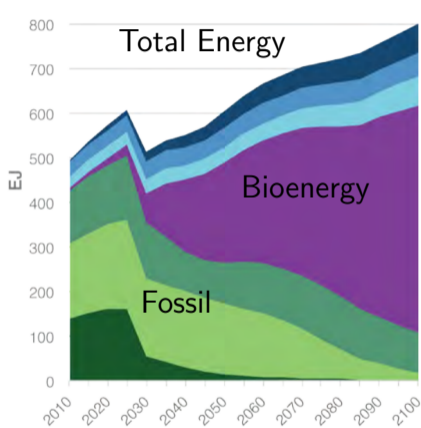


Figure 29. Global Primary Energy (exajoules) under the 2°C scenario with high nuclear costs and median climate response

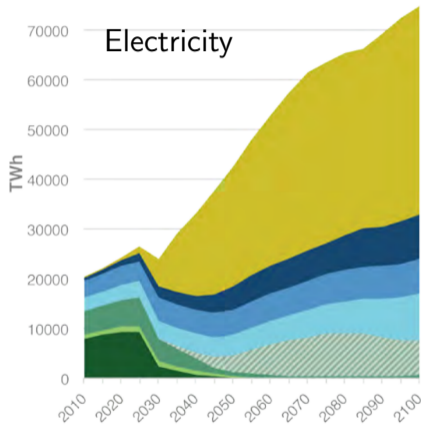


Figure 30. Global Electricity Production (TWh) under the 2°C scenario with high nuclear costs and median climate response

[Assuming bioenergy cost does not escalate because of resource limitations such as water, land.]

Summary of Global Energy Situation

Fossil energy consumption is unsustainable, and causing global climate change.

To prevent it requires a *reduction* by a factor of $\sim \frac{1}{10}$ in global CO₂ emissions.

Implies massive society restructuring even at present global energy usage.

If a global 7 billion population all consumed/emitted at the US rate, CO₂ emissions would instead be *increased* by a factor of ~ 10 .

requiring $\frac{1}{100} \times$ reduction in per-capita emissions.

Replacing all but 1% of per-capita fossil fuel usage

(to reduce CO₂ emission/capita to $\frac{1}{100}$ of the US current rate)

is not just a technical challenge!

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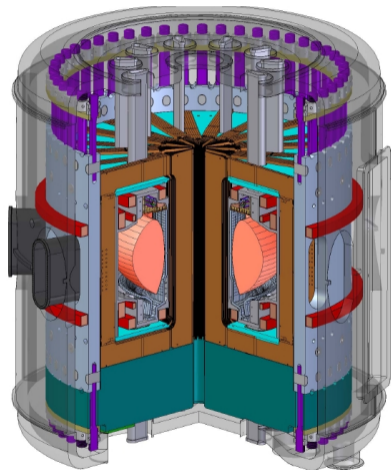
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The Technological Fix

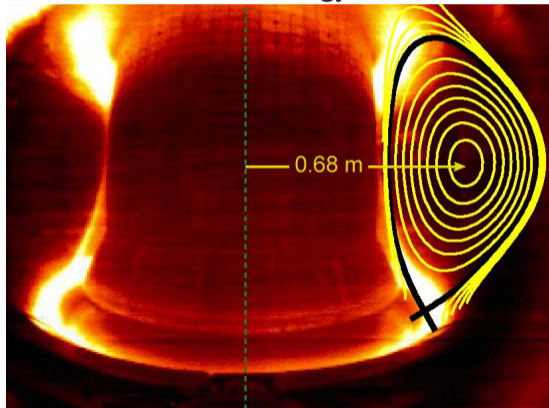
is what a scientific society first looks to: e.g. energy a key challenge for the 21st century

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Nuclear Fusion the Energy Source of the Stars



A worthy scientific/technological endeavor, but there's no magic bullet.

Simple arithmetic shows the infeasibility of a technological solution for Energy.

No matter how successful technological innovation is, the earth cannot sustain a population of 8 billion at American-level per-person energy use.

There is no purely technological fix for energy.

Technology is always Double-Edged (Multiple-Edged)

It has unwanted side effects.

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Nuclear technology is routinely recognized this way.

Sometimes this leads to advocacy for its abandonment.

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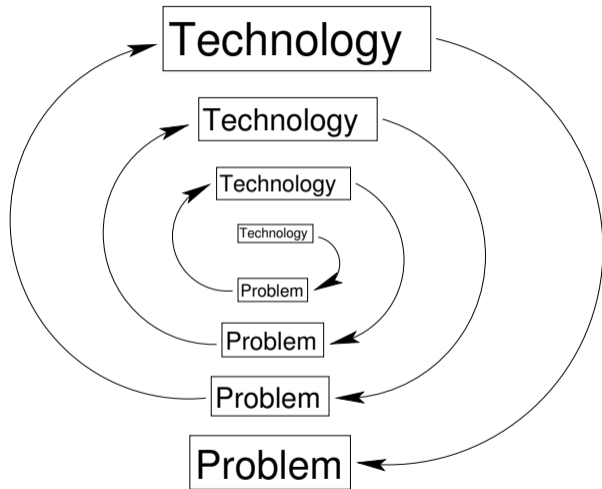
But it is not so widely realized that *every* new technology has comparable ambiguity.



Improved sanitation
↓
Population growth
↓
Environmental Impact

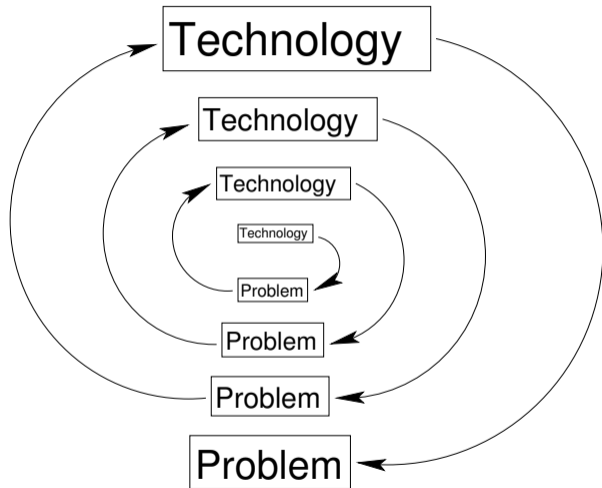


Exponential Growth is Instability



Vicious Spiral

Exponential Growth is Instability



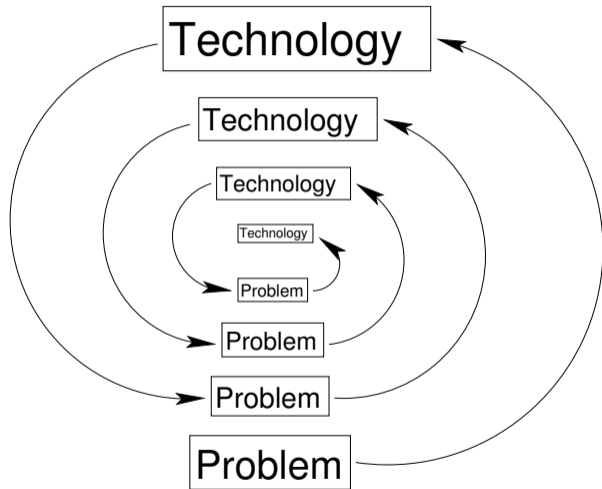
Vicious Spiral

Swallowing the Spider



Leads to the horse!

Stability requires de-escalation, non-growth



Virtuous Spiral

But to give up growth is the opposite of what economists say is good.

The critique of technology is not new — but not outdated.

Luddites feared impoverishment of the workers through industrialization (1811).

But excessive reliance on technology is growing. And feeds on scientism.



Excessive Reliance

Distortion

Critique

Science



Scientism

Epistemology

Technology



Technopoly

Injustice

Scientism and Technopoly are supportive siblings

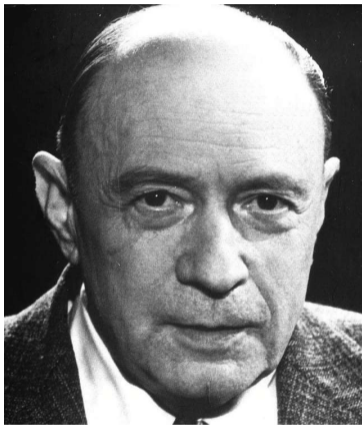
Scientism is not merely the misapplication of techniques such as quantification to questions where numbers have nothing to say; not merely the confusion of the material and social realms of human experience; not merely the claim of social researchers to be applying the aims and procedures of natural science to the human world. Scientism is all of these, but something profoundly more. It is the desperate hope, and wish, and ultimately the illusory belief that some standardized set of procedures called “science” can provide us with an unimpeachable source of moral authority, a suprahuman basis for answers to questions like “What is life, and when, and why?” ... Neil Postman.

Just as **Science and Technology**
are mutually dependent,

So **Scientism and Technopoly**
are likewise mutually dependent

It is critical to repudiate scientism: the belief that science is all of real knowledge.

Two Twentieth Century Technology Critics



Jacques Ellul

La Technique (1954)

The Technological Society (1964)



Neil Postman

Technopoly: the surrender of culture to technology (1993)

Ellul's characterization of the culture of Technique

- 1 **Automatism:** “technical movement becomes self-directing” “The human being is no longer in any sense the agent of choice.” “... everything that is not technique is being eliminated.”
- 2 **Self-augmentation:** “technical progress is irreversible”, “geometric progression”, “poses new technical problems”
- 3 **Monism:** “all techniques are inseparably united” “evolves in a purely causal way”
- 4 **Necessary linking together of techniques:** Organizational technique dominates economics, commerce, society, and state.
- 5 **Technical Universalism:** Technology spreads till it has “taken over the whole of civilization.”

Remarkably. In *La Technique*, Ellul offers no solution or hope for one.

Postman's prescriptions for what to do

(for USA which he thinks is the only culture yet succumbed [1993])

Be a *Loving resistance fighter*.

“refuse to accept efficiency as the pre-eminent goal of human relations”, “refuse to allow psychology or any “social science” to pre-empt the language and thought of common sense”, “take the great narratives of religion seriously”, “do not believe that science is the only system of thought capable of producing truth”, “admire technological ingenuity but do not think it represents the highest possible form of human achievement”.

Reform Education

“all subjects are presented as a stage in humanity's historical development; in which the philosophies of science, of history, of language, of technology, and of religion are taught; and in which there is a strong emphasis on classical forms of artistic expression.”

While admirable, these seem to me totally inadequate, for energy or anything else.

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The underlying problems of sustainability

are not mysterious

- Human Population
- Human Consumption

Too many people wanting too much stuff.

These have no technological fix.

Technology mostly makes the problems worse because of the additional power it gives.

Perhaps they have spiritual solutions. Certainly our faith addresses them.

Technopoly is part of the problem, not the solution

But Christianity offers very substantial resources of the type needed: Values.

Too many people
wanting too much stuff.

Cannot be fixed by technology,
however, benign and enlightened.

The intractable challenges like this are
moral.

They require a change of values.

Values are not provided by science or
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arise from religion.

Wanting too much stuff
is covetousness.

Why should endless economic expansion be sustainable?

Of course economic expansion cannot be an endless objective.
Yet most economic and political analysis and aspiration acts as if it is.
Reasonable aspiration, by contrast, is for a globally “middle class” lifestyle:
Adequate housing. Bicycles. Buses. Nourishing food. Communications.
For industrialized countries that means substantially REDUCED consumption.
But not necessarily a less satisfying life.

Requires a change in VALUES away from consumerism.

Values are largely matters of the spirit.

Spiritual Resources for Sustainability

Motivation for the care of the earth

The God-given creation. A stewardship charge to keep. Genesis 2:15.

Moral Authority that supercedes individualism.

Sustainable economics and development requires global cooperation.
But religious authority cannot in the long run be merely manipulated.
Believers can't just pick and choose their moral teachings.

Principles of action and attitude.

Peace. Justice. Charity. Equity. These are the necessary backdrop.
But what about Population and Consumption?

A Theology of Population

God's love for individuals and the Sanctity of human life does not mean "more humans is better".

All religions older than about 100 years originally addressed a situation where human procreation was vitally needed. (Genesis 1:28 Be fruitful, multiply, fill the earth.)

If the priority is now to limit or reverse population growth, not to encourage it, then this is a new situation. The earth is "full".

Theological reflection on this changed situation must become part of the religious and specifically Christian intellectual landscape.

Consumption

Christian (and Jewish) teaching is unequivocal in condemning the consumptive attitude that pervades modern society.

Examples:

OT prophets (e.g. Amos)

Blessed are the poor (Lk 6:20)

Eye of Needle (Mt 19:24)

Cannot serve God and Mammon (Mt 6:24)

Love of money the root of evil (1 Tim 6:10)



Walking to Church Normal Rockwell (1953)

The Biblical teaching about the Sabbath is as much about rest for the land, for creation, as it is for humans. (Leviticus 25:3-4)

Climate is a Shared Global Issue. Only policy advocacy slide.

Individual action, however principled, does not constitute a coherent policy to address it.

We need government and international priorities to reflect true costs and values.

We need political policies, tax structures, and resource allocations to reflect them.

Example: fossil fuel producers have enjoyed enormous subsidies in the form of tax credits in the US for decades. Should that continue? [No!]

Why shouldn't we have a carbon fee/tax to reflect the real cost to the global environment of carbon pollution? [Answer: We should! And it could be made revenue neutral and hence non-regressive so I don't accept the standard arguments against it. Europe already taxes gasoline at many times the US rate. That's why they have more fuel efficient cars.]

Individualism can't solve climate problem. Love of neighbor should lead us to advocate a national and international approach.

Summary

Global warming is occurring. It is caused overwhelmingly by fossil fuel use.

Sustainable energy is a vital necessity. Focused research is worthy and will help. But there is no Technological Fix for energy and the environment.

At root most sustainability challenges come from Population and Consumption.

Sustainability requires human and spiritual resources/values.

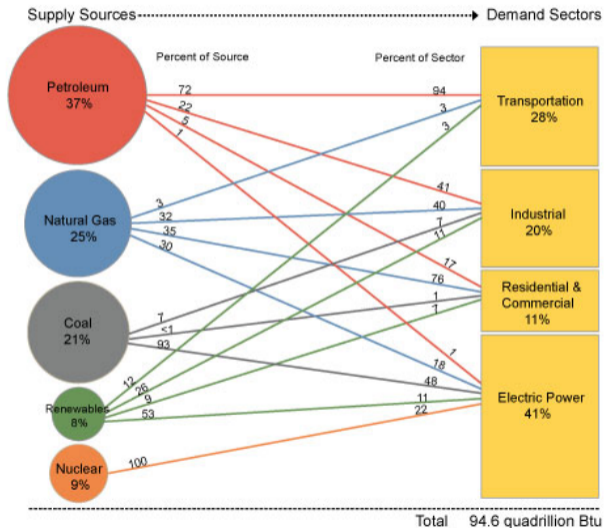
And these must be incorporated into global economics, laws, and policy.

Christian teaching provides many of these resources, but

- Our spiritual values often conflict with the assumptions of modern consumer culture.
- Christians need to be true to their calling, and care for Creation.

Additional Slides

Primary Sources and Consumed Energy Forms



Source: Energy Information Administration, Annual Energy Review 2009