



Can We Overtake Petroleum By 2030?



**Intergovernmental Renewable Energy Organization
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A BREAKTHROUGH TECHNOLOGY TO TRANSFORM ALGAE INTO OIL

New Energy: Where We Stand

A New Mandate:

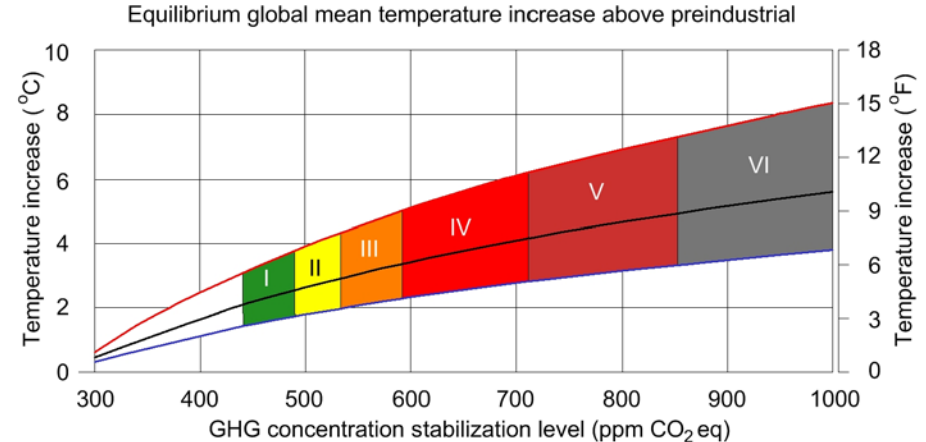
- Climate change issue well accepted.
- US Administration Committed to New Energy for Job Creation.
 - 10 million jobs in next decade, 30 million *net new jobs* by 2030.
 - Economic engine = repatriation of trillion-dollar energy import budget.
- Energy Independence now a National Security Mandate.

New Challenges:

- The 2030-2060 Gap
- A New Model to Overtake Petroleum

CO₂ Emissions Spiraling Out of Control

- As a result of petroleum use, over 3 billion tons of carbon dioxide (CO₂) are emitted into the atmosphere annually.
- Scientists predict that carbon dioxide levels by the year 2100 could be as high as 970ppm, nearly triple the CY2000 levels of 367ppm.
- Meanwhile, 15-37% of all plant and animal species could be wiped out by global warming by the year 2050, which could further cause considerable damage to our planet's ecosystem. Source
- The carbon problem may be accelerating ahead of projections.



The projected temperature increase for a range of greenhouse gas stabilization scenarios (the colored bands). The black line in middle of the shaded area indicates 'best estimates'; the red and the blue lines the likely limits. From the work of [IPCC AR4, 2007](#).

2030 Is Not Too Soon To Solve This Problem.

Limits of Current Approaches

- Researchers built a comprehensive global energy model, and then subjected it to stringent CO₂ limits of 400ppm – just 33ppm above today's levels.
- The outcome:

It is interesting to note that oil remains the dominant energy source in the transportation sector for such a long time, even if stringent CO₂ constraints are applied. However, given the allowable CO₂ emissions (for a 400 ppm target), it should come as no surprise. For such a target, we may emit 500 Gton C over the period 1990-2100. The present oil and natural gas reserves combined contain 200 Gton C. In our scenarios, we have assumed that the available supplies are twice the present reserves. **This means that all oil and natural gas reserves can be used even if we stabilise at 400 ppm.** Now, since carbon abatement policies will increase their relative competitiveness of oil and natural gas over coal, we can expect that most, if not all, of the oil and gas resources will be used. Further, oil has a competitive advantage in the transportation sector. Thus, this is where most of this energy source will be used.

Source: "Hydrogen or methanol in the transportation sector?", July 2000, KFB Stockholm <http://www.kfb.se/pdf/R-00-35.pdf>

Energy Supply Under Current Approaches

A general feature that is obtained in all runs of the model is that the use of biomass increases rapidly in response to stringent CO₂ targets. Biomass is used for residential heating and process heat. Similarly, all other renewable energy technologies, hydropower, wind and solar, grow. Wind and solar start from very low values and it takes several decades before they make a significant contribution to the global electricity supply.

- On the way to 2060:
 - Oil maintains share.
 - Biomass absorbs energy's growth.
- By 2060:
 - Oil finally begins to tail off.
 - Biomass plateaus at 1/3 of total.
 - Coal is on the way back, 'clean'.
 - Wind never becomes a factor.
 - Solar is just starting its run.

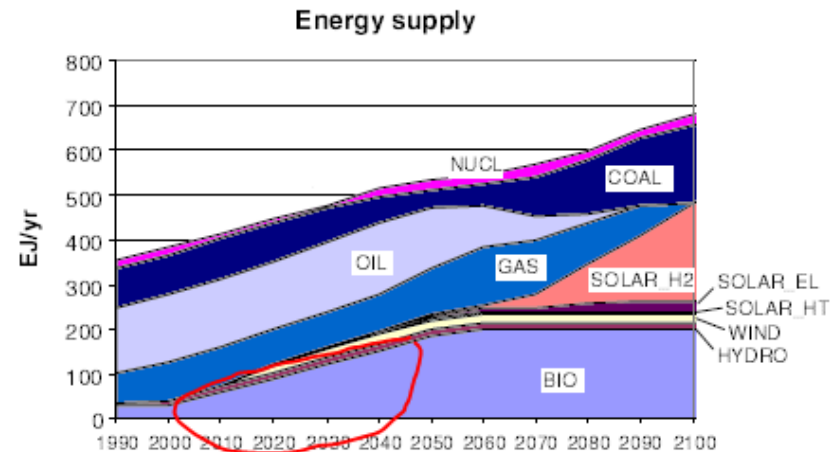


Figure 6.3 World primary energy supply. The three solar energy technologies used in the model (H₂, EL, HT) produce hydrogen, electricity (e.g., PV), and heat (for processing and heating), respectively.

CONCLUSIONS

The problem is petroleum.
Current approaches are not enough.
We need a NEW MODEL to overtake petroleum.



The New Model to Overtake Petroleum

- Three Key Components:
 - Technology Innovation.
 - Entrepreneur Adoption.
 - Technology Export.

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Technology Innovation

- More like the Internet of the 90s
- NOT like the TVA (Tennessee Valley Authority) of the 30s.
- Leading cleantech thinkers agree:
 - “The strategy is more at-bats, more shots on goal...Most of your approaches will fail, but a few will succeed. You will build from each others’ experience, and get better and better.” Vinod Khosla, *Algae Biomass Summit 2008*
 - "Twelve guys and gals going off to Los Alamos won't solve this problem...We need 100,000 people in 100,000 garages trying 100,000 things — in the hope that five of them break through... the climate-destroying fossil-fuel age will end only if we invent our way out of it." Thomas L. Friedman, *Hot Flat and Crowded*

Entrepreneur Adoption

- Entrepreneurs need to have specific, prepackaged applications for their community.
- For algae, this means a compact production system applied to industrial settings (proximity of CO₂, nutrients, waste energy and waste water, plus the big stick of carbon penalties).
- Example applications in algae:
 - a. **Natural Gas-Fired Furnaces:** Absorb CO₂, gasify for onsite combustion as natural gas.
 - b. **BioDiesel Refining:** Captive algae oil production plus biomass for supplementary power.
 - c. **Wastewater treatment:** Provide nutrient (N, P) removal capabilities and rapidly absorb CO₂ generated by energy consumption processes.
- If we can prepackage these applications (including financing), entrepreneurs will implement them worldwide.

Technology Export

- Motto: “help the rest of the world build what we invent”.
- Key points:
 - Refuse to be a producer – technology provider only.
 - Promote a knowledge industry to help local entrepreneurs worldwide.
 - Open Source the low tech parts.
 - Simplify, simplify: “If you can build a brewery, you can make algae”.
 - Corporate model: light and adaptive, low capital.
- The Technology Export model supports technology innovation and entrepreneur adoption:

“Mushrooms After Rain.”

It's Been Done Before

- Historical Analogy: The Personal Computer
 - In 1982, IBM invented the PC.
 - IBM expected to sell most of the PCs in the world.
 - Instead, the PC was massively cloned.
 - But... every PC had a Microsoft OS.
- The PC transformed society because :
 - The machine was a commodity (could be built anywhere).
 - The technology became universal (a common global platform).

The Technology Export Model:

- **Premium Technology,**
- **Commoditized Hardware,**
- **Universal Distribution.**

What Can We Do?

- Create a great environment for innovation. *Fund innovation, not brick & mortar (yet)!*
- Focus on achieving rapid adoption through entrepreneur-friendly prepackaged applications.
- Export innovations worldwide through the Technology Export Model:

**The Technology Export Model
Can Help Us Overtake Petroleum by 2030.**



THANK YOU!

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