



Turning Oil into Salt: Energy Security Through Fuel Choice



"To the British Admiralty the solution to lack of salt was to acquire through force or diplomacy places that could produce it. Portugal had salt [...] but needed protection [...] And so England and Portugal formed an alliance trading naval protection for salt."

Mark Kurlansky, *Salt: A World History*

“It has always been our view that the value of commodities, including oil, should be determined in open, competitive markets, and not by these kinds of anti market production decisions.”

White House response to today's OPEC production cut.

Why fuel choice?

- Choice=insurance
- Choice provides price stability
- Choice permits competition
- Choice protects against supply disruptions
- Having choice doesn't mean you have to exercise it.

Fuel choice is key to victory

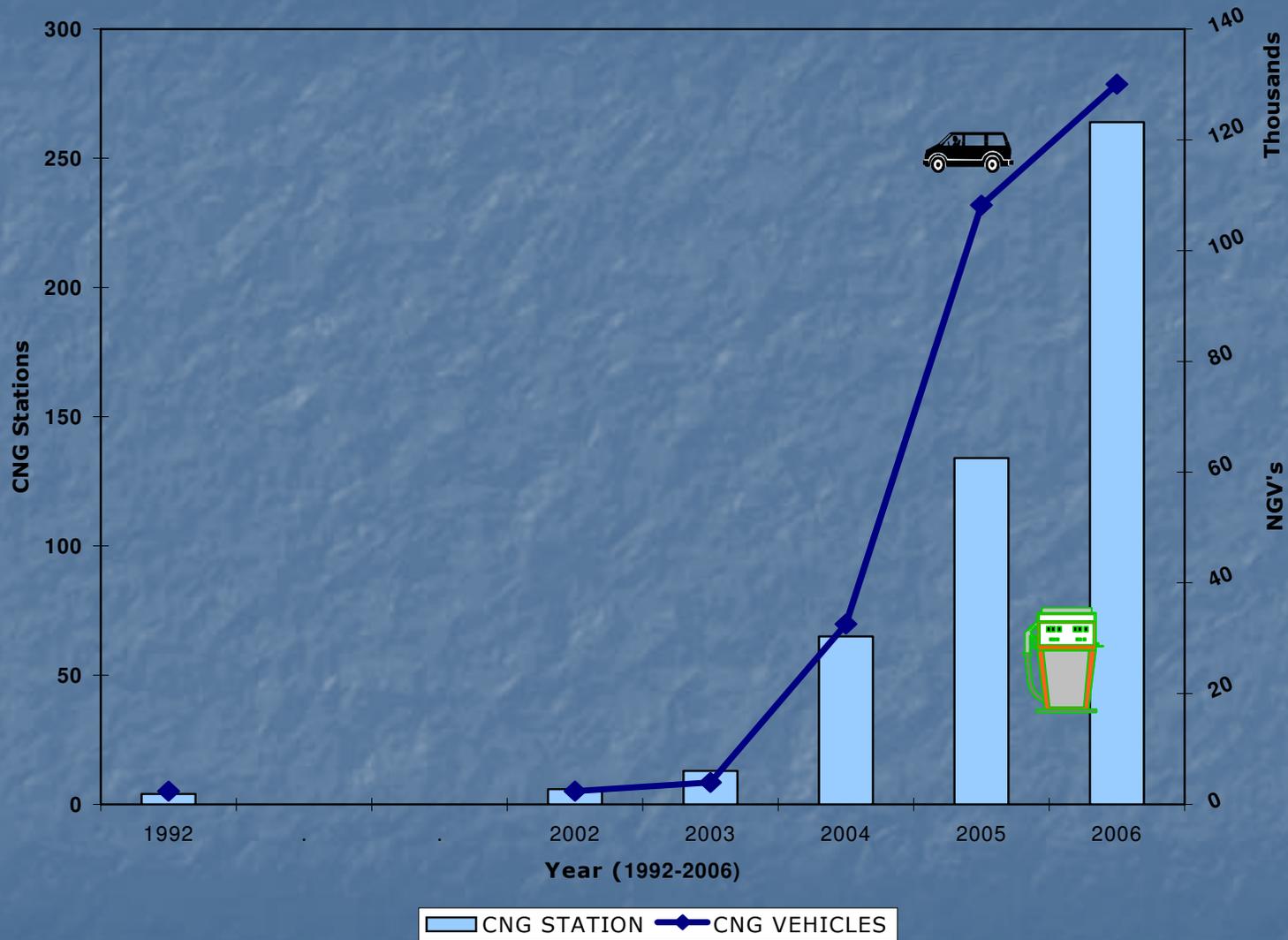


Alcohol is
our enemy!

What is a compressed natural gas (CNG) vehicle?



Iran CNG revolution



Retrofit



At present 107 conversion centers have been equipped in 45 cities in entire of country and some other centers will be built soon.
The government pays 85% of total car conversion costs. Car owners pay only \$55

OEM CNG vehicles



Refueling infrastructure



Mashhad



Esfahan

Conversion of gas stations is fully funded by the government to the tune of \$300,000 per station.

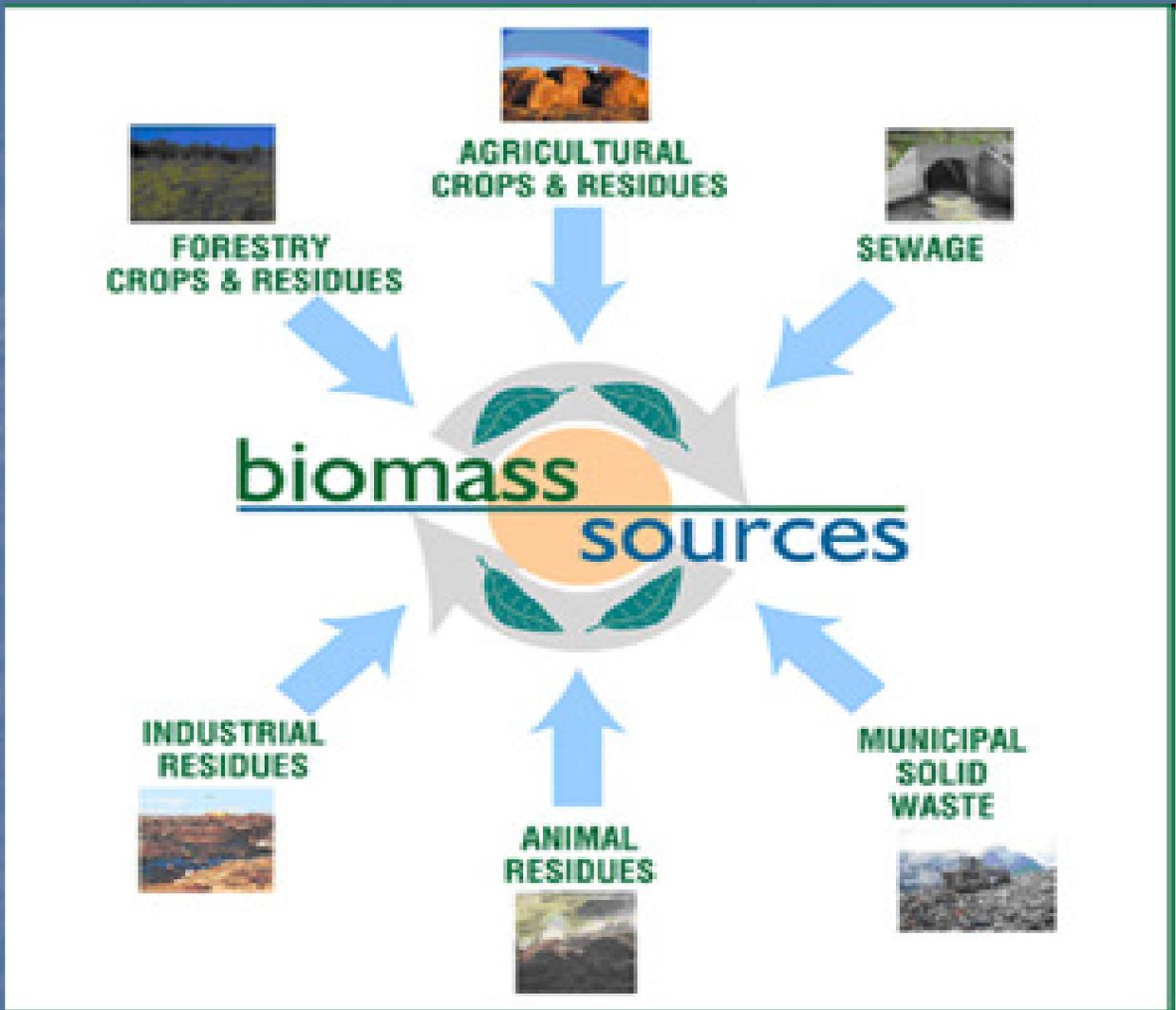
All cars should become platforms on which fuels can compete:

- GEM FFV
- PHEV
- GEM-PHEV
- Biodiesel compatible vehicle
- Diesel-PHEV
- Bi-Fuel
- Tri-fuel (gasoline, ethanol, CNG)



Tap into all of our national resources





Many ways to use biomass

■ Process type	Temperature	Time	Medium	End products
■ Anerobic Microbal decay	Ambient	Weeks/years	moisture	Compost, CH ₄
■ Aerobic Microbal decay	100F	Days/weeks	moisture	Compost, CO ₂
■ Fermentation	110F	72 hours	Water/yeast	Ethanol, CO ₂
■ Enzymatic saccharification	110F-300F	60 hours-10 min	GMB, acid, water	Ethanol, CO ₂
■ Acid hydrolysis	400F	20 min	Water/acid	Acids->P-series
■ Pyrolysis	1200F	5-10 sec		Bio-oil, tar
■ Gasification	1700F	30 sec	Steam, air	H ₂ , methanol
■ Combustion	2700F	1sec	Dry air/O ₂	Flyash, CO ₂

Stop wasting our waste



P-Series Fuels

- P-series is a liquid, renewable, affordable, made-in-the-USA non-petroleum fuel formulated for flexible fuel vehicles (FFV's) whose engines are designed to run on gasoline/methanol blends. In 1999, P-series was recognized by the U.S. DOE as an alternative fuel.
- The fuel is a blend of:
 - 35% liquid hydrocarbons derived from natural gas production
 - 45% ethanol
 - 20% MTHF, the material derived from biomass waste, which comprises 50-60% of the urban waste stream.
- The level of regulated and toxic emissions resulting from P-Series is lower, and carbon dioxide emissions are reduced by 50%, as compared to gasoline.

National potential

- Large quantities of unrecycled organic waste is generated in the U.S. each year:
 - 47 million tons of unrecycled waste paper
 - 27 million tons of food
 - 24 million tons of wood and yard waste
 - 15 million tons of paper sludge
- This could make 24 billion gallons of P-Series annually (1.5 million bpd) replacing 15% of U.S. petroleum imports, and is enough to run 25 million vehicles.

Why using seaweed's carbohydrate for ethanol production?

- High concentration of fermentable carbohydrates
- High growth rate (order of magnitude higher than corn)
- Do not require fertile land or potable water



CO₂-to-fuel Micro Algae



Focus on scalable solutions-Alcohols

Feedstock	Yield in gallon/acre/year
Corn	350-450 ethanol
Switchgrass	1000-1500 ethanol
Gasified biomass->methanol	2175 ethanol equiv.
Sugarcane	890-2500 ethanol
Seaweed	Up to 3000 ethanol
Bio-methanol	2175 methanol
Algae	Up to 6000 ethanol (Algenol)

Focus on scalable solutions-oils

Feedstock	Yield in gallon/acre/year
Soybeans	48
Sunflower	102
Rapeseed	127
Oil Palm	635
Micro Algae	5000-15000

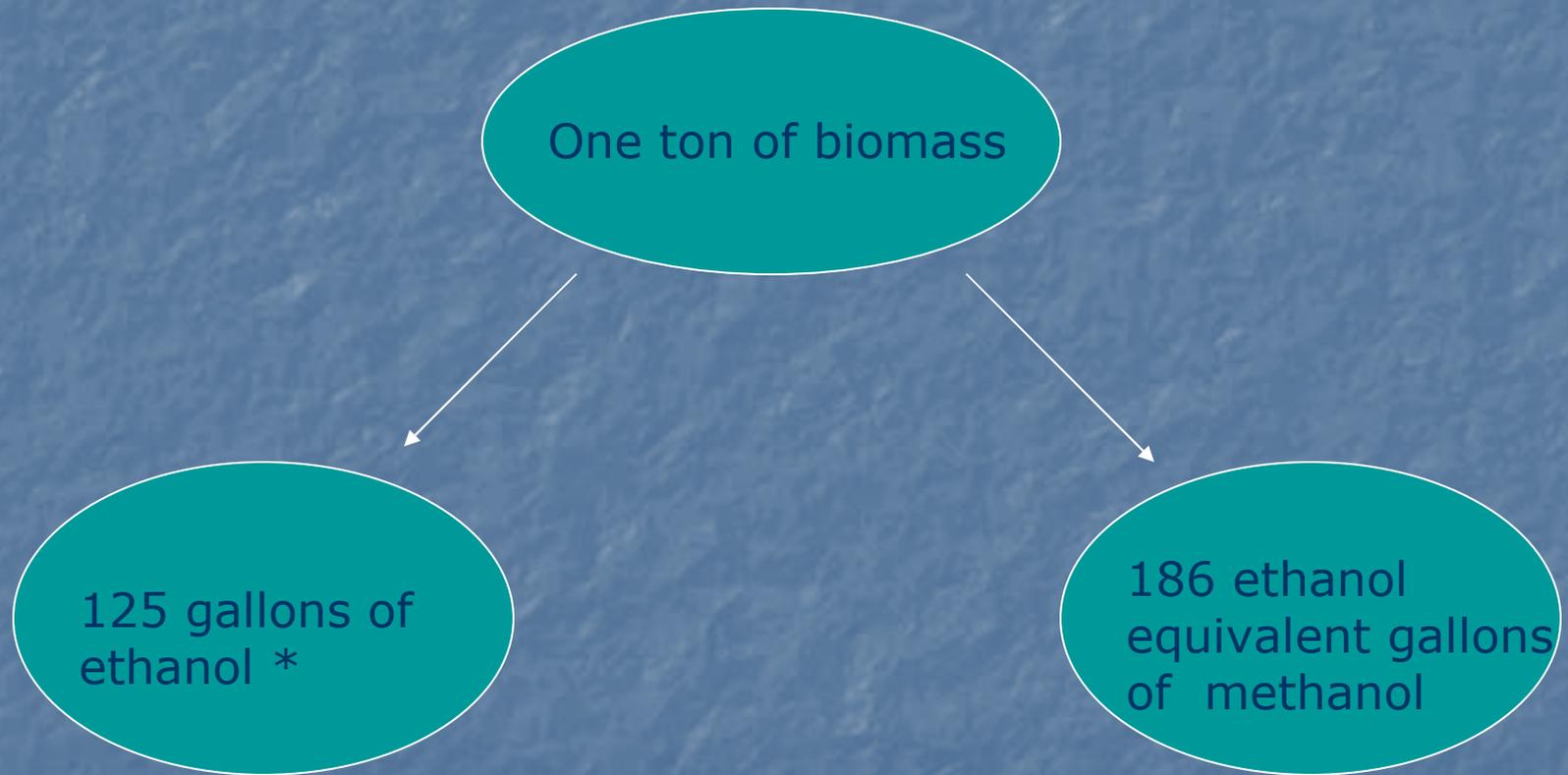
Government should not be picking R/D winners

"Hydrogen remains the ultimate opportunity, and worth pursuing even if it takes some time." David Garman, Undersecretary of Energy

"We'll also fund additional research in cutting-edge methods of producing ethanol, not just from corn, but from wood chips and stalks, or switch grass. Our goal is to make this new kind of ethanol practical and competitive within six years."

President Bush, State of the Union Address, January 31, 2006

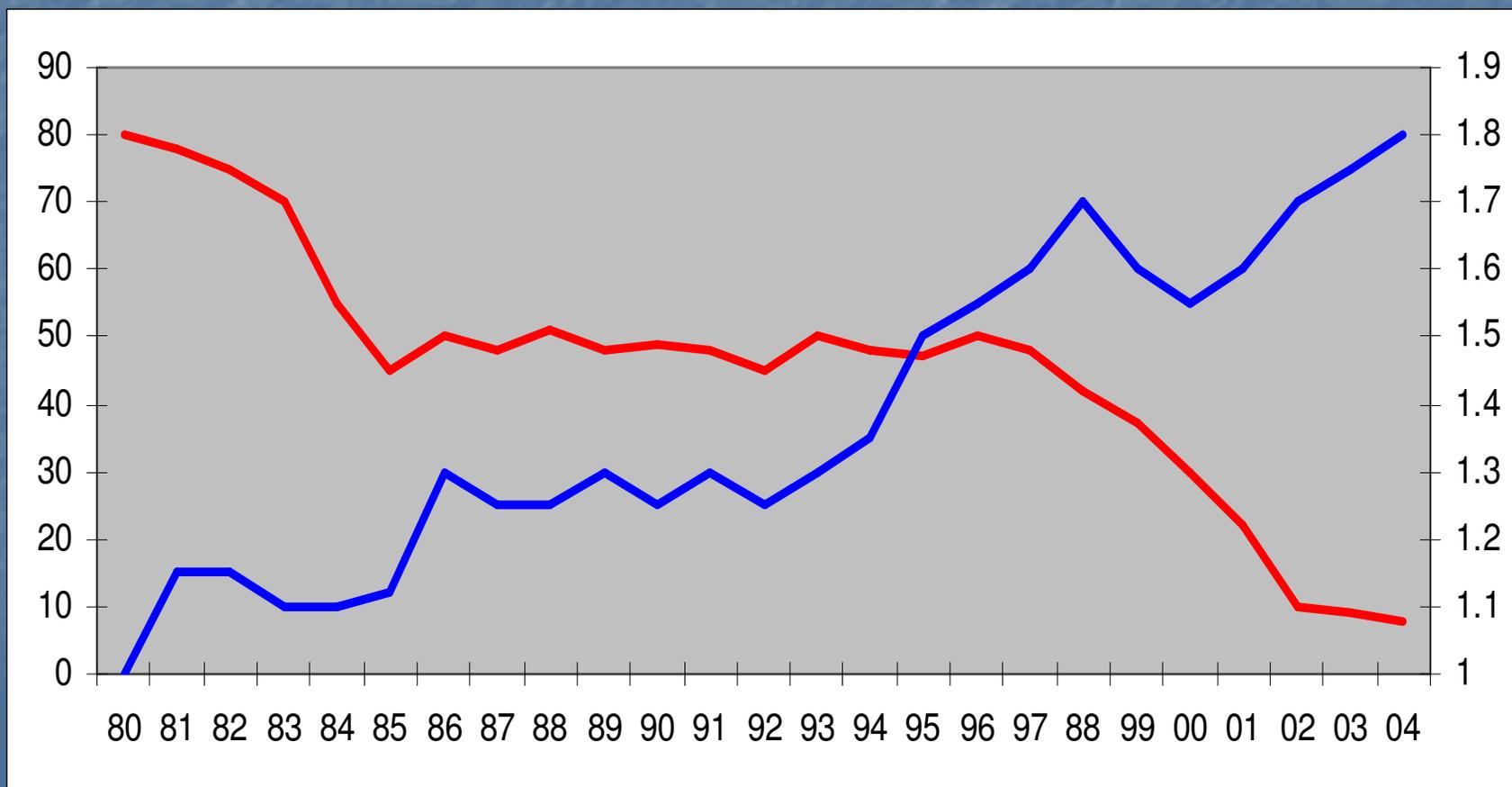
Chemistry vs. biology



*based on Iogen technology

Stay the course long enough

In the past 25 years Brazil's fuel consumption grew by 80% yet the country's oil dependence dropped from 80% to 10%.



Level the playing field with oil

- Tax incentives
- Infrastructure
- Remove trade barriers

Mapping the interests

Tree huggers: only ethanol, only high blends, only from renewables and only if done in a sustainable manner.

Do gooders: good for development but no food for oil.

Sodbusters: only ethanol and preferably from corn. Pro-cellulosic. Keep the tariff and don't touch our farm subsidies.

Cheap hawks: As much as possible of everything and quickly.

*We can turn oil into salt,
but we must act now.*

