How Can We Zero Out America's Need to Import Oil and Gas (and emit CO_2) at the Soonest Possible Time?

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IEEE-USA, NSF, ACUNU/MP, Howard U.

-- presenting personal, not official, views

PJW: 80's: EIA/DOE lead analyst for long-term energy futures

www.werbos.com/energy.htm

IEEE Computational Intelligence Society – Alternate Energy Task Force

http://ieee-cis.org/isa/alternative/

- Rajashakeera, Rolls-Royce (former Delphi hybrid leader)
- Prokhorov, Toyota
- Marko, Bosch
- Feldkamp, Ford
- Javaherian, GM
- Bonissone, GE
- Zimmerman, Siemens
- Fei-Yue Wang, Chinese Academy of Science
- Chair: Werbos
- Estevez
- Fukuda
- Sarangapani
- Venayagamoorthy
- Liu

-- Research for Honda, Caterpillar, ABB, others

IEEE-USA Position Paper on Plug-in Hybrids Available In Draft

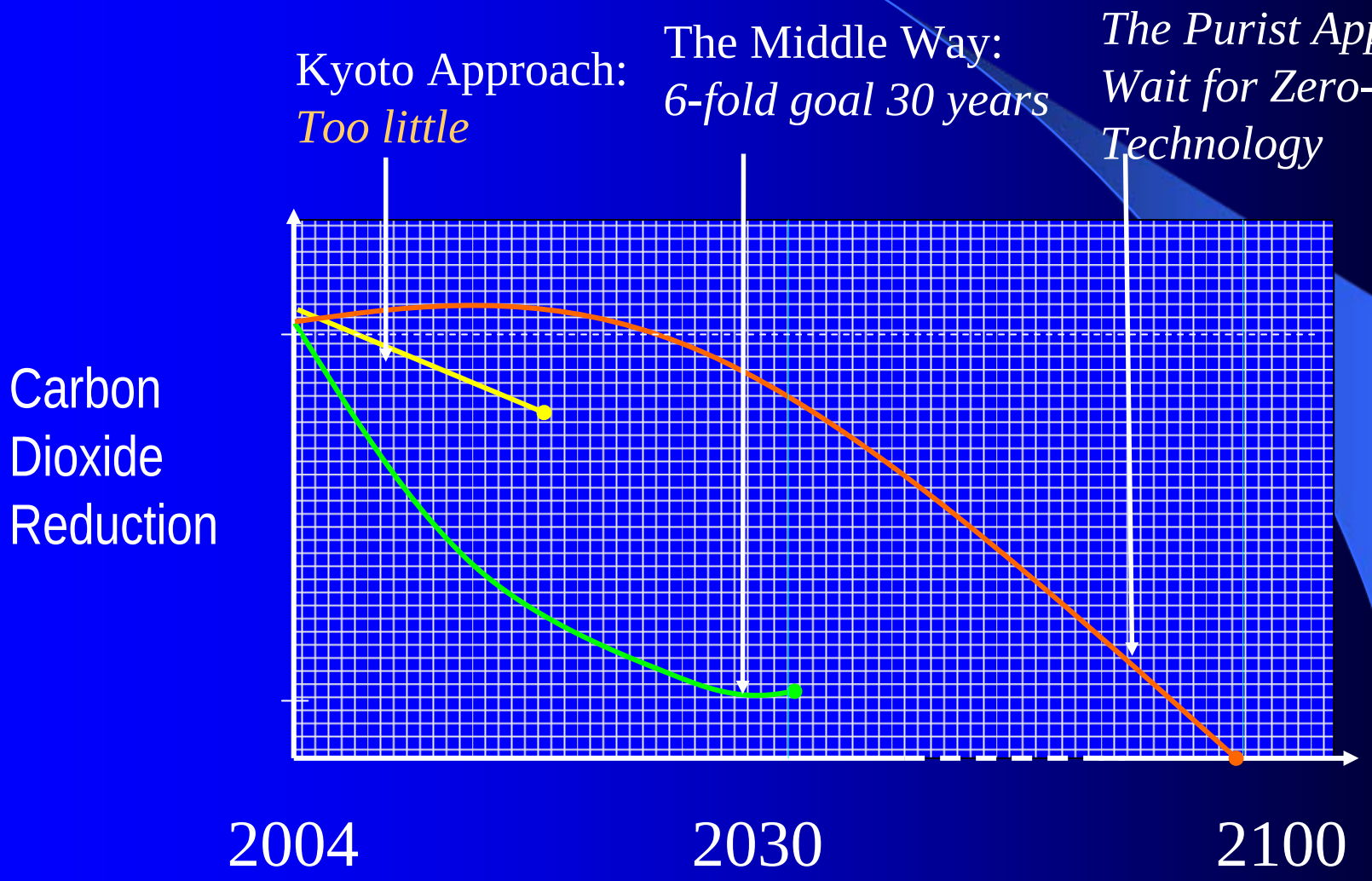
3 Linked Big Threats Already Cost us $ -- We need you to help solve ALL 3!

CAR FUEL SECURITY: Can US economy still work and feed us all if oil is cut off or unaffordable? Is there hope we can pay less for fuel?

DAYTIME ELECTRICITY: Will we have shutdowns if imports of natural gas to US or EU or Latin allies is cut off or unaffordable?

24-HOUR ELECTRICITY: Can we make large scale renewable electricity (solar) cheap enough, soon enough worldwide – before every terrorist cell in the world has material for many bombs & CO_2 ⇒ far worse hurricanes & maybe more snowstorms in Europe, and hunger… ?

General Strategy: CO_2 As Example of Hard Work But No Solution



Can we Cut our Need to Use Oil and Gas by >50% in 20 years? How?

- How do we keep our cars running?
- The big problem: the car fleet takes 15 years to turn over. Thus new cars must be >50% gasoline independent in 5 years to make it possible.
- Giving up would be crazy – but where is there hope? (But: fuel has more time to catch up.)
- Where does the new fuel or electricity come from? Sources? Distribution?
  - Rapid growth in imports of LNG
- Serious hope of avoiding a crisis of dependency in time but no guarantee

Long-Term Options For Zero-CO2, Zero Import Dependence Cars

- Energy in Batteries – not ready yet, but huge recent progress, serious R&D breakthru hopes, plug-in hybrids can help get us there. $2000 for 10 kwh battery from China – for 20-mile plug-in. See HR 1331 for incentives.
- Alternative Liquid Fuels – eventually, zero-carbon liquids & carbon-neutral biofuels. GEM flexibility can help get us there. See HR 670 for best comprehensive approach.
- Heat batteries for cars? Large heat batteries now have 70-90% two-way efficiency, $250 for 10kwh, but in large (3 MWh) systems so far (NREL/SR-550-27925 (2000).) R&D to develop 3rd generation Stirling engines or "JTEC" essential to make this a real possibility, maybe. Allows a heat plug-in option. New R&D Directions…
- Not so plausible: wind-up cars, compressed air or zero-carbon gasses, all reviewed during NSF PNGV SBIR effort. (Chicken and egg, etc.)

Plug-in Hybrids (PHEV) : A Large-Scale Opportunity Here and Now

- Hybrids cut liquid fuel use 50% already. Plug-ins cut 50% of that.
  - "Researchers have shown .. (PHEV) offering.. electric range of 32 km will yield… 50% reduction.." (IEEE Spectrum, July/05). Shown in working Prius.

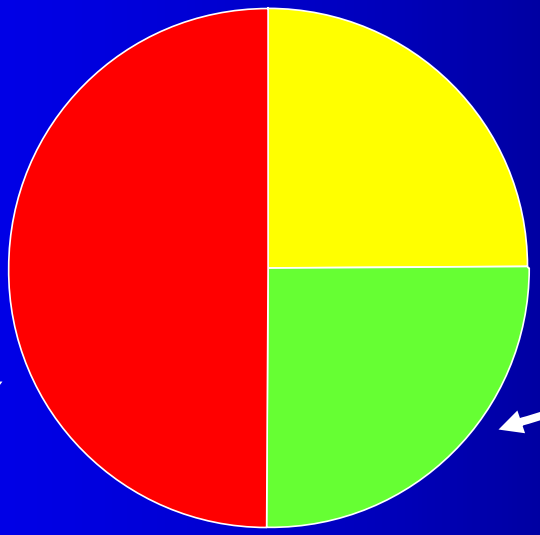
- Battery breakthroughs in China: from 10/07, 10kwh batteries (larger than) cost $2,000. www.thunder-sky.com. Thus an extra $2,000 per car can cut gas dependence in half.
- Gives economic security in case of sudden gasoline cutoff.
- Does not strain grid – actually strengthens it, if done right

How To Zero Out Gasoline:

Best Near-Term Hope for 100% Renewable Zero-Net-CO2 cars & Zero Energy Imports

With GEM fuel-flexible cars, biofuels might supply ¼ of present liquid fuel demand trends

Best Advanced Hybrids Cut Gas per Mile By 50%



Plug-in Hybrids with 10kwh batteries get half their energy from electricity

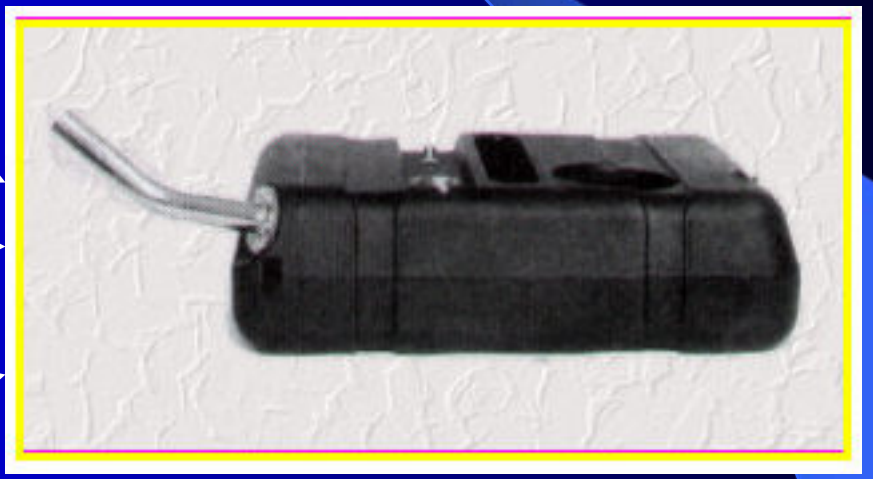
Superflex: GEM fuel-flexible hybrid cars offer a 100% solution based on near-term technology!

GEM Flexibly Fuel Vehicles (FFV)
One Tank To Hold Them All

G: Gasoline

E: Ethanol

M: Methanol



With an FFV, you choose each day which to buy

At $100-200/car, a more open competition, level playing field, better unleash the power of the free market

GEM flexibility ⇒ use of any corrosive fuel, adaptive engine control

But How Much Benefit Can We Get From Alcohol Fuels Near-Term?

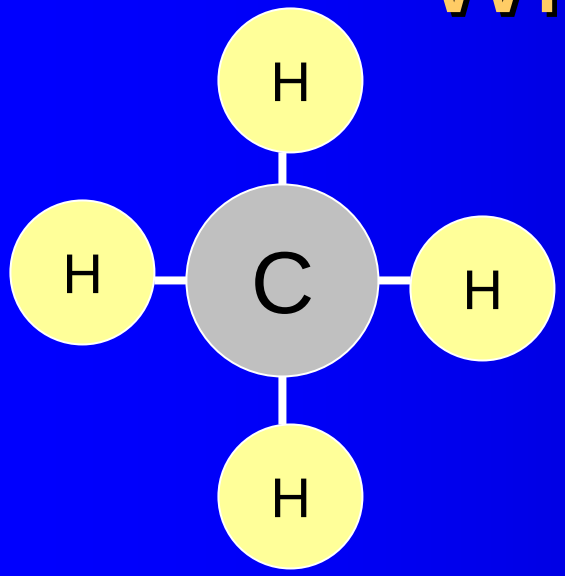
- The maximum conventional ethanol supply from US corn is only a tiny fraction of US needs, and only a tiny fraction of biofuel potential revenue
- Can we expand it by an order of magnitude?
- Can we find technologies that work off a much wider varieties of plants, more efficiently, at an acceptable price? Can we find technologies well enough proven that they could really scale up fast?

Yes we can, if we stop requiring so much purity in our ethanol/alcohol!

We need to give this guy permission to compete with Saudi Arabia and Iran for the car fuel market! He doesn't need a subsidy – only more freedom and an open door! Just give him a chance, and within 15 years…

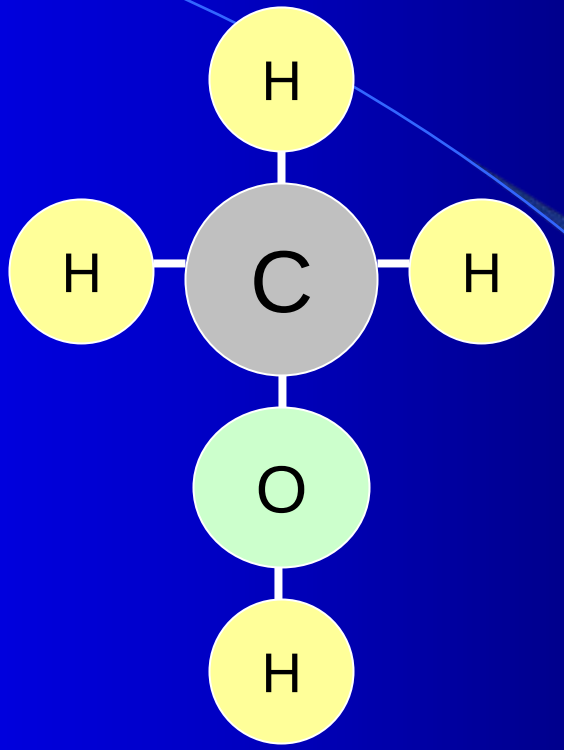
(Also, try a google on "forest industry" methanol.)

What IS Methanol?



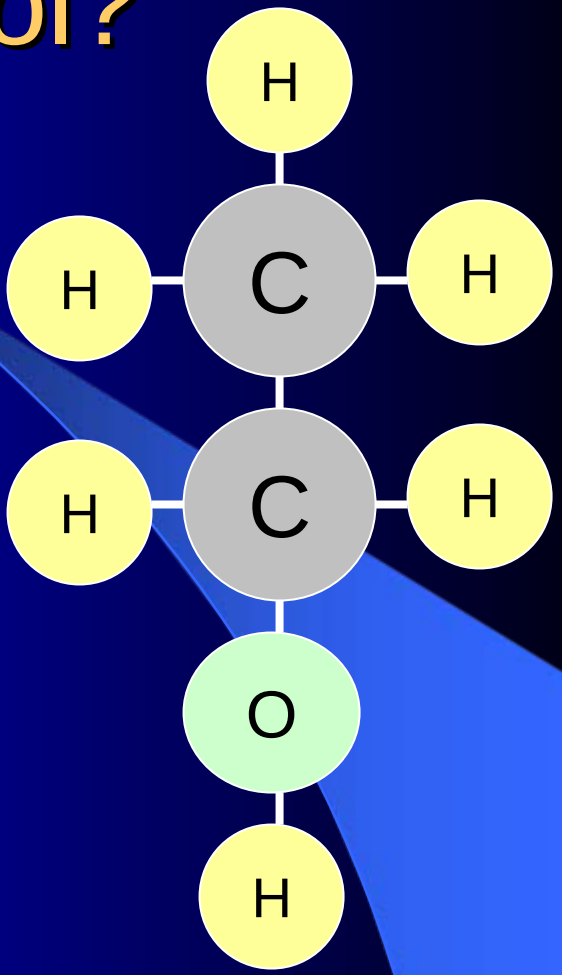
Methane

Natural Gas
Scarce as Oil
Needs Special Tank



Methanol

Good H Carrier
Can Be Bioliquid
Or From Coal, Gas



Ethanol

e.g From Corn
Drinkable

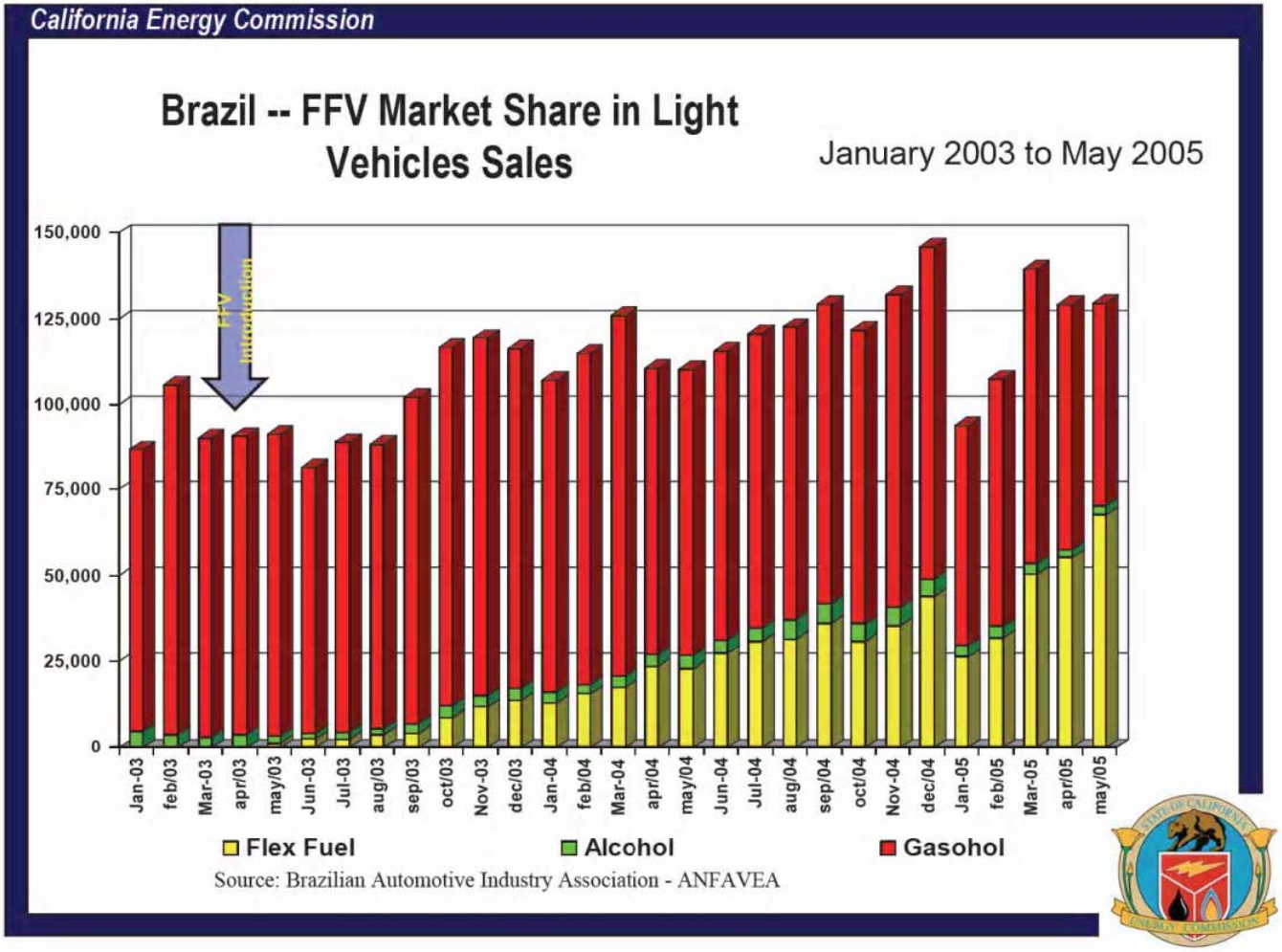
GEM Flexibility Is Well-Established

ALCOHOL FUELS

"Detroit is ready now to -- make cars that would run on any combination of gasoline and alcohol -- either ethanol, made from corn or methanol, made from natural gas or coal or even wood. Cars produce less pollution on alcohol fuels, and they perform better, too. Let us turn away from our dependence on imported oil to domestic products -- corn, natural gas, and coal -- and look for energy not just from the Middle East but from the Middle West."

Source: **George Bush 1988 Campaign Brochures**
www.4president.org

Fuel flexibility can be brought online very quickly, much faster than hybrids merely doubling every year!



All major manufacturers which sell in US have sold such cars in Brazil!!

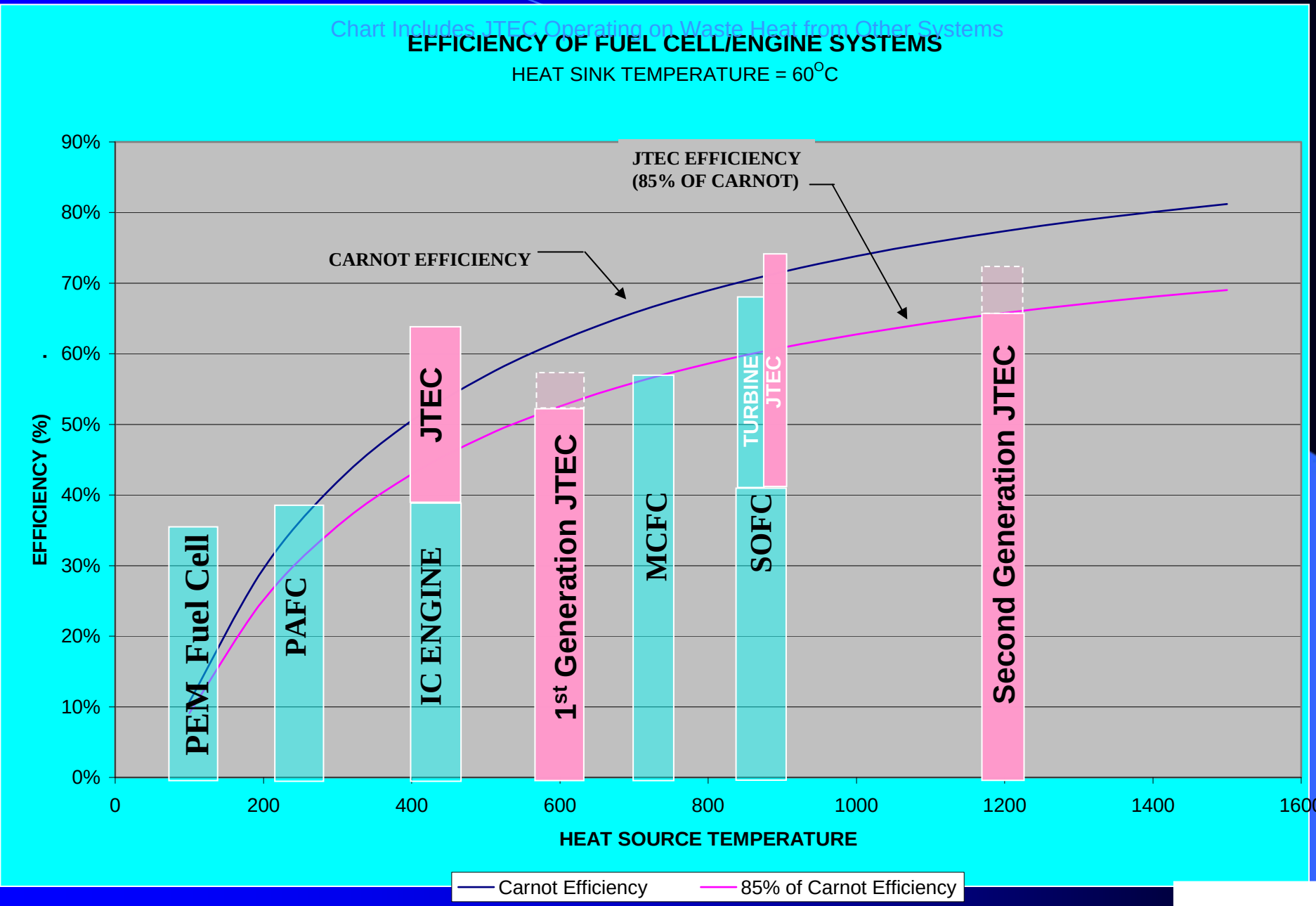
Should GEM Flexibility Be REQUIRED in New Cars & Trucks?

- This is not a government choice of fuel, but an open standard to create competition, to unleash market forces where today there is a monopoly.
- What is open fuel competition worth? Costs –
  - 15 million new cars/yr US ⇒ $1.5-3 b/yr for 100% GEM flexibility
  - Vs. TV: New digital standards cost: $ 2 Comcast alone, $3 billion user subsidies, $1.8b PBS, and more..
- Do we need new TVs more than we need to protect the foundation of the US economy?
- As with TV, can combine law with transition payments

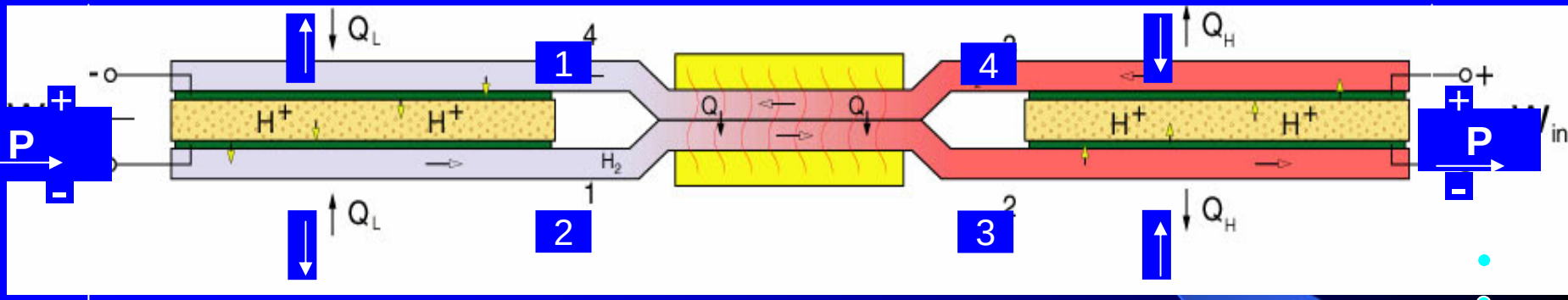
Rough but Unbiased Guess at What we Pay Today For Fuel Rigidity in Cars

- What would we save if used methanol in cars, if US wholesale price of $220/tonne? (Strong 2004 price)
- 216 b. gallons/yr of gasoline≡ 418 b. gal. methanol
- EIA Primer on Gasoline Prices: $1.56 in ’03, 14% distribution, 15% refining&profits, 27% all tax
- To $220/tonne, add same distribution cost cost per physical gallon, same profit and tax per Btu (Note: Exxon then doubles its revenue from distributing liquid fuels. The current revenue loss is to the folks who now own the oil… but even they make more money in total stretched over more years…)
- At pre-Katrina $2.50/gallon-gasoline, using methanol would have cost $324b, versus $540b!
- New methanol costs well under $220/tonne! (Google on “Canaccord methanol”)

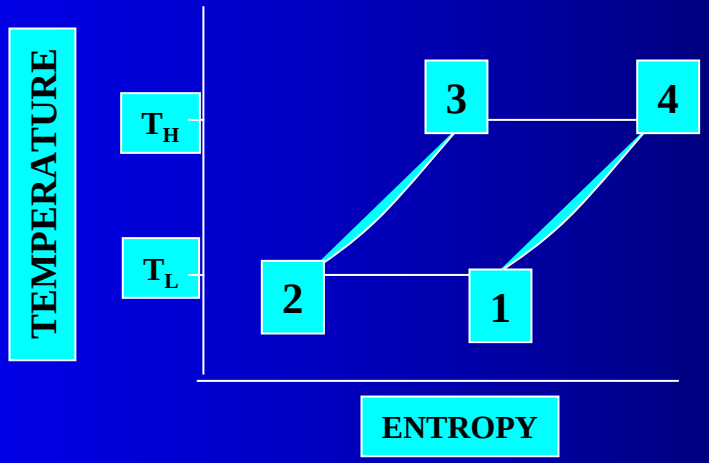
If JTEC works, we don't need fuel cells for cars & can use any fuel!!!



JOHNSON THERMO-ELECTROCHEMICAL CONVERTER (JTEC)

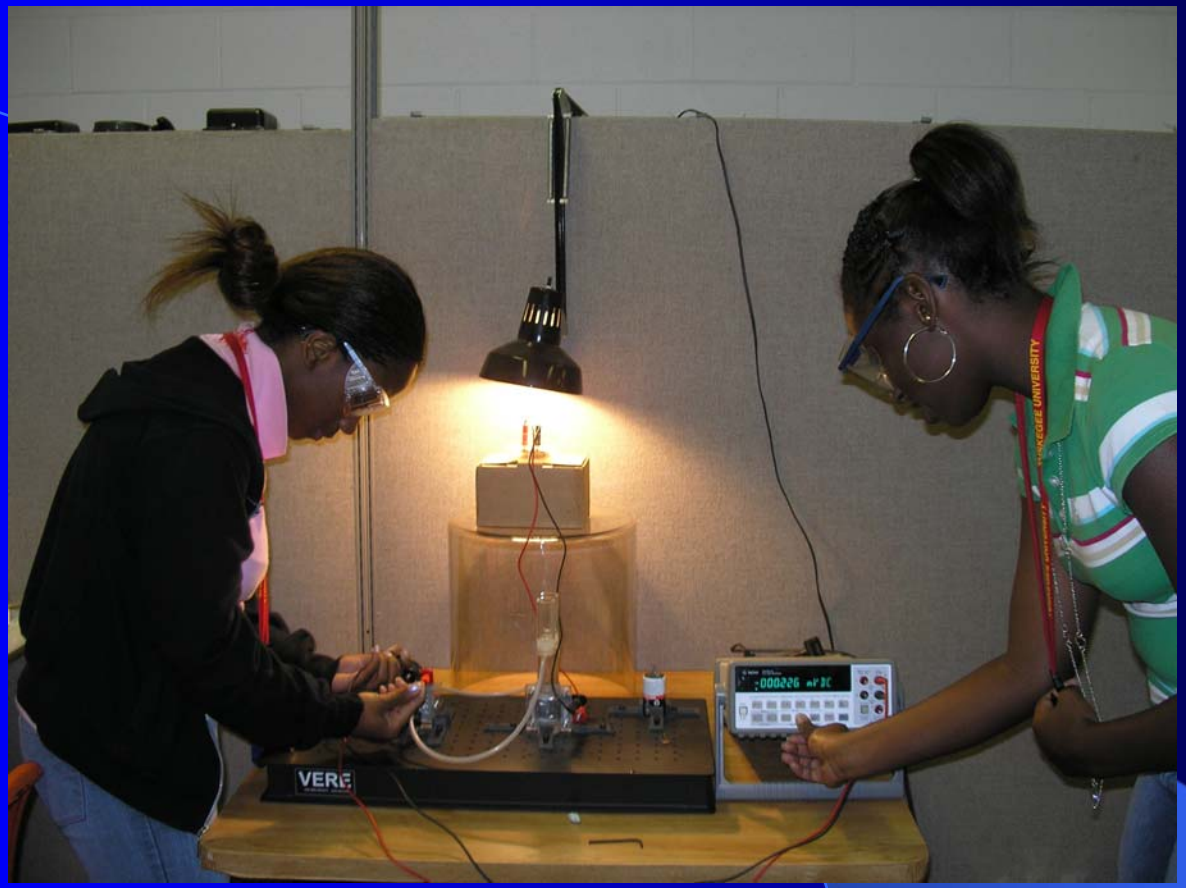


TEMPERATURE ENTROPY DIAGRAM FOR ERICSSON CYCLE



Not a heat-to-electricity chip! Not a heat engine to make heat to go to a generator!
A fundamentally new way to go from heat to electricity, grounded in basic science!
But it all depends on new membranes. Who could provide such membranes?...

Here's who: the laboratory of Prof Aglan at Tuskegee University!



Summer school students changing the world –

- May 07: New simulations settle on design; lab tests verify the tough half of the system; NSF "highlight" coming…

Batteries Too: Two New Concepts to Use Those Membranes to Outperform Asia on Batteries for Plug-in Hybrids (Maybe Even Affordable True Electrics!)

	Specific Energy (Wh/kg)	Energy Density (Wh/l)	Discharge Rate (C)	Specific Power (W/kg)	Cycle Life
Nickel Cadmium	80	150	10	500	800
Nickel Metal Hydride	150	250	5	200	800
Lithium ion	211	577	5	300	500
DMFC	250	75	5	500	500
Johnson Lithium Air	2000	2000	5	400	500