

# TRANSITIONING FROM PETROLEUM-BASED TRANSPORTATION FUEL: A MIRACLE OR A HOAX?

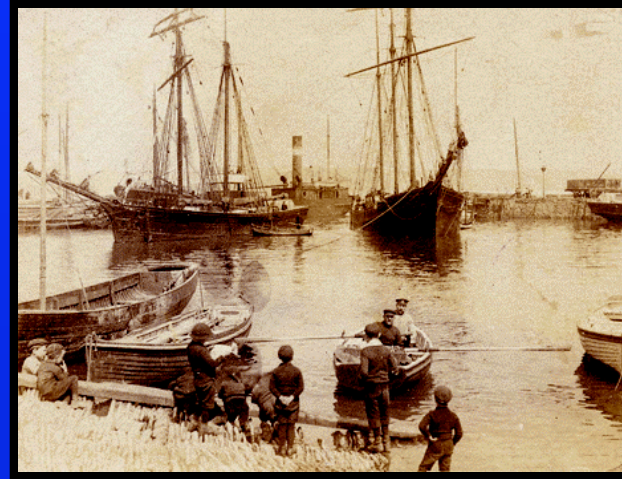


6th Annual Ammonia Fuel Network Meeting  
October 12, 2009  
Kansas City, MO

By:  
Matthew R. Simmons, Founder  
Ocean Energy Institute

# Petroleum Invented Modern Transportation

- Before oil was cracked into motor gasoline, diesel and aviation fuel, travel was laborious.
- Before the era of steamships and steam operated trains, man's travel ability unchanged for millennium:
  - Walking
  - Sailing
  - Horse riding





# Pre-Oil Travel Was A Dirty Business

- Trees were destroyed to create fuel for steam engines.
- Wind for sail power was most advanced form of transportation for many centuries.
- Diseases were rampant from horse dung and dead horses:
  - At the turn of the nineteenth century, New York City's infrastructure relied upon disease-creating entities such as the horse. Between 100,000 and 200,000 horses lived in the city at any given time and about 15,000 dead horses were removed from the streets of New York each year. Each one of those horses gave off 24 pounds of manure and several quarts of urine daily.



# A Lot Began To Change By 1900



(Ladies' Home Journal December 1900)

- 20<sup>th</sup> century miracles seemed far-fetched in December 1900.
- Every miracle finally materialized thanks to petroleum, internal combustion engines, electricity, Ford's horseless buggy and Wright Brothers' plane experiment.

8 THE LADIES' HOME JOURNAL

## WHAT MAY HAPPEN IN THE NEXT HUNDRED YEARS

By JOHN ELFRETH WATKINS, JR.



**Trains One Hundred and Fifty Miles an Hour.** Trains will run two miles a minute, normally; express trains one hundred and fifty miles an hour. To go from New York to San Francisco will take a day and a night by fast express. There will be cigar-shaped electric locomotives hauling long trains of cars. Cars will, like houses, be artificially cooled. Along the railroads there will be no smoke, no cinders, because coal will neither be carried nor burned. There will be no stops for water. Passengers will travel through hot or dusty country regions with windows down.

**To England in Two Days.** Fast electric ships, crossing the ocean at more than a mile a minute, will go from New York to Liverpool in two days. The bodies of these ships will be built above the waves. They will be supported upon runners, somewhat like those of the sleigh. These runners will be very buoyant. Upon their under sides will be apertures expelling jets of air. In this way a film of air will be kept between them and the water's surface. This film, together with the small surface of the runners, will reduce friction against the waves to the smallest possible degree. Propellers turned by electricity will screw themselves through both the water beneath and the air above. Ships with cabins artificially cooled will be entirely fire-proof. In storm they will dive below the water and there await fair weather.

**Telephones Around the World.** Wireless telephone and telegraph circuits will span the world. A husband in the middle of the Atlantic will be able to converse with his wife sitting in her boudoir in Chicago. We will be able to telephone to China quite as readily as we now talk from New York to Brooklyn. By an automatic signal they will connect with any circuit in their locality without the intervention of a "hello girl."

**Man will See Around the World.** Persons and things of all kinds will be brought within focus of cameras connected electrically with screens at opposite ends of circuits, thousands of miles at a span. American audiences in their theatres will view upon huge curtains before them the coronations of kings in Europe or the progress of battles in the Orient. The instrument bringing these distant scenes to the very doors of people will be connected with a giant telephone apparatus transmitting each incidental sound in its appropriate place. Thus the guns of a distant battle will be heard to boom when seen to blaze, and thus the lips of a remote actor or singer will be heard to utter words or music when seen to move.

**Photographs will be Telegraphed** from any distance. If there be a battle in China a hundred years hence snapshots of its most striking events will be published in the newspapers an hour later. Even to-day photographs are being telegraphed over short distances. Photographs will reproduce all of Nature's colors.

**Grand Opera will be Telephoned** to private homes, and will sound as harmonious as though enjoyed from a theatre box. Automatic instruments reproducing original airs exactly will bring the best music to the families of the untalented. Great musicians gathered in one inclosure in New York will, by manipulating electric keys, produce at the same time music from instruments arranged in theatres or halls in San Francisco or New Orleans, for instance. Thus will great bands and orchestras give long-distance concerts. In great cities there will be public opera-houses whose singers and musicians are paid from funds endowed by philanthropists and by the government. The piano will be capable of changing its tone from cheerful to sad. Many devices will add to the emotional effect of music.

**Vegetables Grown by Electricity.** Winter will be turned into summer and night into day by the farmer. In cold weather he will place heat-conducting electric wires under the soil of his garden and thus warm his growing plants. He will also grow large gardens under glass. At night his vegetables will be bathed in powerful electric light, serving, like sunlight, to hasten their growth. Electric currents applied to the soil will make valuable plants grow larger and faster, and will kill troublesome weeds. Rays of colored light will hasten the growth of many plants. Electricity applied to garden seeds will make them sprout and develop unusually early.

**Few Drugs will be Swallowed** or taken into the stomach unless needed for the direct treatment of that organ itself. Drugs needed by the lungs, for instance, will be applied directly to those organs through the skin and flesh. They will be carried with the electric current applied without pain to the outside skin of the body. Microscopes will lay bare the vital organs, through the living flesh, of men and animals. The living body will to all medical purposes be transparent. Not only will it be possible for a physician to actually see a living, throbbing heart inside the chest, but he will be able to magnify and photograph any part of it. This work will be done with rays of invisible light.

**Coal will Not be Used for Heating or Cooking.** It will be scarce, but not entirely exhausted. The earth's hard coal will last until the year 2050 or 2100; its soft-coal mines until 2200 or 2300. Meanwhile both kinds of coal will have become more and more expensive. Man will have found electricity manufactured by water-power to be much cheaper. Every river or creek with any suitable fall will be equipped with water-motors, turning dynamos, making electricity. Along the seacoast will be numerous reservoirs continually filled by waves and tides washing in. Out of these the water will be constantly falling over revolving wheels. All of our restless waters, fresh and salt, will thus be harnessed to do the work which Niagara is doing to-day: making electricity for heat, light and fuel.

# By 2001, World Took All These Miracles For Granted

- Concorde could cross Atlantic in a few hours.
- Consumers could fly San Francisco - Paris round-trip for \$350.
- Americans drove 9,450 miles in a single year and paid very little for this miracle.
- Conventional wisdom believed energy prices would steadily drop, increasing these miracles exponentially.





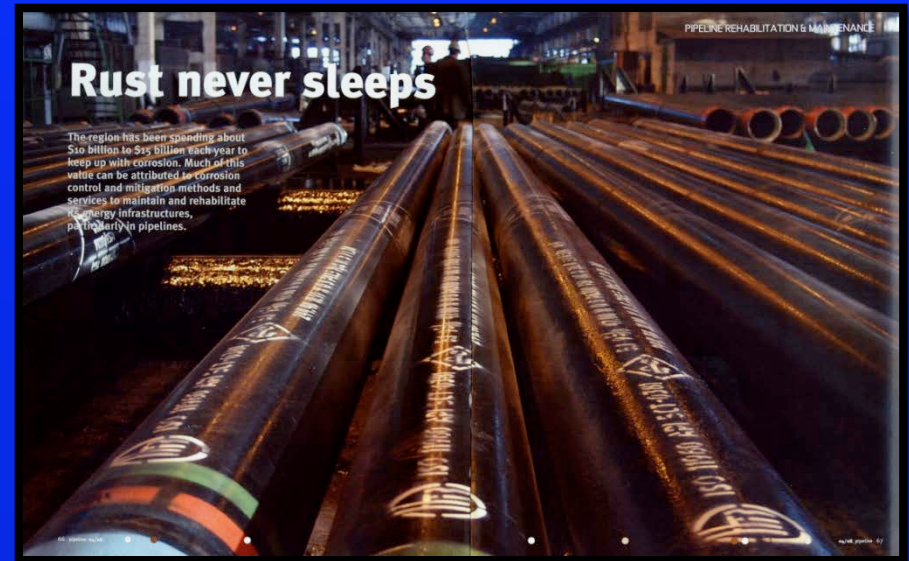
# Trembles Morph Into Earthquakes

- Belief that oil prices would fall and stay low became cruel hoax.
- From late 1998 to early July 2008, oil prices rose 14-fold.
- New supplies were getting scarce and very expensive to turn into usable energy.
- Maturing supplies were all in decline (at accelerating rates).



# Decades Of Cheap Oil Took Their Toll

- While oil consumers enjoyed this cheap oil ride, unforeseen consequences were devastating:
  - Few new assets were added
  - Few new employees were hired
  - Returns on invested energy capital were pathetic



The petroleum system got very rusty and gray while demand continued to soar.

# Suddenly, Gasoline Was Not Cheap

- Rising oil prices caused gasoline, diesel and jet fuel to soar.
- By mid-2008, U.S. motorists had “Pain at the Pump” (\$4.00/gallon).
- European motorists had agony at the pump (\$8.00 - \$11.00/gallon).
- Airlines were losing billions due to high cost of jet fuel.
- Trucking companies were losing money.



But, oil prices were still cheap, just not almost free.



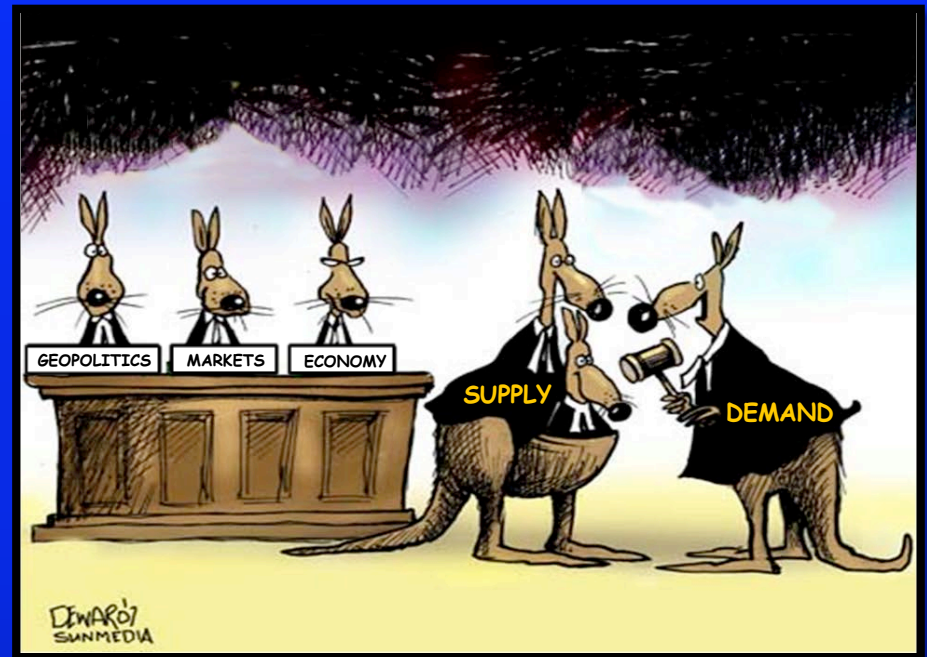
# How Expensive Was \$140 Oil (Or \$4.00 Gasoline)?

- It still represented remarkable bargain.
- \$140/barrel is \$3.33/gallon or \$0.21/cup.
- A cup of oil costs 1/5 of other consumables:
  - Bottled water
  - Coke
  - Cheap wine



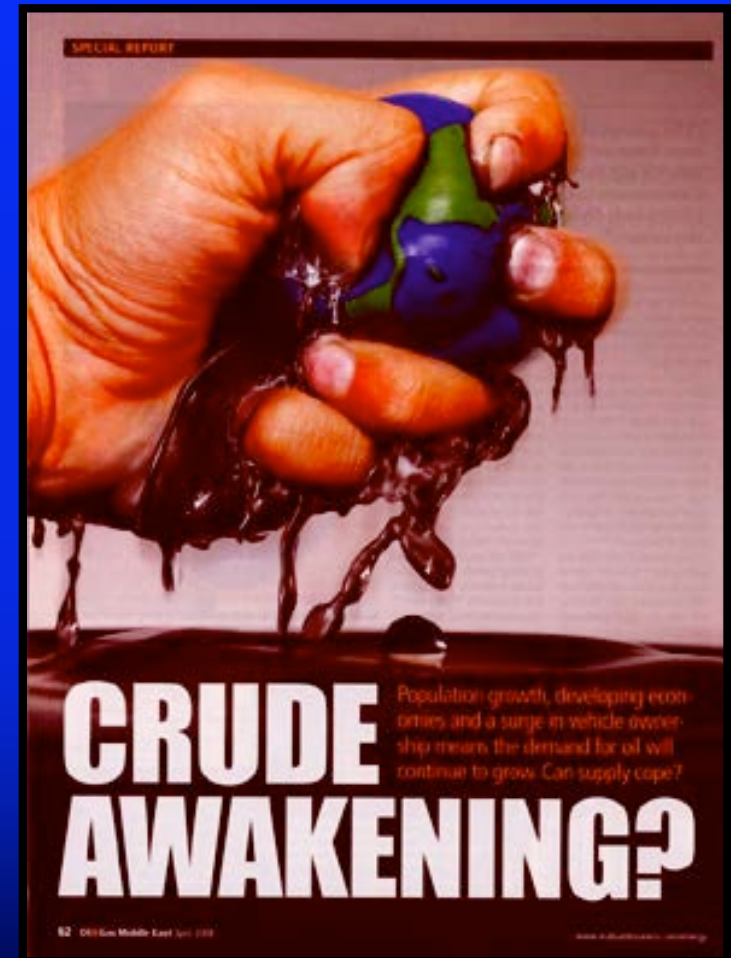
# Why Did Oil Prices Soar?

- Many pundits still blame this nightmare on spectators or market manipulators.
- The real twin culprits were:
  - Demand: It grew too fast
  - Supply: It peaked and began into a long decline
- This was no aberration but beginning of a new post-oil era.



# World Still In Denial Of This Change

- Transition from a world addicted to oil to world living with less oil will be biggest challenge of 21<sup>st</sup> century.
- How world reacts to this challenge might determine how long 21<sup>st</sup> century will be peaceful.
- Stakes to make rapid conversion will not be easy.

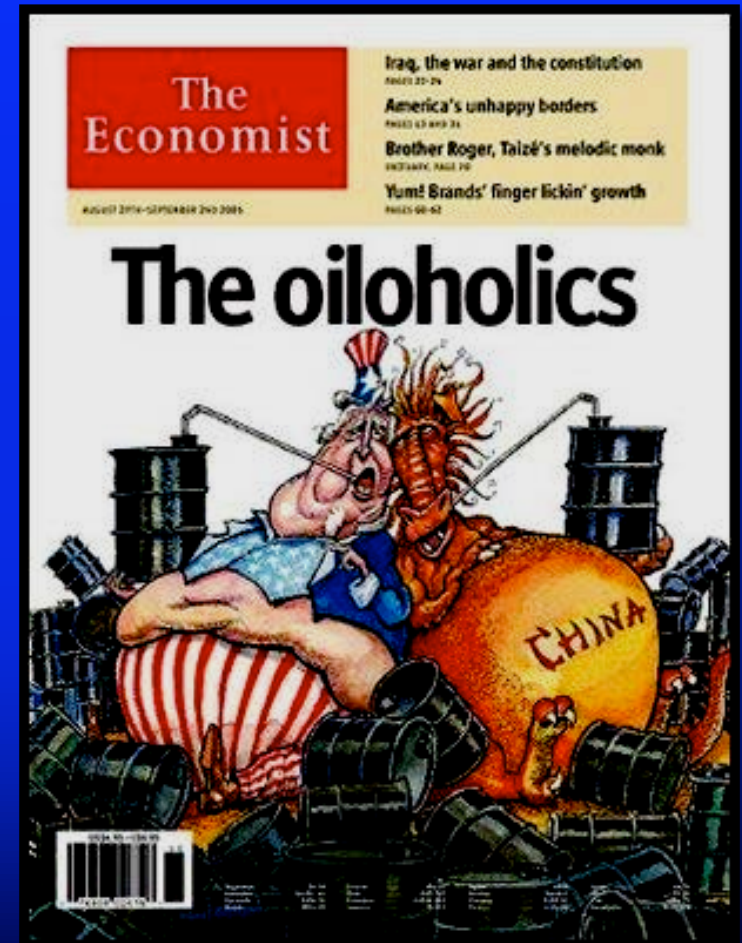


Source: Oil & Gas Middle East - April 2008



# We All Got Addicted To Oil

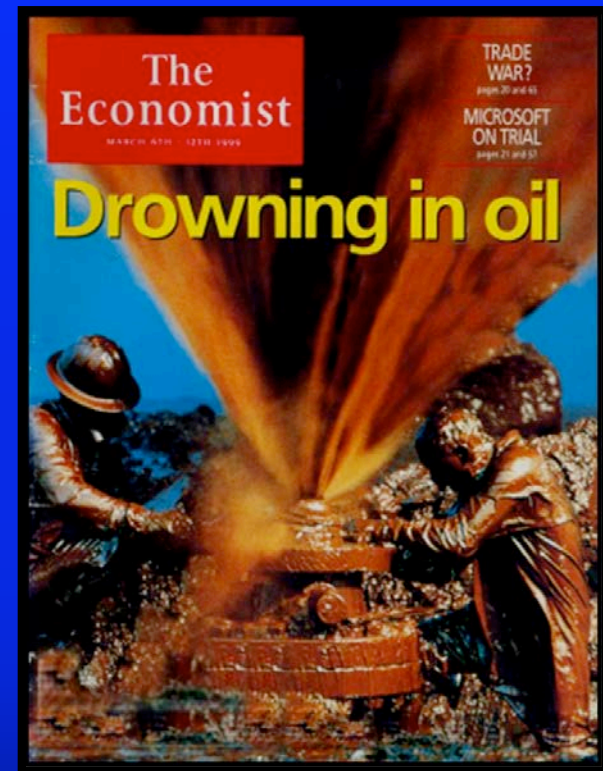
- The oil miracle was such a blessing that the whole world became accidentally addicted.
- America became public enemy #1:
  - With 5% of global population, we now use 25% of world's oil
- Rest of world is now also addicted:
  - China now uses 9 MM B/D of oil
  - India uses 3.5 to 4 MM B/D of oil
- Together they have 16 times more people than USA.



Source: The Economist, August 25, 2005

# We Were Hallucinating About Abundant Energy

- Greatest myth was that Middle East oil was limitless in supply and almost free.
- Second myth: “Modern technology” had made finding new oil steadily cheaper.
- Third myth: Demand growth is peaking.



Source: The Economist, March 6, 1999

These three convictions kept encouraging worlds addiction to oil-based transportation.

# Oil Supplies Will Fall...Demand Will Not

- Odds are high that global oil flow peaked in 2005.
- Each successive year, we need to anticipate less available crude to turn into transportation.
- Meanwhile:
  - America still adds 10 - 13 million cars/year
  - We have 850 cars per 1,000 people
  - China has 18 cars per 1,000 people...and this number is growing steadily

Table 11.1b World Crude Oil Production: Persian Gulf Nations, Non-OPEC, and World (Thousand Barrels per Day)

	Persian Gulf Nations <sup>a</sup>	Selected Non-OPEC <sup>a</sup> Producers								Total Non-OPEC <sup>a</sup>	World	
		Canada	China	Egypt	Mexico	Norway	Former U.S.S.R.	Russia	United Kingdom			United States
1973 Average	20,658	1,798	1,990	165	495	82	8,524	NA	2	9,208	34,888	55,670
1975 Average	18,934	1,430	1,400	236	706	180	9,623	NA	12	8,736	35,892	52,828
1980 Average	17,951	1,436	2,114	696	1,939	489	11,709	NA	1,022	8,607	32,802	60,668
1985 Average	9,830	1,471	2,606	887	2,746	770	11,686	NA	2,530	8,971	37,664	53,900
1990 Average	15,278	1,653	2,774	873	2,563	1,600	10,976	NA	1,820	7,365	38,822	60,462
1995 Average	17,511	1,806	2,960	920	2,918	2,706	---	6,995	2,489	6,600	36,736	62,386
1999 Average	17,397	1,817	3,131	922	2,866	3,091	---	5,860	2,568	6,495	39,582	63,762
1997 Average	18,095	1,922	3,200	865	3,023	3,142	---	6,020	2,518	6,462	37,320	65,744
1998 Average	18,337	1,981	3,100	834	3,070	3,011	---	6,864	2,610	6,262	37,460	66,040
1999 Average	18,087	1,907	3,196	766	2,906	3,019	---	6,079	2,084	6,881	37,509	65,922
2000 Average	19,895	1,977	3,249	765	2,927	3,222	---	6,076	2,276	6,823	38,482	68,406
2001 Average	19,068	2,029	3,300	720	3,137	3,222	---	6,917	2,282	6,801	39,014	68,101
2002 Average	17,794	2,171	3,390	716	3,177	3,121	---	7,408	2,292	6,748	39,919	67,168
2003 Average	16,983	2,309	3,409	713	3,371	3,042	---	6,132	2,090	6,681	40,724	66,448
2004 Average	20,787	2,398	3,485	673	3,383	2,954	---	4,405	1,846	6,419	41,537	72,512
2005 January	21,295	2,330	3,561	658	3,351	2,720	---	8,870	1,905	5,441	41,358	73,231
February	21,355	2,296	3,370	658	3,349	2,809	---	8,920	1,771	5,494	41,516	73,514
March	21,405	2,172	3,594	662	3,252	2,897	---	8,525	1,802	5,501	41,111	73,842
April	21,555	2,300	3,584	659	3,409	2,864	---	8,888	1,771	5,556	41,140	74,140
May	21,375	2,360	3,611	656	3,441	2,795	---	8,800	1,743	5,581	41,552	74,258
June	21,485	2,330	3,646	656	3,425	2,398	---	9,026	1,643	5,460	41,558	74,258
July	21,695	2,339	3,654	658	3,082	2,715	---	8,950	1,625	5,240	41,143	73,757
August	21,655	2,372	3,668	655	3,414	2,643	---	9,140	1,342	5,218	41,169	73,818
September	21,915	2,262	3,623	659	3,367	2,663	---	9,170	1,518	5,204	40,413	73,399
October	21,525	2,452	3,649	664	3,221	2,577	---	9,230	1,612	4,534	40,885	73,497
November	21,425	2,548	3,621	667	3,311	2,645	---	9,210	1,543	4,837	41,425	73,980
December	21,325	2,645	3,520	647	3,388	2,683	---	9,240	1,645	4,984	41,803	74,268
Average	21,601	2,399	3,900	658	3,334	2,698	---	9,043	1,649	6,178	41,401	73,807
2006 January	21,175	2,595	3,670	654	3,372	2,657	---	9,030	1,707	5,106	41,579	73,759
February	21,375	2,504	3,662	657	3,311	2,620	---	9,040	1,639	5,045	41,412	73,647
March	21,250	2,411	3,710	651	3,380	2,610	---	9,150	1,597	5,045	41,396	73,489
April	21,250	2,531	3,680	663	3,370	2,407	---	9,170	1,590	5,128	41,496	73,591
May	21,050	2,341	3,712	655	3,329	2,535	---	9,150	1,500	5,161	41,386	73,154
June	21,305	2,336	3,700	607	3,287	2,365	---	9,260	1,392	5,160	40,979	73,061
July	21,690	2,512	3,716	620	3,232	2,571	---	9,240	1,453	5,102	41,627	74,076
August	21,710	2,543	3,660	630	3,252	2,430	---	9,330	1,202	5,059	41,179	73,754
September	21,360	2,601	3,649	640	3,258	2,338	---	9,350	1,354	5,037	41,242	73,465
October	21,135	2,602	3,650	660	3,173	2,380	---	9,450	1,482	5,106	41,793	73,809
November	20,805	2,558	3,672	615	3,163	2,466	---	9,220	1,534	5,105	41,905	73,437
December	20,695	2,569	3,592	619	2,978	2,508	---	9,420	1,472	5,166	41,664	73,218
Average	21,232	2,626	3,673	639	3,266	2,491	---	9,247	1,490	5,102	41,404	73,639
2007 January	20,476	2,578	3,811	616	3,143	2,431	---	9,420	1,510	5,196	41,857	73,133
February	20,356	2,518	3,739	614	3,148	2,454	---	9,460	1,654	5,147	42,124	73,315
March	20,445	2,594	3,685	612	3,182	2,391	---	9,473	1,554	5,178	41,993	73,240
April	20,494	2,634	3,749	609	3,182	2,427	---	9,369	1,566	5,218	42,267	73,520
May	20,494	2,585	3,781	649	3,110	2,181	---	9,390	1,564	5,240	41,680	72,985
June	20,403	2,590	3,826	679	3,206	1,521	---	9,440	1,495	5,139	41,521	72,710
July	20,508	2,572	3,643	679	3,166	1,327	---	9,460	1,436	5,160	41,566	73,154
August	20,462	2,709	3,746	679	2,843	1,135	---	9,390	1,228	4,976	41,003	72,459
September	21,012	2,670	3,716	679	3,161	1,190	---	9,520	1,381	4,899	41,229	73,318
October	21,159	2,592	3,722	609	2,995	2,273	---	9,500	1,507	5,038	41,614	73,928
November	20,973	2,594	3,727	609	3,021	2,287	---	9,425	1,409	5,071	41,582	73,751
December	21,474	2,515	3,607	609	2,954	2,235	---	9,400	1,436	5,072	41,355	74,202
Average	20,682	2,611	3,729	637	3,082	2,270	---	9,437	1,477	5,103	41,607	73,910

\* Organization of the Petroleum Exporting Countries.  
<sup>a</sup> The Persian Gulf Nations are Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates. Production from the Neutral Zone between Kuwait and Saudi Arabia is included in "Persian Gulf Nations."  
 Re-Visited: NA=Not Available; --=Not Applicable; E=Estimate.  
 Notes: \* Crude oil includes lease condensate but excludes natural gas plant liquids. \* Monthly data are often preliminary figures and may not average to the annual totals because of rounding or because updates to the preliminary monthly data are not available. \* Data for countries may not sum to World totals due to independent rounding. \* U.S. geographic coverage is the 50 States and the District of Columbia.  
 Web Page: See <http://www.eia.doe.gov/emeu/intler.html> for all available data beginning in 1973.  
 Sources: See end of section.

Source: EIA Monthly Energy Report – March 2008



# We Face A “Clash” Of Society

- Unless world adopts Plan B to use less oil and creates a source of energy to transport “things”, we face chaos:
  - Global food shortages
  - Economic collapses
  - End of globalization
  - Etc., etc.



# We Can Use Less Oil

■ Plan B can be implemented quite fast (if we have the will):

- End long-distance commuting. Work where you live
- Grow food locally
- Travel efficiently (water trumps rail, rail trumps roads)
- Produce things close to consumption point

■ But, these merely buy time to invent replacement for transportation energy.



# Viabile New Fuel Source Needs To Use Current Fleet

## ■ Assuming we can create non-internal combustion vehicles:

- America has 280 million oil-consuming vehicles
- World has almost 900 million vehicles
- Airplanes will never “plug-in”

## ■ Early experiments to create biofuels were also dim:

- Corn ethanol became almost a scam
- Cooking oils, bio-mass, manure, etc., creates only tiny amounts of useable fuel

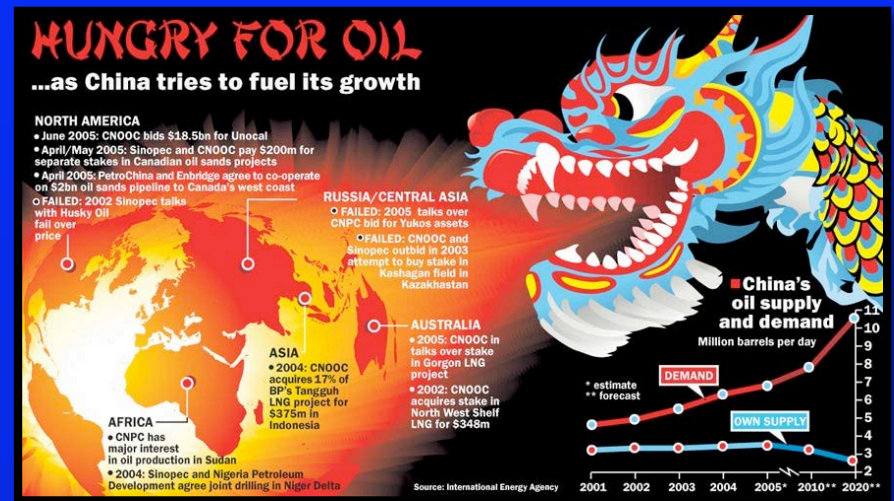


Source: Harvard Magazine



# It Is Daunting To Replace Small Percentage Of Petroleum Fuel

- World currently uses over 25 MM B/D of gasoline, diesel and aviation fuel.
- This amounts to over one billion gallons/day or 42,000 gallons/hour.
- But, 75% is used by 15% of world's population.
- China is second highest car buyer.
- They now have 18 vehicles/1,000 people.
- USA has ≈900 vehicles/1,000 people.



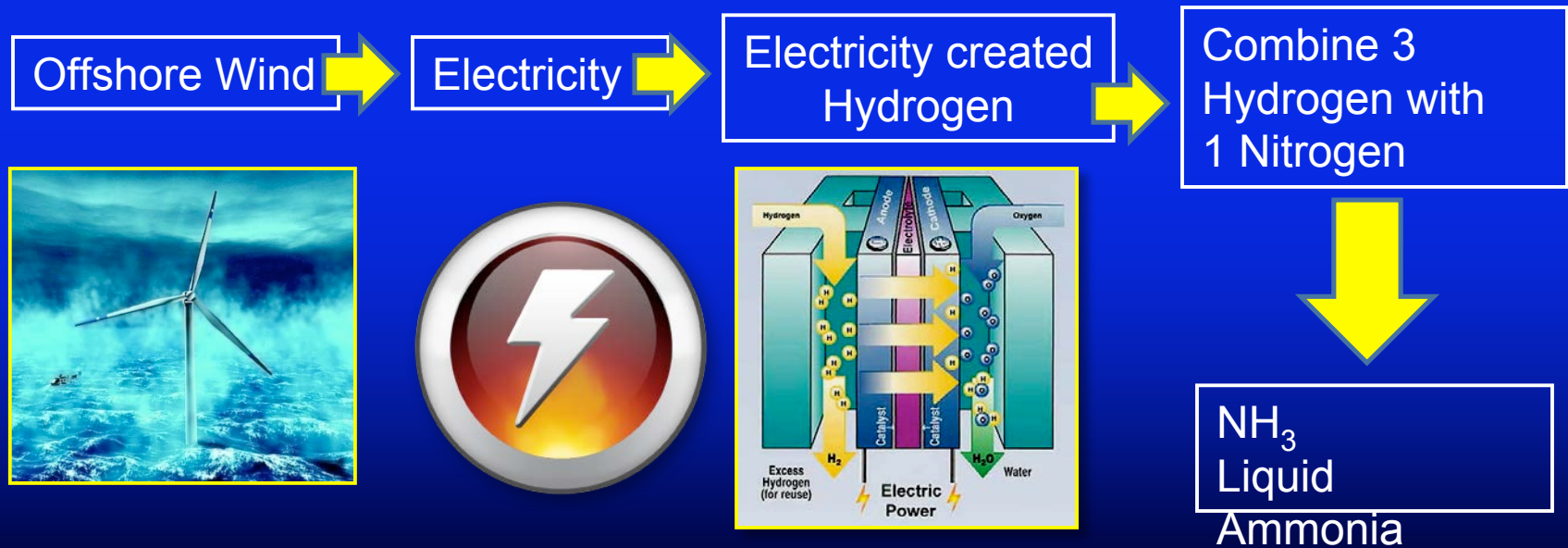
# The World Needs New Transportation Energy Source

- Biofuels would destroy our food chain.
- Algae holds promise, but current supply is tiny.
- There are few viable alternate supply sources that can scale to become important.
- Conservation (“Plan B”) can buy time but it is not a permanent solution.



# NH<sub>3</sub> (Liquid Ammonia) Is Only Realistic Solution That Makes Sense

- Since NH<sub>3</sub> can be created through offshore wind, its feedstock is abundant.
- Since 60% of world's population live within 50 miles from shorelines, it is available locally.
- The conversion process has been proven:





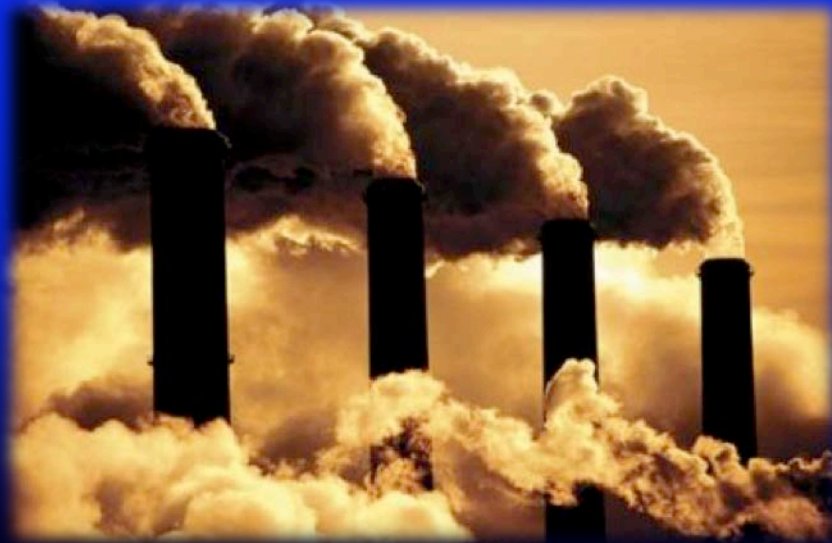
# We Know NH<sub>3</sub> Works

- Air Force and NH<sub>3</sub> pioneers have proven this high density fuel can power cars, boats and planes.
- Offshore winds are abundant.
- The wind quality does vary:
  - May be too mild (Cape Wind)
  - Or, too strong
- We need to capture the sweet spots and begin creating liquid ammonia.



# NH<sub>3</sub> Bi-Product Is Not Sooty...It Is Clean

- Offshore wind conversion process also creates:
  - Desalinated water
  - High quality salt
- What is does not create – Carbon emissions!



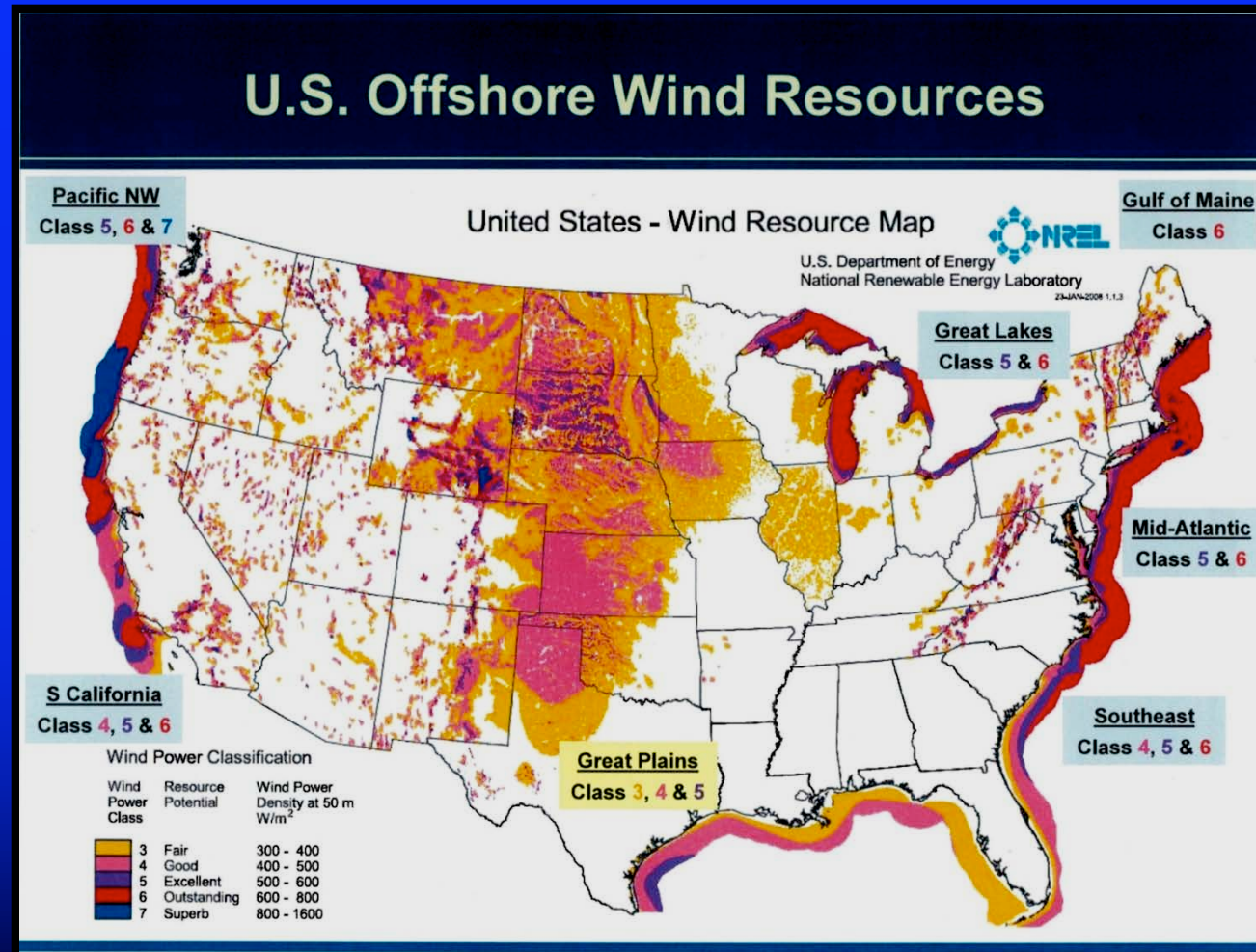
# How Much $\text{NH}_3$ Can Offshore Wind Create?

- 100MW plant creates  $\approx 4,800$  B/D of  $\text{NH}_3$ .
- 5 gigawatts of offshore-created electricity can create  $\approx 180,000$  B/D of  $\text{NH}_3$ .
- This is goal of Gulf of Maine Wind Project (during non-winter months).



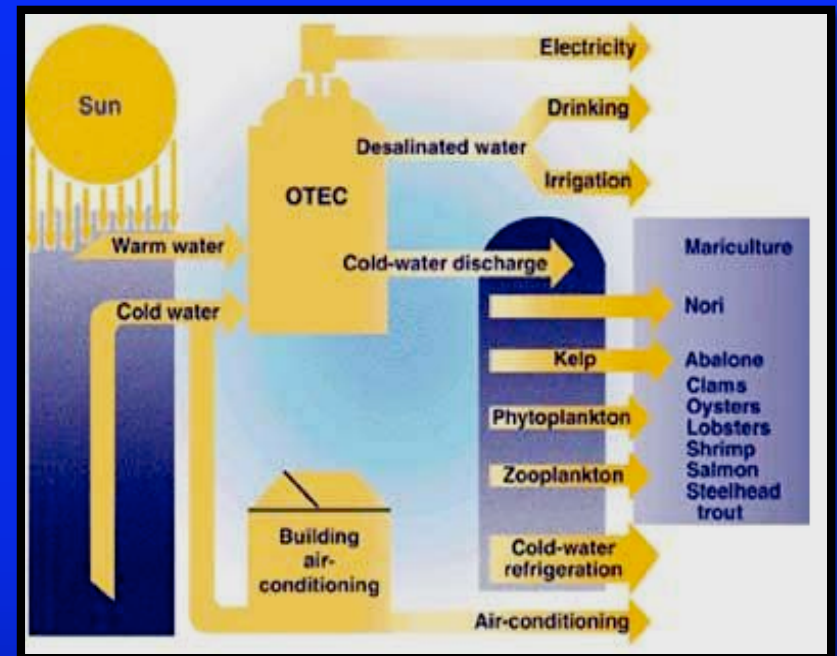


# How Much Energy Is In USA's Offshore Winds?



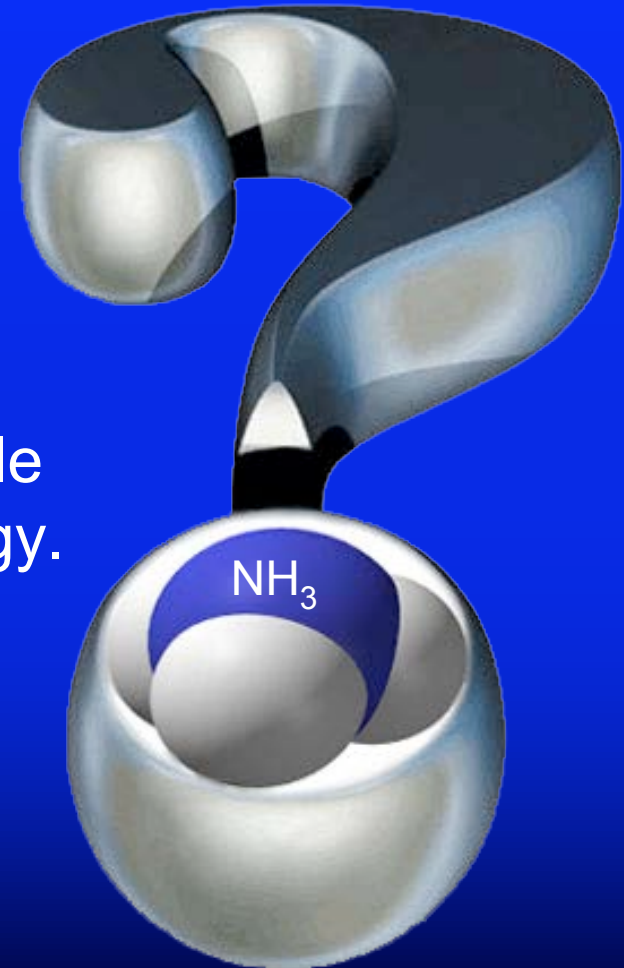
# Offshore Wind Can Also Create Potable Water

- All fossil fuel power plants consume enormous volumes of water. Some is recovered, most is lost.
- Offshore winds can produce desalinated, pure water and high quality salt.
- Potable water could soon become our scarcest resource.



# How Will 21<sup>st</sup> Century Work Out?

- We do not have abundance of oil and natural gas.
- We must rapidly create a Plan B.
- We must create a viable and scalable replacement for transportation energy.
- Thus far, only viable solution is  $\text{NH}_3$ .





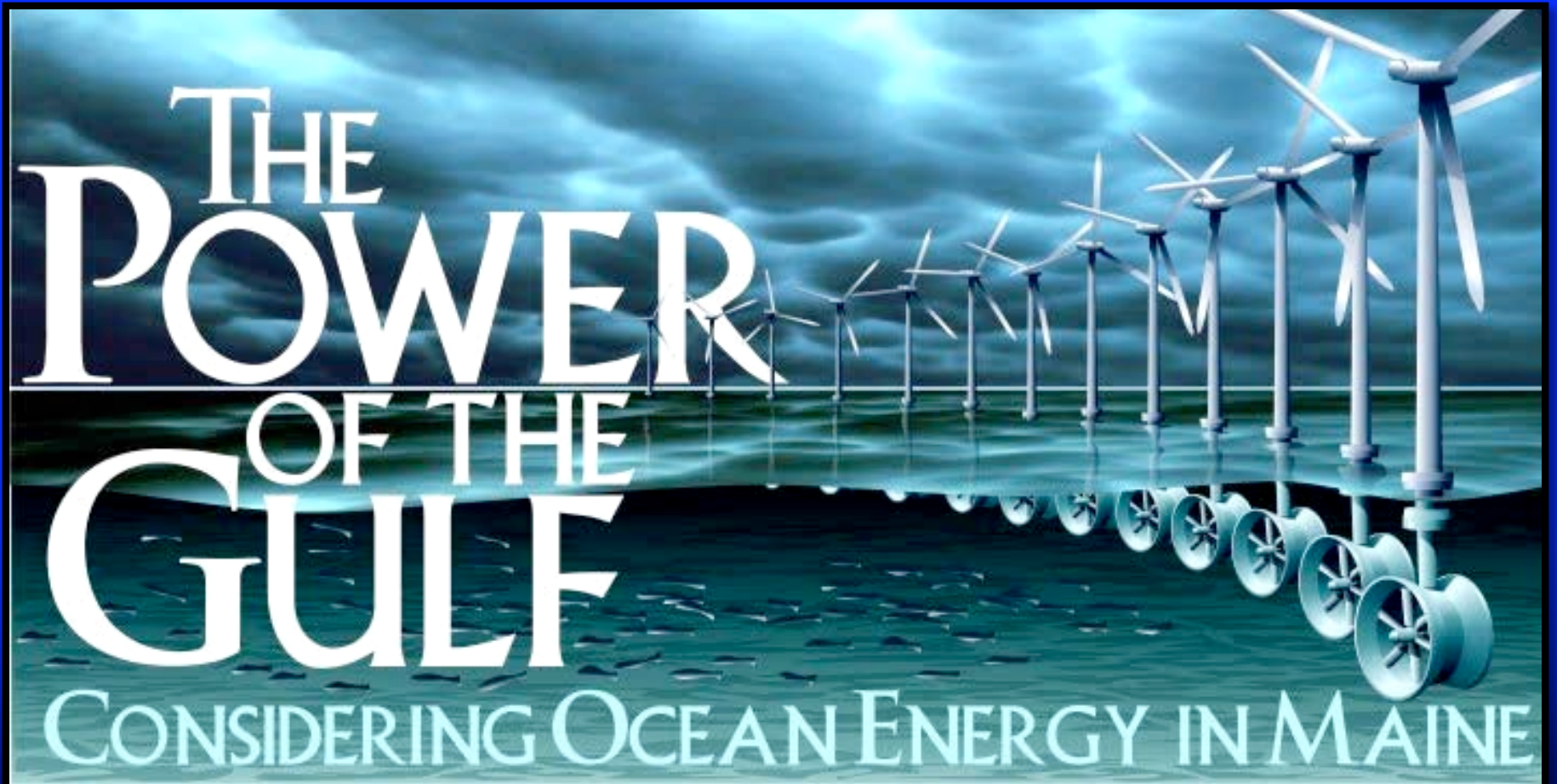
# The Solution To A Nightmare Was Before Our Eyes

- Ocean winds can create transportation fuels for 21st century and beyond.
- $\text{NH}_3$  preserves use of internal combustable engines.
- Oceans cover 71% of the globe.
- 60% of world's population live within 60 miles of our coast lines.



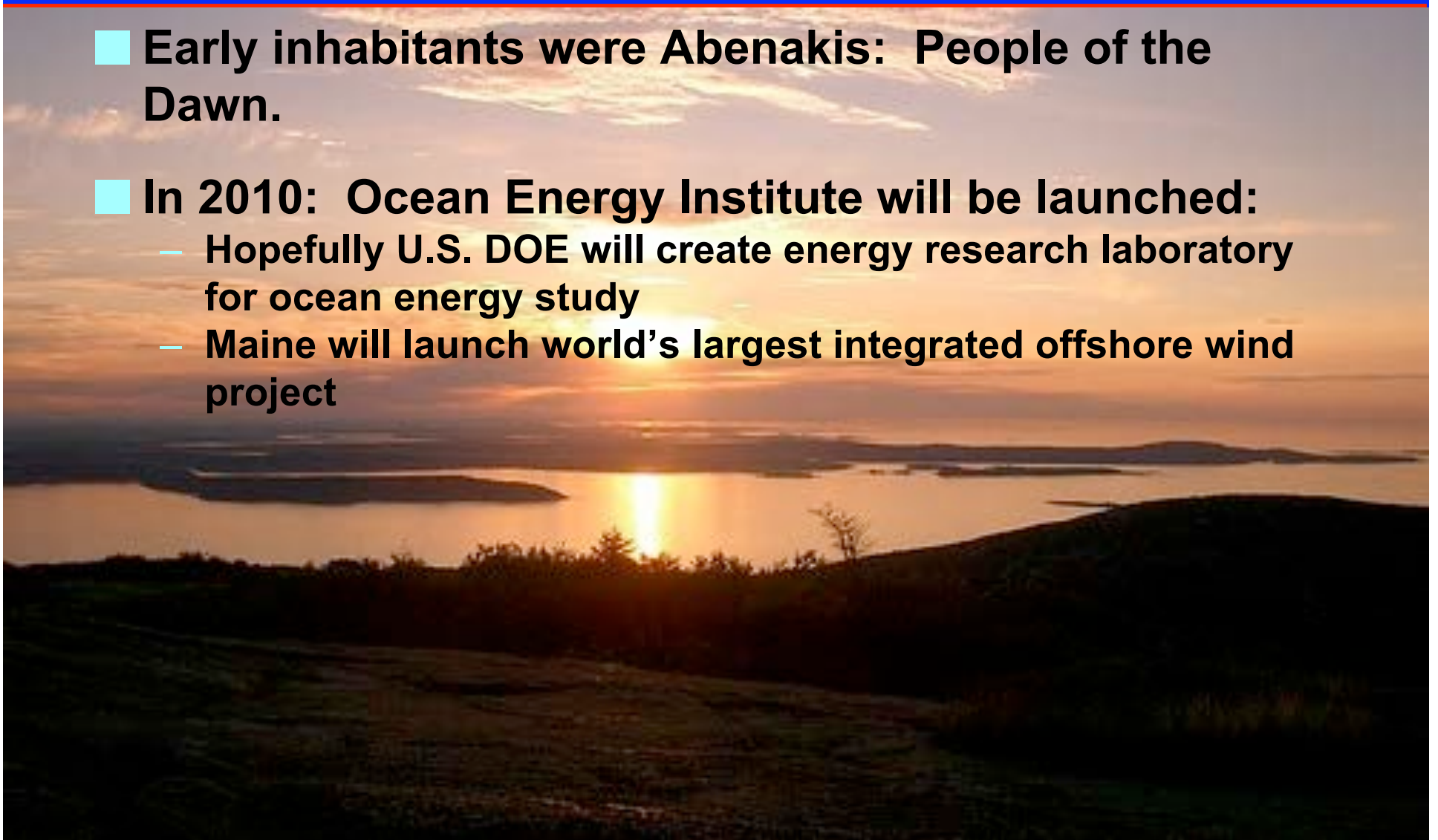
$\text{NH}_3$  can scale to finally replace oil as transportation fuel.

# Gulf Of Maine Will Soon Become Test Case For The New Energy Miracles



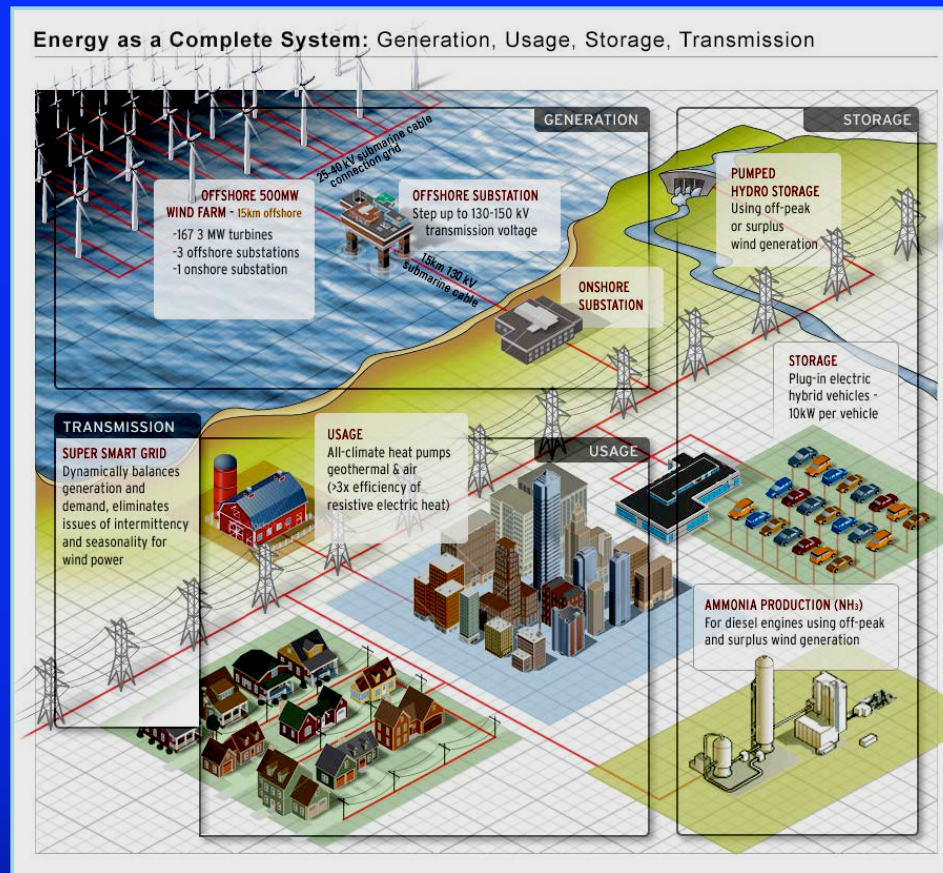
# Gulf Of Maine Has America's First Light

- **Early inhabitants were Abenakis: People of the Dawn.**
- **In 2010: Ocean Energy Institute will be launched:**
  - **Hopefully U.S. DOE will create energy research laboratory for ocean energy study**
  - **Maine will launch world's largest integrated offshore wind project**





# Ocean Energy Institute



## Making Ocean Energy A Reality...

For information and/or copies regarding this presentation, please contact Laura Russell at 713-546-7211.