
# ONR Global Briefing
# American Academy of Science & Technology

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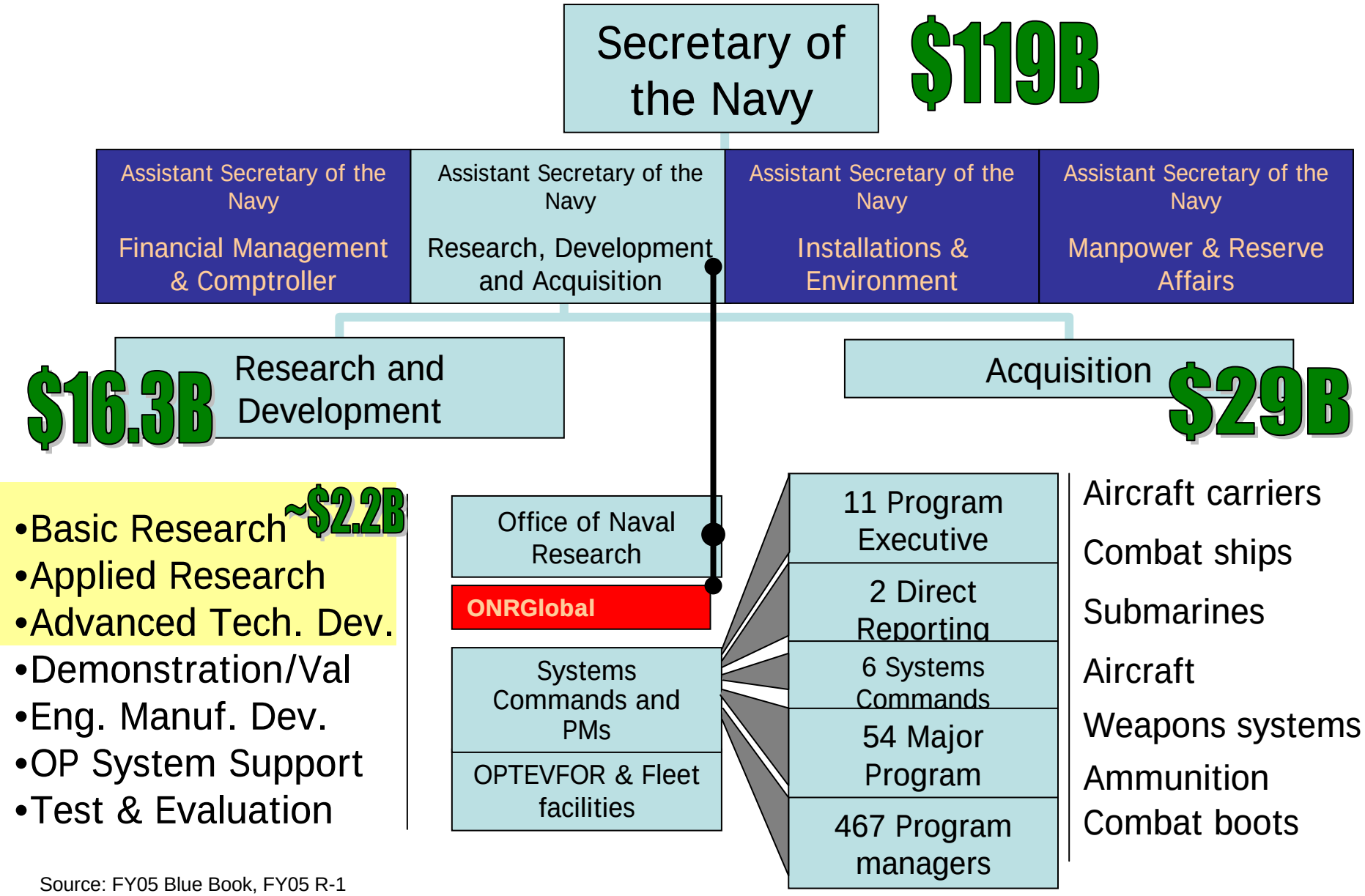
ONR Global
September 13, 2007

# ONR

1. **ONR** – S&T Program Funding and Management – Mid to Long-term R&D
2. **Naval Research Lab (NRL)** – Performs contract research
3. **ONR Global** – International Outreach
    1. ONRG Associate Directors (12 + Area Office AD's) – Discipline liaisons (e.g. Biotechnology, Ships, Oceanography/Space, Sensors/Electronics, Materials, etc.)
    2. Science Advisors (27) – Attached to Fleet Commanders
    3. Techsolutions- Short-term technology development for problems identified by 'boots on the ground' or SA's in fleets.

# President's Budget: FY 2005




Source: FY05 Blue Book, FY05 R-1

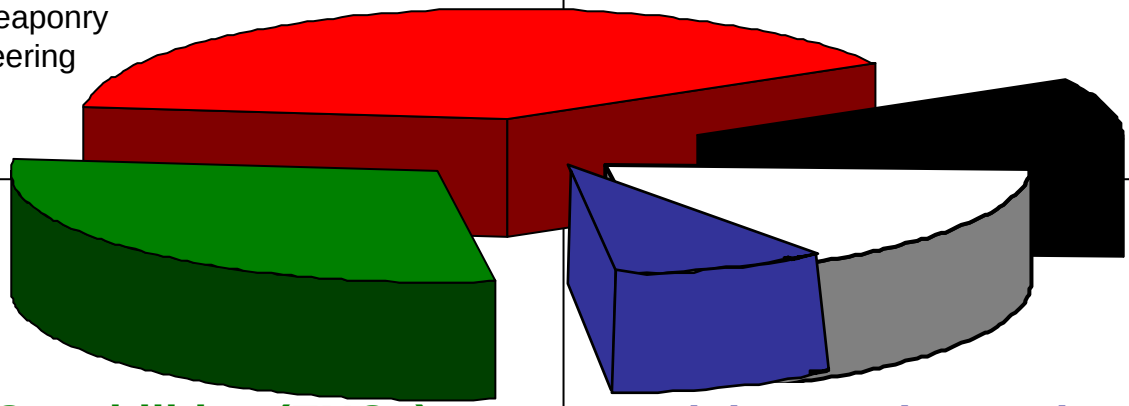
# S&T Investment Categories

## Discovery & Invention (D&I)

- NRL Base Program
- Science shortfalls in topics with Naval interest
- Nurturing science opportunity
- High impacts/surprises
- Health of Academic pipeline – ideas/workforce
- National Naval Responsibilities
  - Ocean Acoustics
  - Undersea Weaponry
  - Naval Engineering
  - Naval Air (proposed)

## Innovative Naval Prototypes (INPs)

- Directed Energy Weapon
  - Rail gun
  - High Energy Laser
- Tactical Use of Space
- Sea-Basing



## Future Naval Capabilities (FNCs)

- Time Critical Strike (TCS)
- Organic Mine Countermeasures (OMCM)
- Knowledge Superiority & Assurance (KSA)
- Littoral Antisubmarine Warfare (LASW)
- Expeditionary Logistics (ExLog)
- Fleet/Force Protection (FFP)
- Littoral Combat and Power Projection (LCCP)
- Missile Defense (MD)
- Advanced Capability Electric systems (ACES)
- Autonomous Ops (AO)
- Total Ownership Cost Reduction (TOC)
- *Capable Manpower (CM)*
- *Warfighter Protection (WP)*

## Quick Reaction and Other

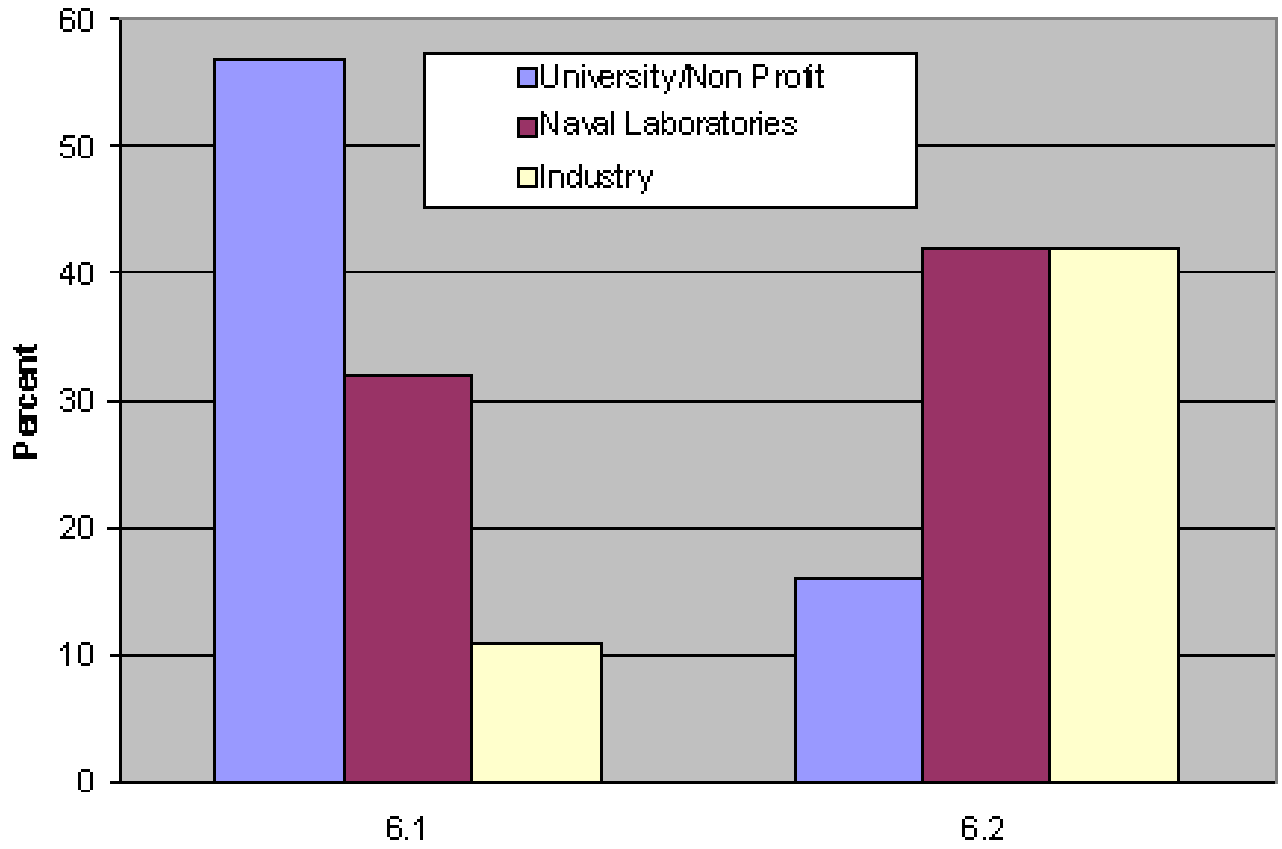
### Quick Reaction

- SwampWorks
- Tech Solutions
- MCWL

### Other

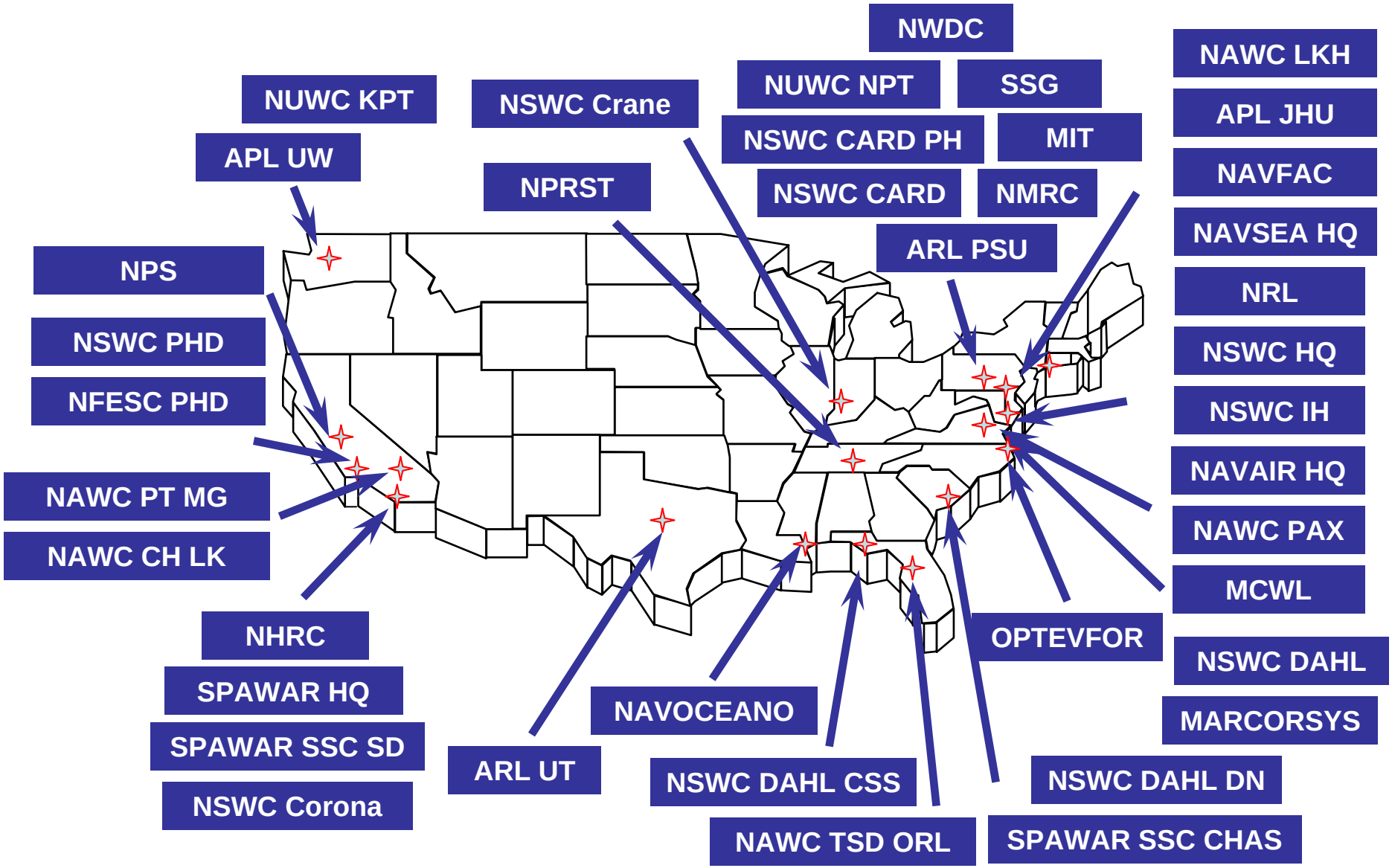
- Pass-Through - to JFCOM
- OSD Directed
- Infrastructure - Efforts enabling ONR's mission execution such as IFO, conferences, outreach

# Percent of Funding to R&D Performers

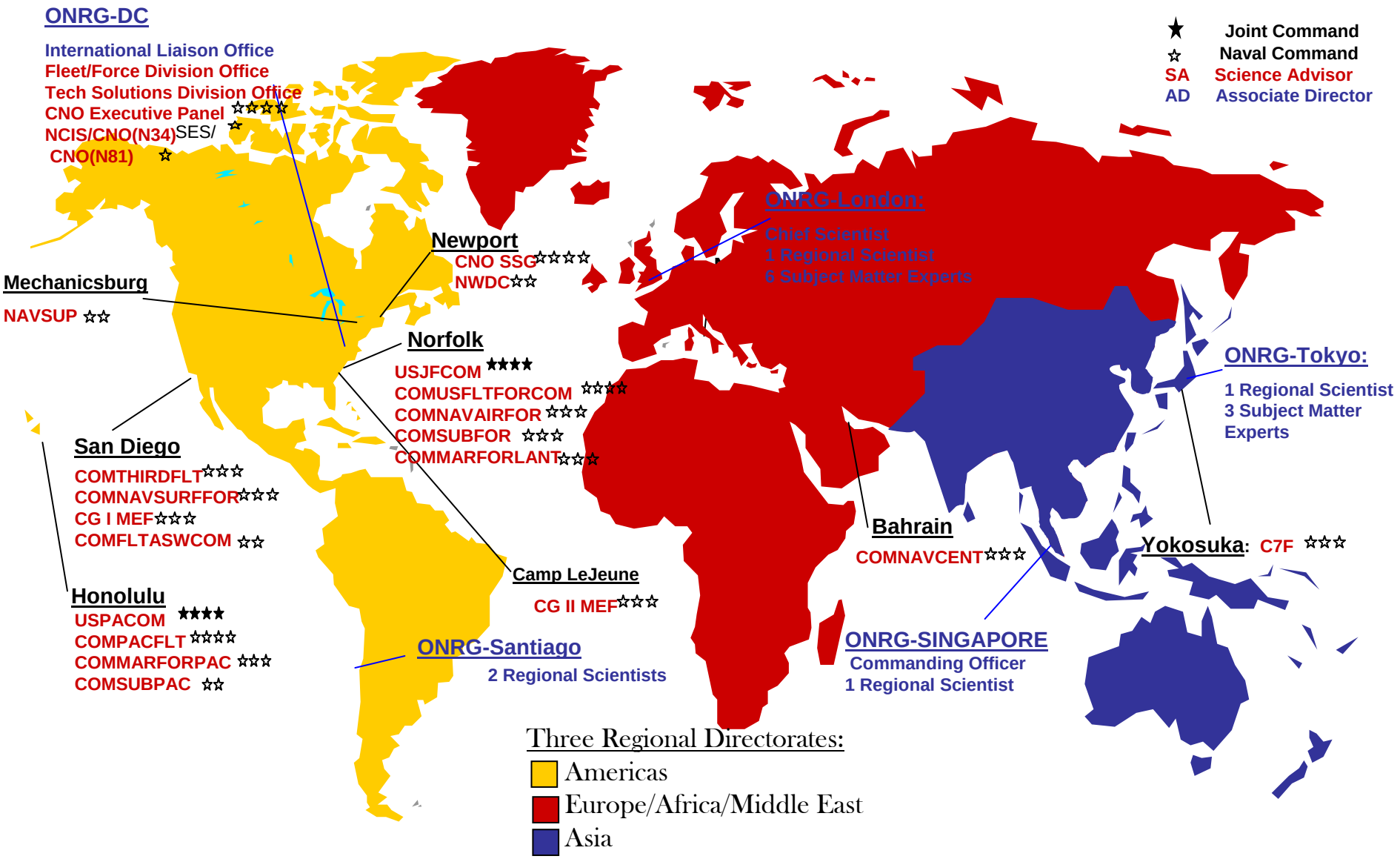


# Naval Research Enterprise

(Where the work is accomplished)



# ONR Global Presence



# Global Scientists

| NAME | HOME INSTITUTION | AREA OF INTEREST |
|---|---|---|
| **EUROPE/AFRICA (London, UK)** | | |
| Prof. Charles Calvano | NPS | Systems Engr / Chief Scientist |
| Dr. Vinod Agarwala | NAVAIR | Structural Materials |
| Dr. John Fay | NUWC | Undersea Systems |
| Dr. Jim Frank | Argonne National Lab | Biosciences/Energy |
| CDR Eric Gottshall | ONR Global | Ocean, Atmosphere & Space |
| CDR David Markert | NAVAIR | Air Platforms & Systems |
| Dr. William Miceli | ONR | Sensors-Electronic Materials |
| Dr. Michael Morgan | SPAWAR | Information Technology |
| Dr. James Pitton | APL Univ. of Washington | Maritime Domain Awareness |
| Dr. John Zimmerman | CRDF | Physics/Mathematics |
| *Vacant* | | *Ship Systems* |
| **EAST ASIA (Tokyo, Japan)** | | |
| CDR David Jazdyk (OIC) | ONR Global | Optics, Air Systems |
| Dr. Peter Cho | NSWC Philadelphia | Electronic Materials |
| Dr. Tony Liu | NASA | Ocean, Atmosphere & Space |
| Dr. Hitoshi Narita | Japanese Industry | Naval Architecture |
| Dr. Brett Pokines | Rochester Inst. of Technology | Information Technology |
| Dr. Mostafa Talukder | NAWC China Lake | Structural Materials |
| **SOUTH ASIA (Singapore)** | | |
| CAPT Charles Fowler | ONR Global | Air Systems, SW Asia |
| Dr. Chong Ong | ONR Global | Computer Technology, SE Asia |
| **LATIN AMERICA (Santiago, Chile)** | | |
| Mr. Elmer Roman | NSWC Dahlgren | Mechanical Eng., Regional |
| Mr. William Melton | NSWC Carderock | Naval Architecture, Regional |

# Accessing Leading International S&T

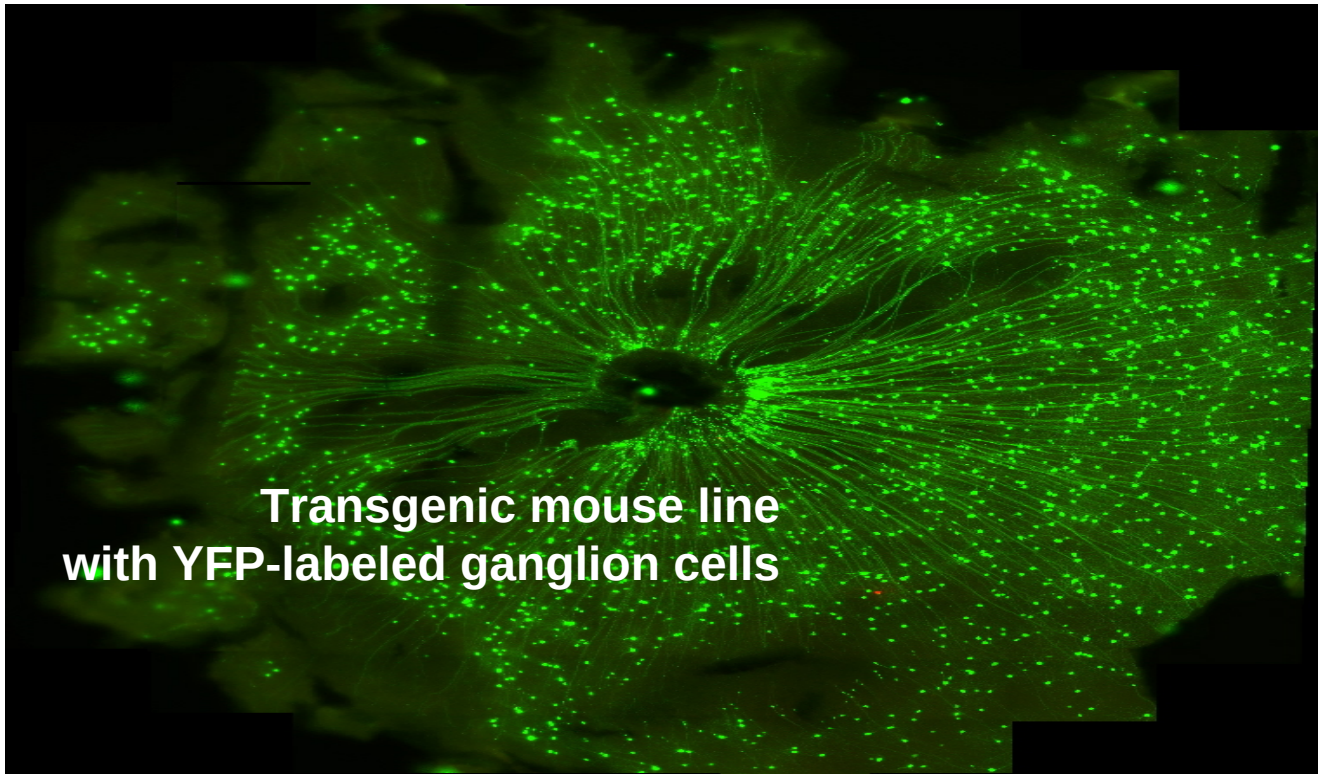
## International Science Program Tools:

- Liaison Visits
  - ONRG Scientists visit international institutions to develop access and discover cutting edge S&T
- Conference Support Program (CSP)
  - Support foreign or international conferences of Naval interest
- Visiting Scientist Program (VSP)
  - Support travel of foreign scientists to the US to socialize new S&T ideas or findings with the NRE
- Naval International Cooperative Opportunities Programs (NICOP)
  - Support the insertion of innovative, international S&T into core ONR, NRE, and Acquisition Programs

# Current Focus in Biotech
# September 07

1. Bio-Inspired systems including artificial vision
2. Marine Genomics – e.g. (biofouling, biocorrosion)
3. Biodefense and Biosensors (e.g. Pandemic Surveillance – West Africa)
4. Bio-Nano materials and devices
5. Alternative Energy (e.g. liquid fuels, various power sources)

# Bio-Inspired Systems




- Artificial vision, smell, propulsion, etc. Need low power, small sensors – based on bio-inspired systems
- Many applications for UAV's.
- Funding project on single neuron pathways for specific types of vision. Will test algorithms in state-of-art analog/digital vision chip being developed by a company in Spain. Working with SPAWAR and ONR in this area.

# High- Throughput Marine Genomics

**Technology Trend:**

**•High-Throughput Marine Genomics Sequencing will result in major changes in our perception of the marine environment.**

**Technical revolution in Human genomics starting to impact applications in the marine environment. Logarithmic increase in data.**

NRE is not active in this emerging area at present

• New instruments (2006) such as this 454 Life Sciences Sequencer (U.S.) can replace entire sequencing facilities

• This single machine has 100x the capacity of current instruments driving down costs and dramatically increasing speed.

**Impacts to the Navy will eventually include:**

- **Mitigation of corrosion & biofouling**
- **•Improved understanding of global climate changes, pandemics, and marine mammal behavior**
- **•Improvements in acoustic/optical sensing in littoral zones**
- **•Mitigation of Environmental impacts of naval operations**

## Current situation:

• EU wants lead in Marine Genomics. 1st EU Marine Genomics meeting co-sponsored by ONRG in Nov 2006.

• ONRG working with EU, NSF, CNRS (France), Japan, and CSIRO (Australia) and are holding a small workshop with industry/sponsor/scientist to discuss technical, economical, environmental and strategy implications of recent developments. We expect participants from Nature & Science.

# Technology Leapfrog Opportunity

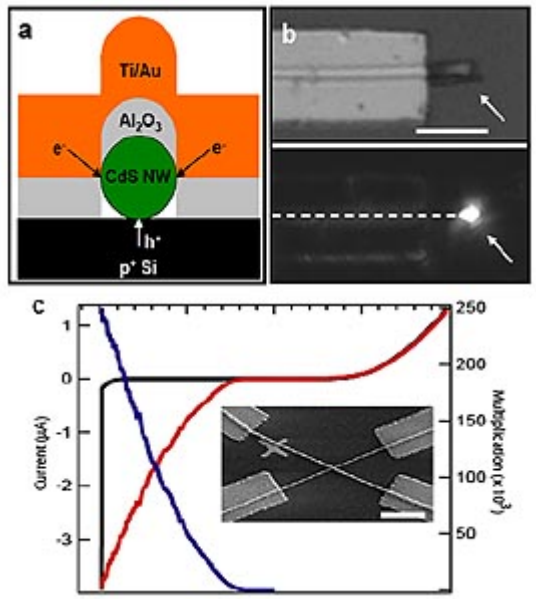

**Introduction of advanced broad-spectrum pathogen identification capability at the local level in West Africa could allow by-pass of an entire generation of diagnostics and surveillance tools.**

***TWO SPECIFIC OPPORTUNITIES:***

**1. Shipboard (US Navy presence in Gulf of Guinea)**

**2. Land-based (US-based Non-Profit Hospital / Lab with advanced technologies and US corporate support)**

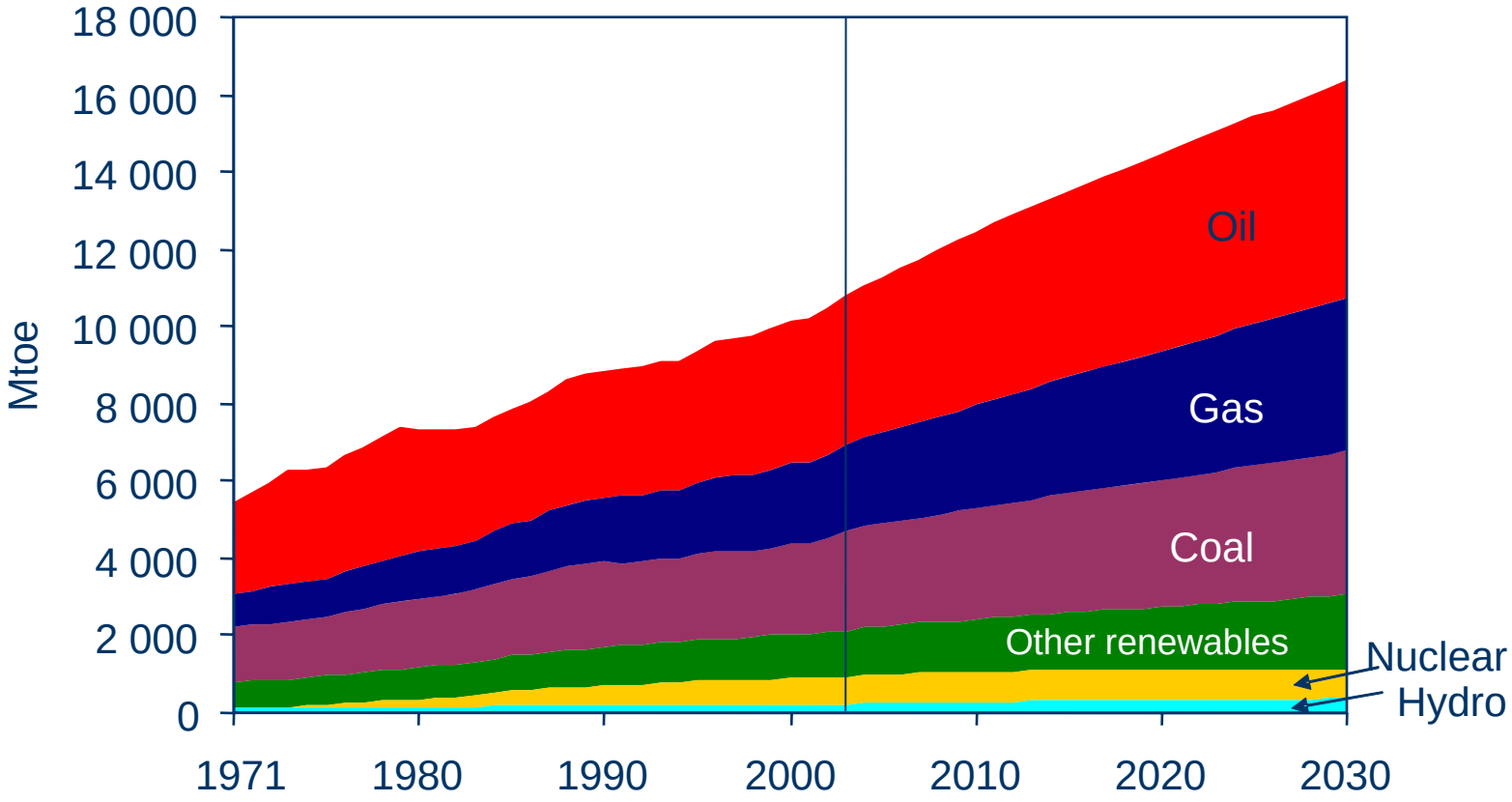
# Bio-Nano




- Next generation chemical and biodefense
- Nano power devices
- New materials (e.g. self-assembly)

# International Perspectives on Power & Energy

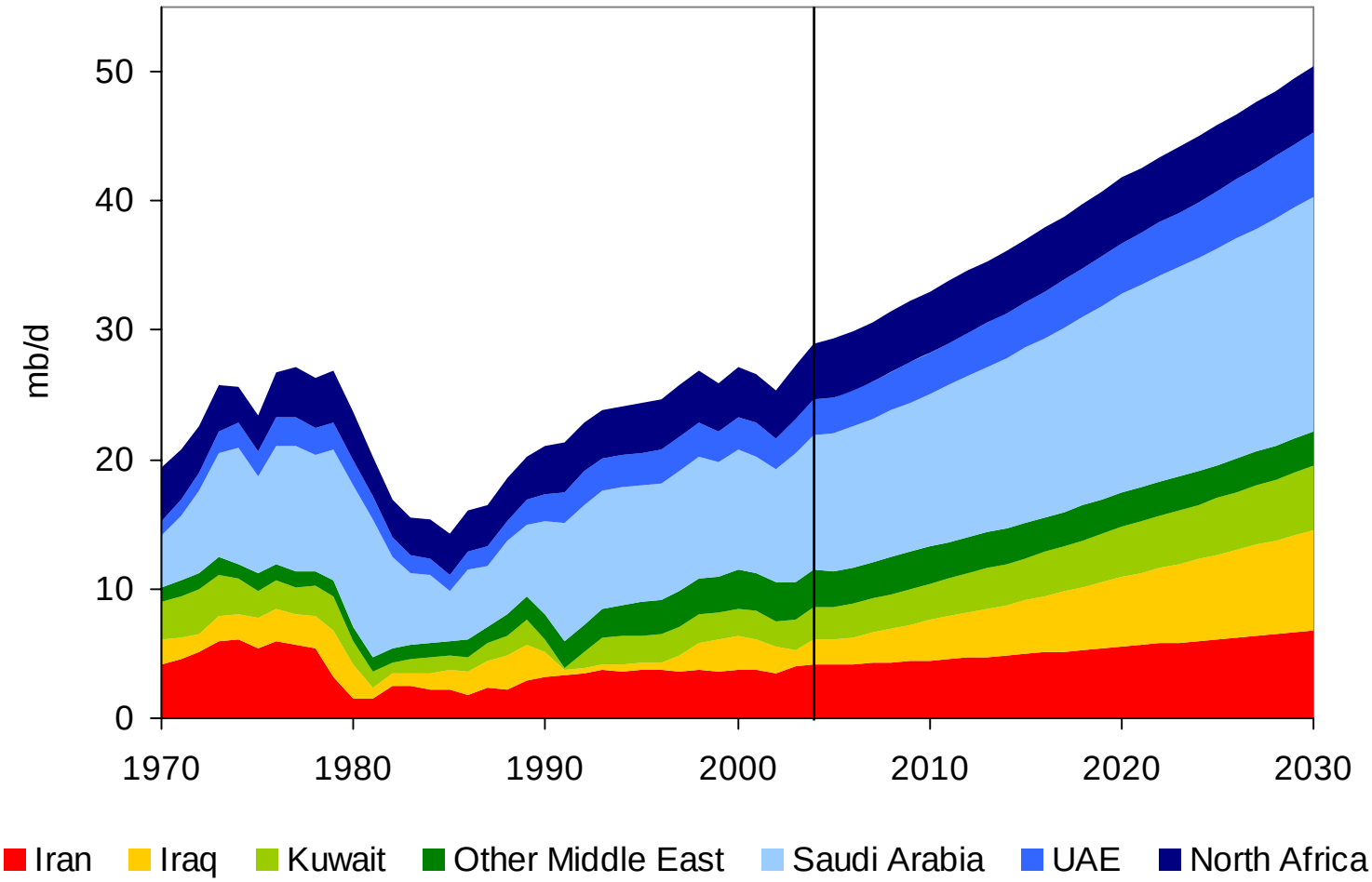
# World Primary Energy Demand




***Oil and gas together account for more than 60 % of the growth in energy demand between now and 2030 in the Reference Scenario***

***Source: IEA***

# MENA Crude Oil & NGL Production by Country

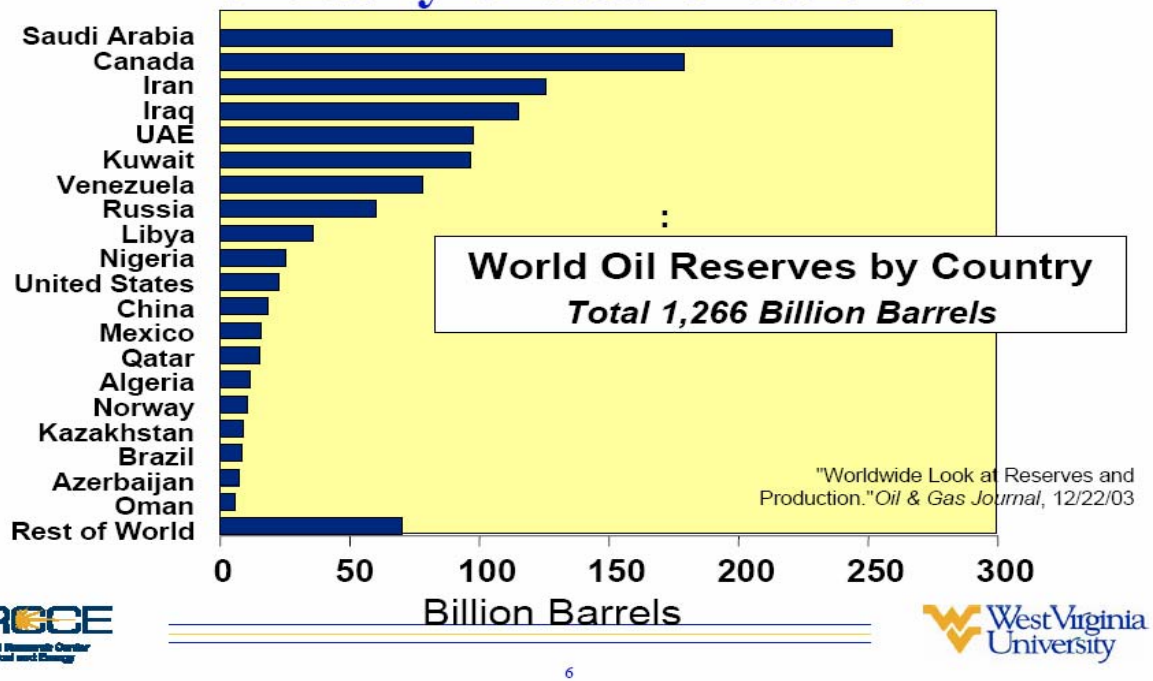



***MENA's share of world oil production rises from 35% in 2004 to 44% in 2030 in the RS, with Saudi production rising to over 18 mb/d***

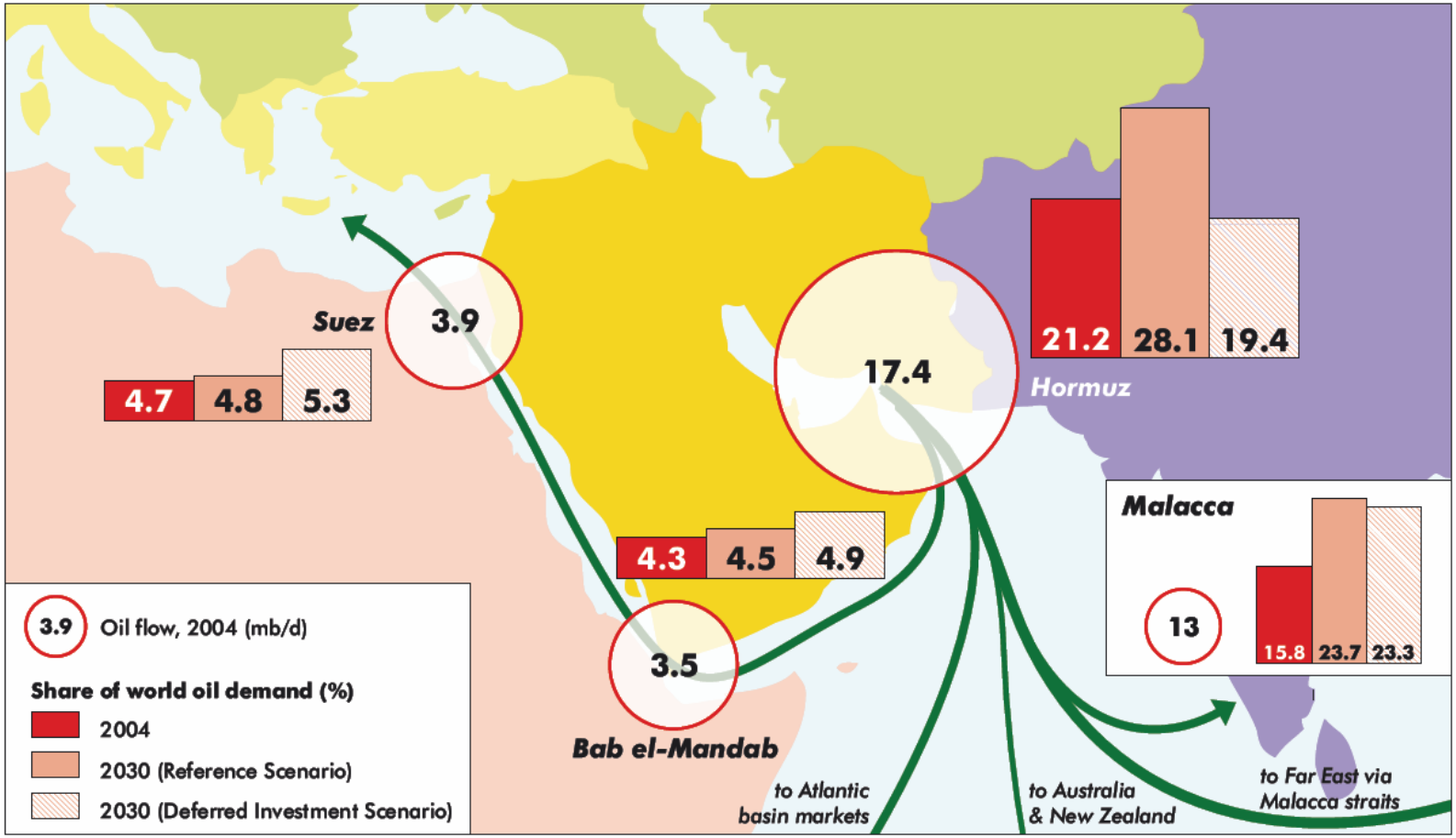
# Key Messages

- If governments stick with current policies, global energy needs in 2030 will be more than 50% higher than today. **THIS IS NOT SUSTAINABLE !**
- In any plausible scenario, MENA oil & gas resources will be critical to meeting the world's growing appetite for energy
- Further underinvestment in oil and gas would drive up prices & depress global GDP growth, eventually harming producers too
- Major importing countries are already considering more vigorous policies to curb demand growth & reduce reliance on oil and gas
- Continued need for dialogue between producers and consumers to find mutually beneficial outcomes

# Another Confounding Issue

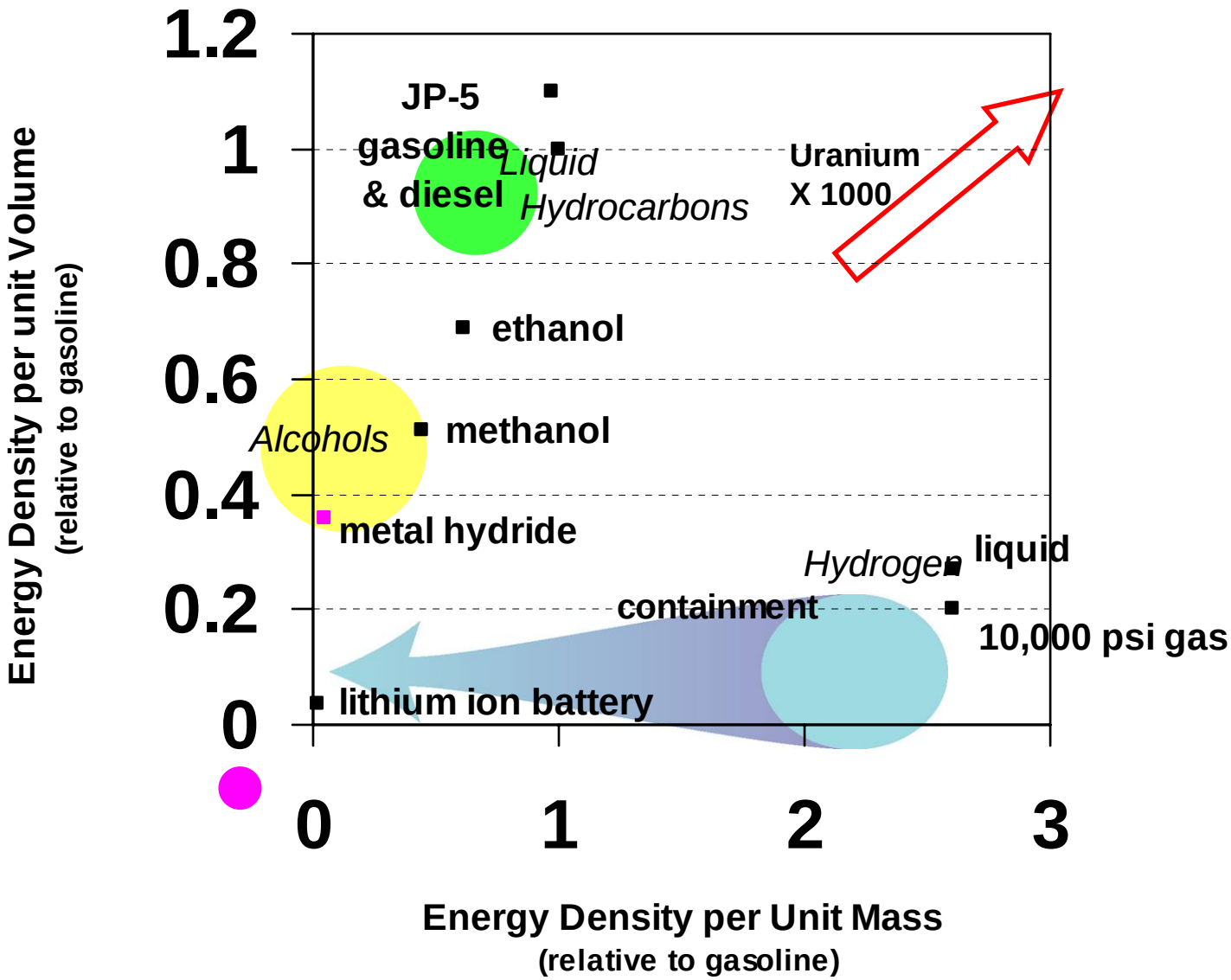


# MENA Oil Exports through the "Dire Straits"




***Much of the additional oil and LNG exports from MENA in the future will be shipped through just three maritime routes***

# Energy Density of Fuels



# European Drivers towards Diesel and Biodiesel Fuels

- Europe driven by high prices, increased gas mileage requirements, and low emissions requirements (including a major emphasis on C02)
- Europe exports gasoline to the U.S. (excess) and imports diesel fuel
- EU requires 2% biodiesel (2004) and 5.7% in 2010. A target of 20% is being considered for 2020.
- EU and industry serious about 1st and 2nd generation biodiesel fuels (including subsidies)

# Increased Production of



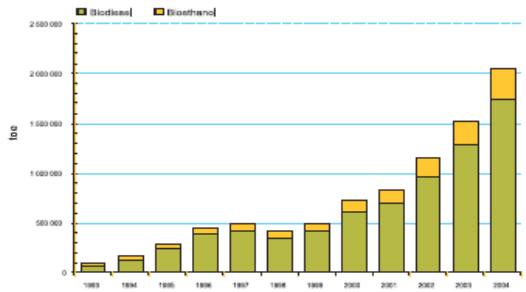



Figure 2.1: Biofuel production in the EU since 1993. (2004: EU25). Source: Eurobserv'er 2005.

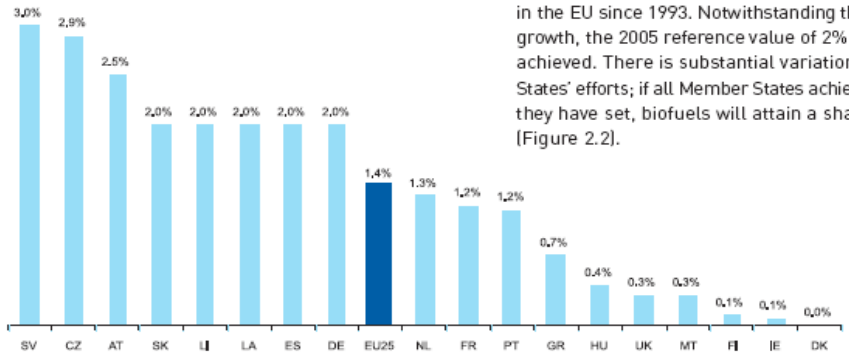



Figure 2.2: Biofuel targets for 2005 (EU25). Source: European Commission.

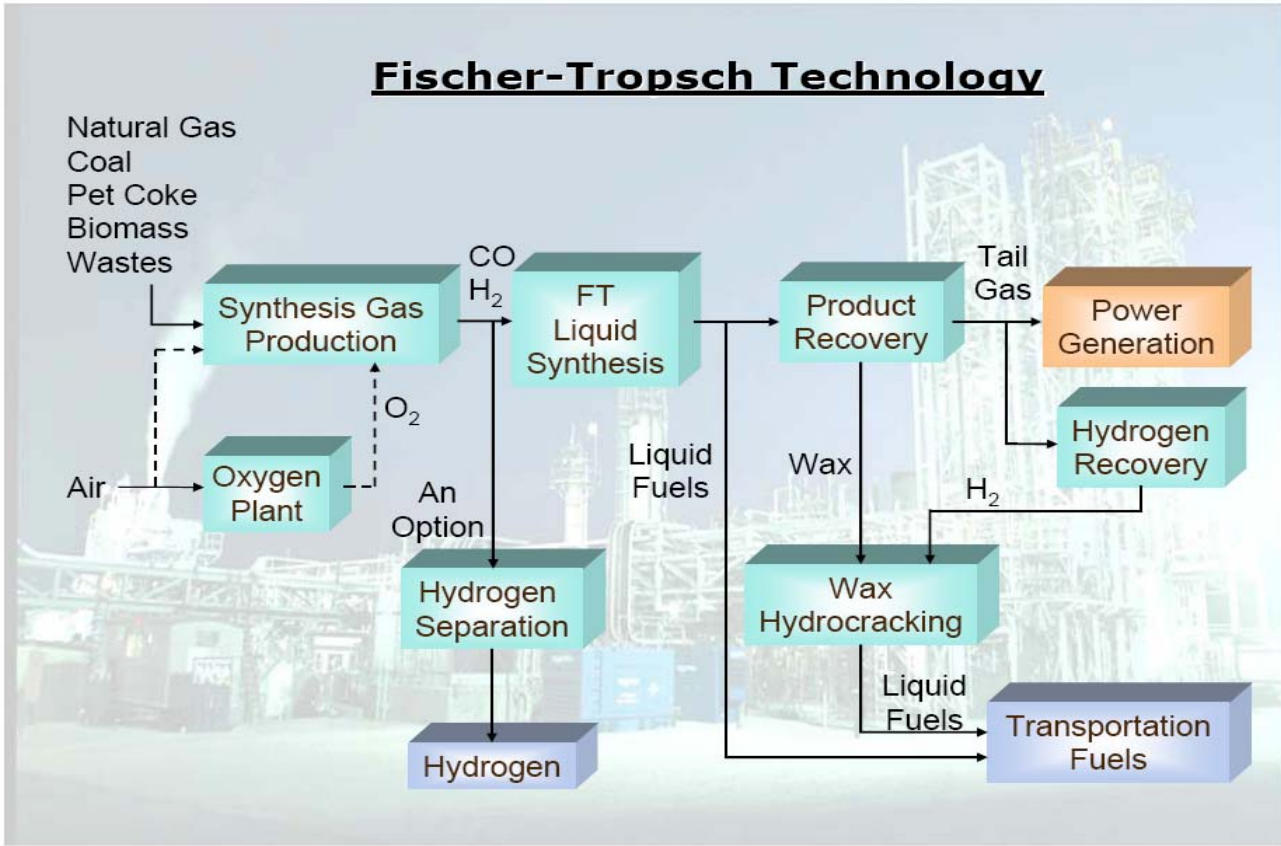
## EU25 biofuels production

Liquid biofuels production in the EU 25 amounted to 2040 ktoe in 2004 or about 0.7% of the market. Biodiesel from rapeseed predominates with a production of around 1720 ktoe in 2004. Ethanol is mainly produced from wheat, and to a lesser extent sugar beet, in Spain, France and Sweden, with a total of around 320 ktoe tonnes in 2004. These two fuels are commonly referred as first generation biofuels.

Biodiesel and ethanol are mainly used blended with diesel or gasoline, respectively, in low proportions (max 5%). High proportion blends, e.g. ethanol used for adapted vehicles (Flexi Fuel), and pure forms are also available in some countries. Most ethanol is processed into ethyl tertiary butyl ether (ETBE) as an additive to gasoline. Other transport fuels are developed at currently low market volumes, e.g. biogas in Sweden or pure vegetable oil in Germany.

Figure 2.1 shows the growth in biofuel production in the EU since 1993. Notwithstanding the significant growth, the 2005 reference value of 2% has not been achieved. There is substantial variation in Member States' efforts; if all Member States achieve the targets they have set, biofuels will attain a share of 1.4% (Figure 2.2).

# Synthetic Diesels (XTL)



# Synthetic Diesels are Identical

- Get identical XTL products from coal, gas, and biomass. Different tradeoffs.
- All High quality fuels with excellent combustion properties
- No sulfur, high cetane, potentially suitable for aviation fuels with higher flashpoints.

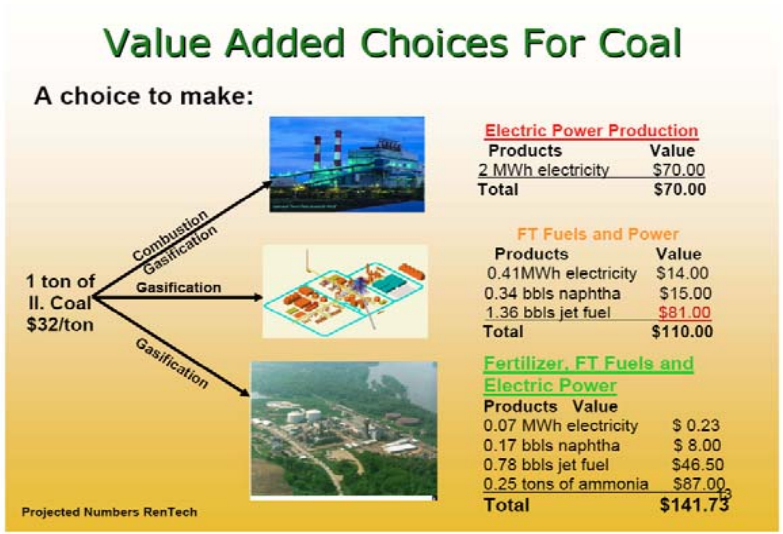
# Coal to Liquids

*Advantages*:

- Coal is plentiful domestically and worldwide.
- Significant experience building coal to liquids plants (
- Low emissions for S and NOx

*Disadvantage*:

- High $C0_2$ emissions



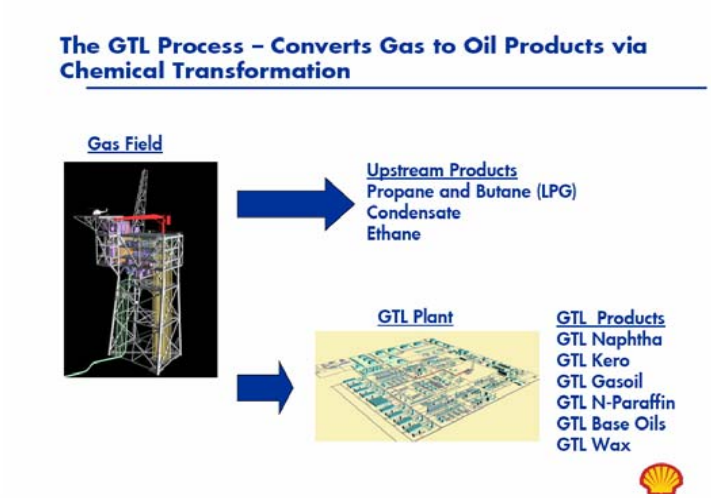
# Natural Gas to Liquids

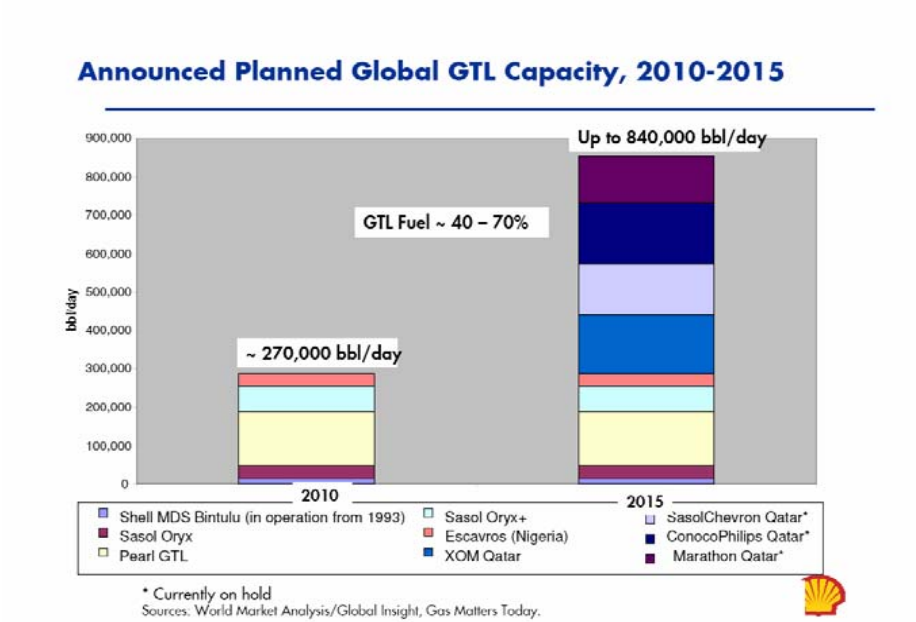
*Advantages:*

- Economical (similar in price to conventional diesel.
- Lower C02 emissions than coal

*Disadvantage:*

- Significant size and investment/plant
- Most of NG in Middle East



# *Biomass to Liquids*

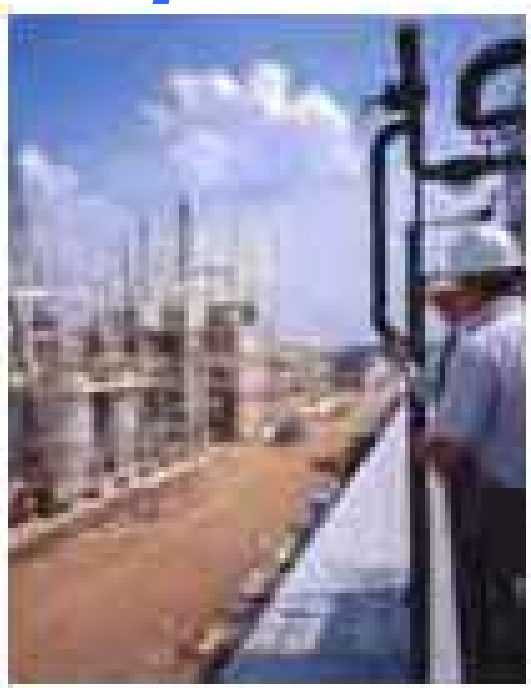
FAMES – 1st generation biodiesel

*Advantages*:

- Significant $C0_2$ reduction
- Small scale systems can be skid-mounted and use available vegetable oils, animal fats, or cooking oils – potential for on-site energy production
- Potential for lowest cost route to renewable, low carbon energy
- Comparable emissions to current fuel options

*Disadvantages:*

- Limited compatibility with conventional powertrains above 15%
- Lower energy content than comparable fuels
- Storage and biocontamination concerns



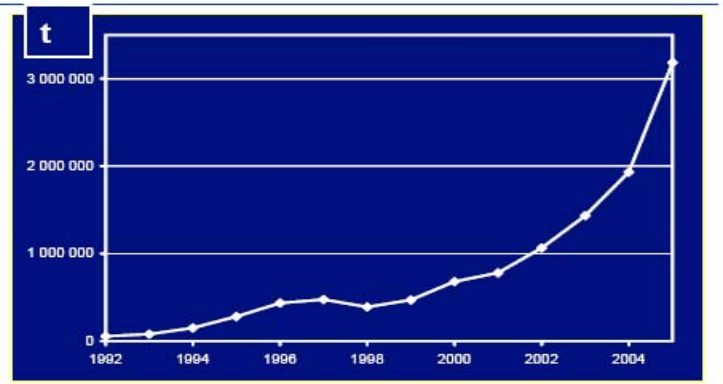
World's largest FAMES plant is in Hamburg, Germany and run by ADM

# Rapid biodiesel production increase in Europe

## Biofuels production is growing fast

FAME

+65% between 2004 and 2005 in Europe




Ethanol

+15% between 2000 and 2005 worldwide


*Future Energy Sources for Transport- Bruxelles- 20/06/06*

# Biomass to Liquids – The 2nd Generation

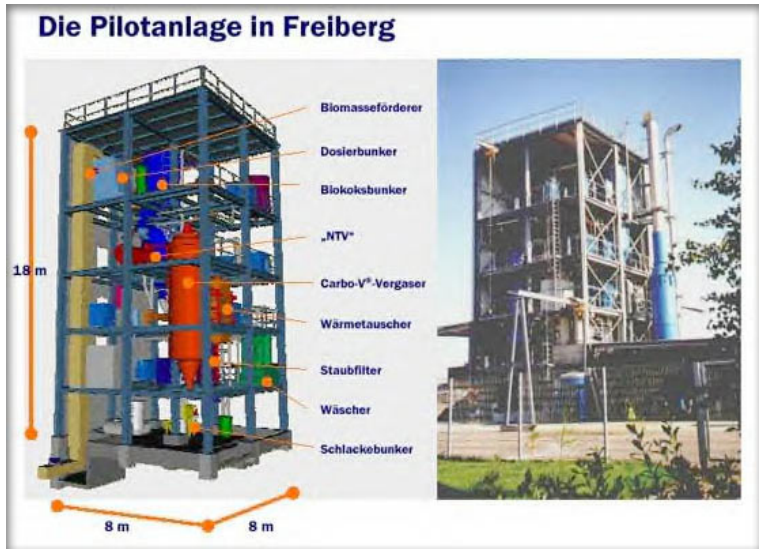
## Biomass to Liquids

*Advantages:*

- Same product as XTL
- Can use all biomass materials including lignocellulose (Choren)
- Fully compatible with diesel use
- Lower emissions (no S, aromatics, $C0_2$ reduction significant)
- Potential for high flashpoint aviation fuels
- Decentralized relatively small-scale plants (5000 bpd) – Energy security
- Subsidized by EU

*Disadvantages:*

- Subsidized by EU
- New technology
- Probably more costly
- Neste process requires proximity to refinery for $H_2$




Choren/Shell Plant (Germany)

**Neste Oil refinery (vegetable oil) in Poorvoo, Finland**

# Potential for biofuels production

- IEA. Biofuels for Transport ( 2004) : 33% of transportation fuels worldwide in 2050-2100
- BIOFRAC vision (2005) : 25% of transportation fuels in Europe in 2030 (20% local production, 5% imports)
- CONCAWE/EUCAR/JRC study (2005) :in 2012 less than 10% for 1st gen. and 2nd gen. biofuels,20 % for Hydrogen ex biomass
- IFP estimates (2005) : 12-18% of transportation fuels in 2015 in Europe (1st and 2nd generation fuels)

# Base Case Projection for Road-transport Liquid Fuels in 2020

- Fossil Gasoline – 44%
- Fossil Diesel - 45%
- Bio Gasoline - 4%
- Bio Diesel - 3%
- XTL Diesel (Coal/Gas) - 4%

Biofuels >7% for baseline scenario

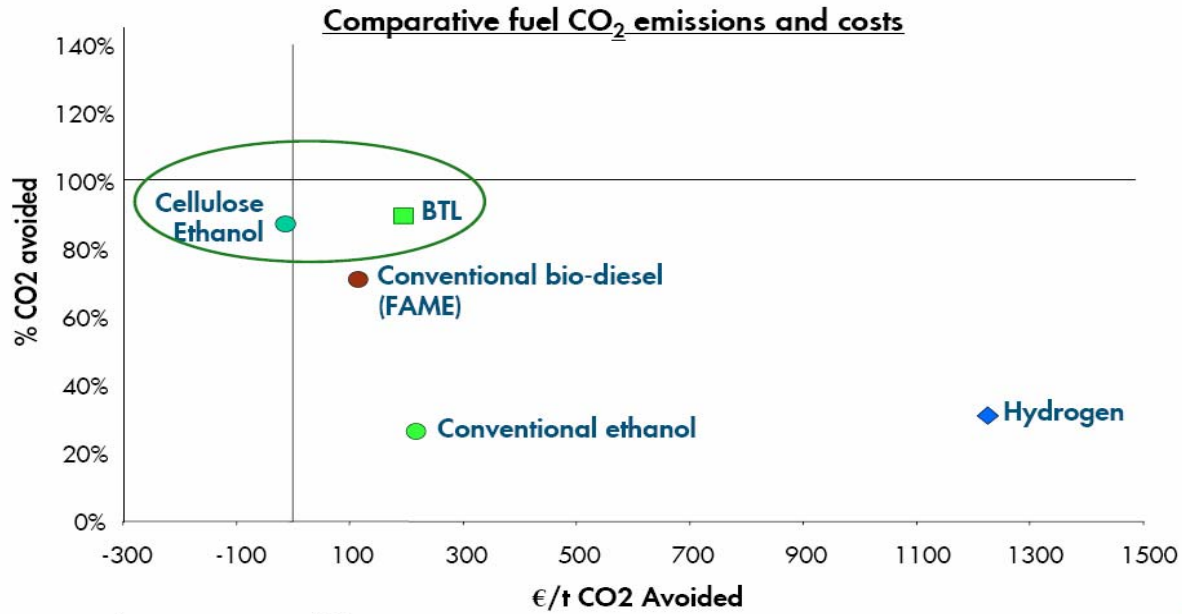
$C0_2$ reduction from Biofuels
3 MT 2005
17MT 2025

Source: Shell

# Biofuel Impact on $CO_2$ emissions

Bio-fuel briefing

**...and second generation bio-fuels will deliver substantial $CO_2$ benefits**



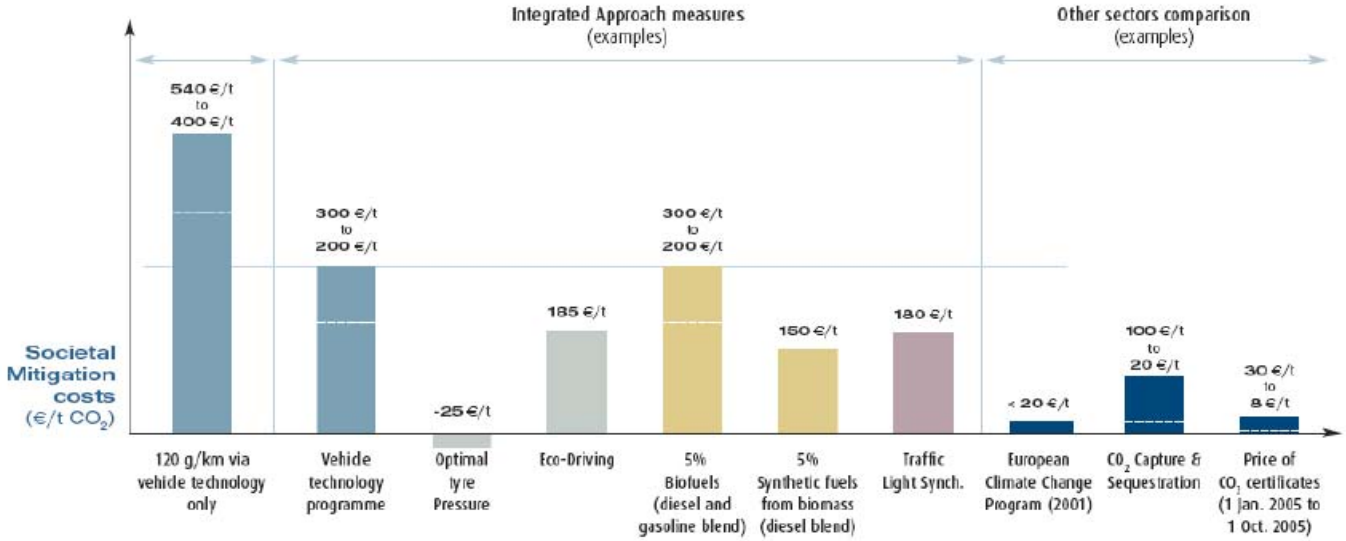

Assumes oil price scenario: 50 €/bbl

Source: EUCAR / JRC / CONCAWE

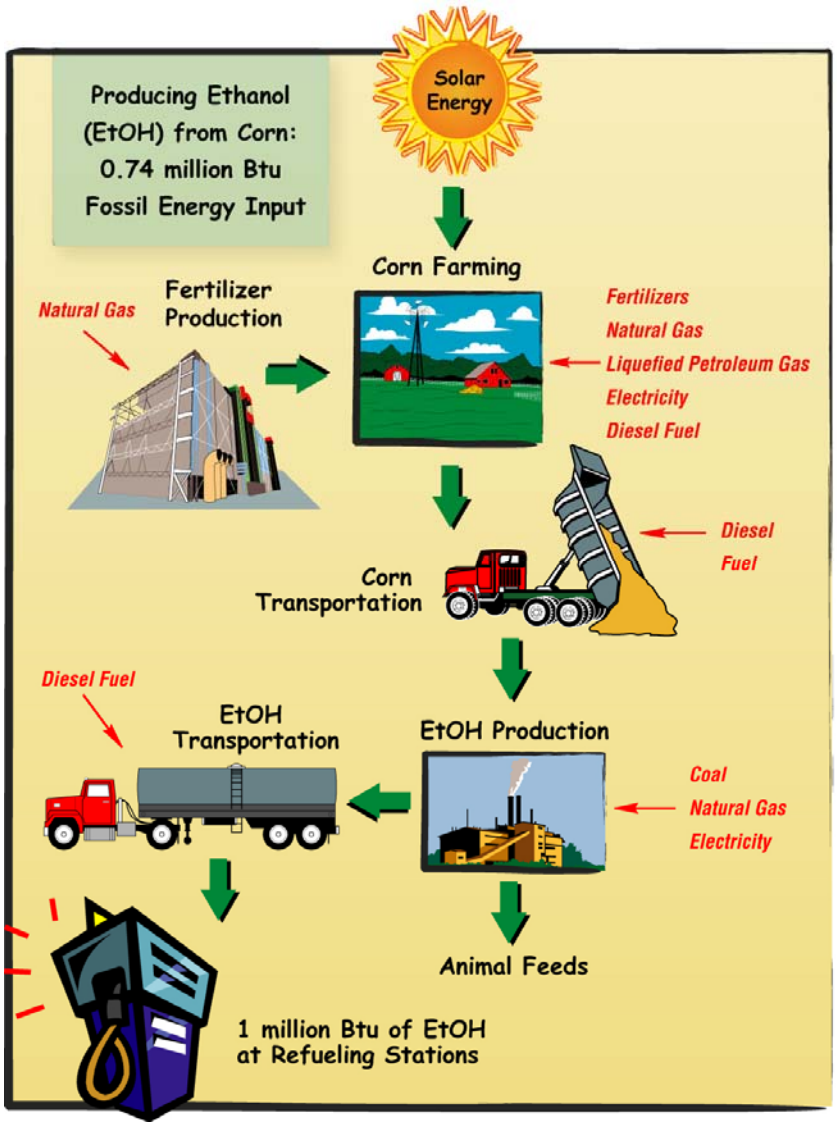
# Several approaches to reduce

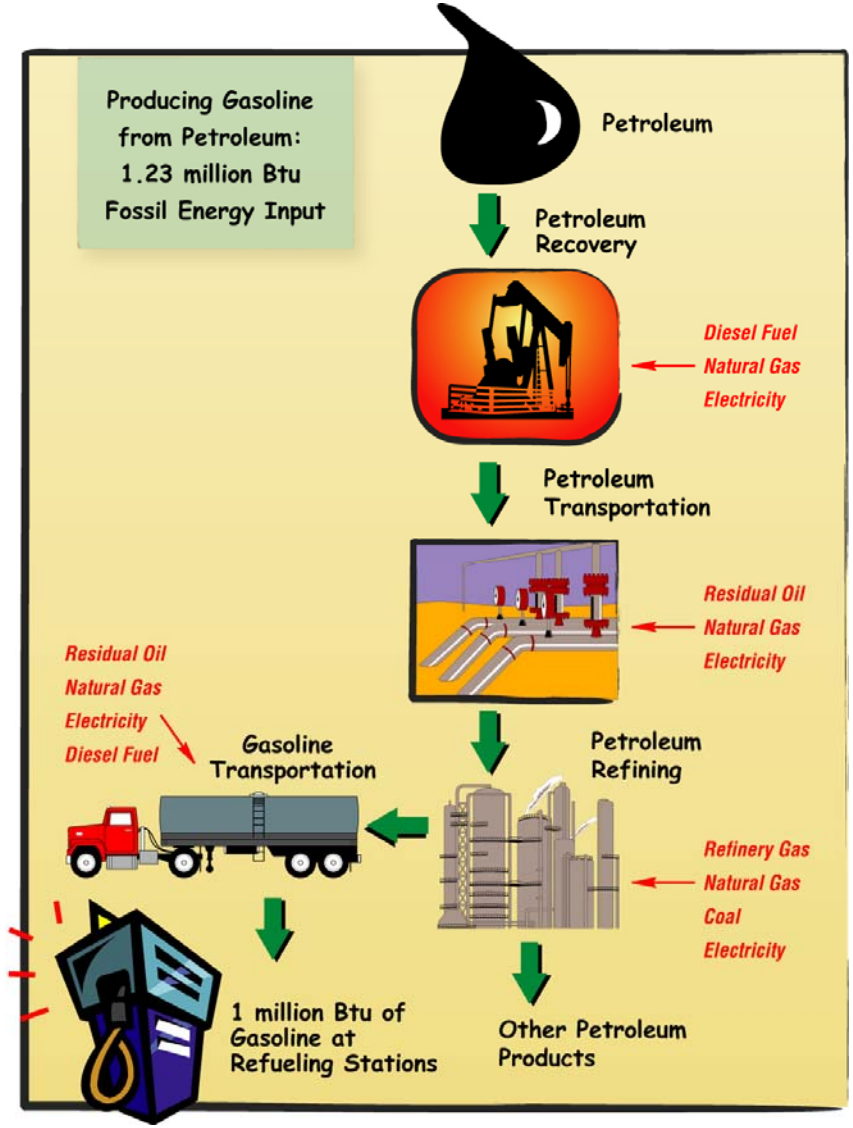


## Cost per ton CO2 avoided for different measures

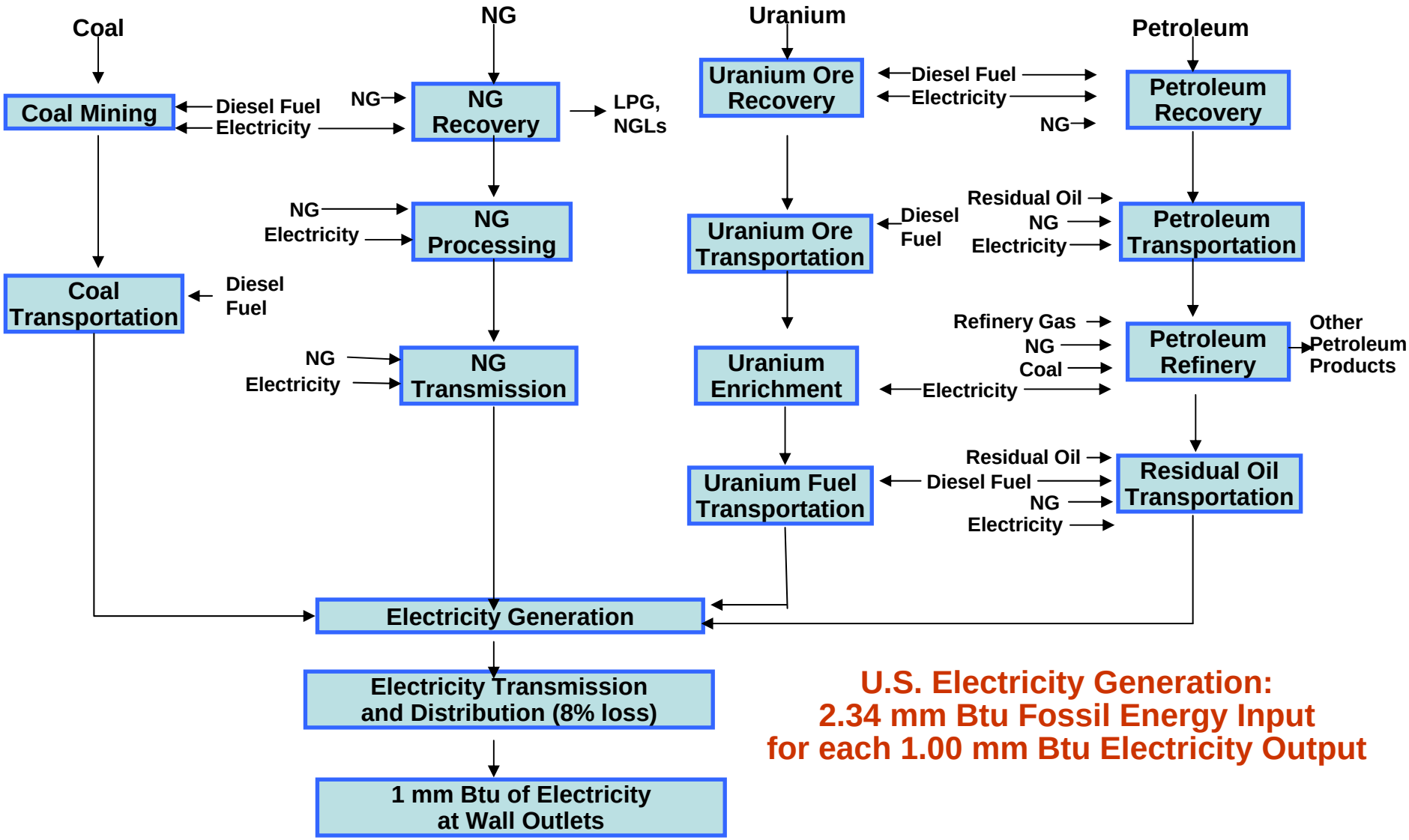


# Comparative Results Between Ethanol and Gasoline Are More Relevant to Policy Debate



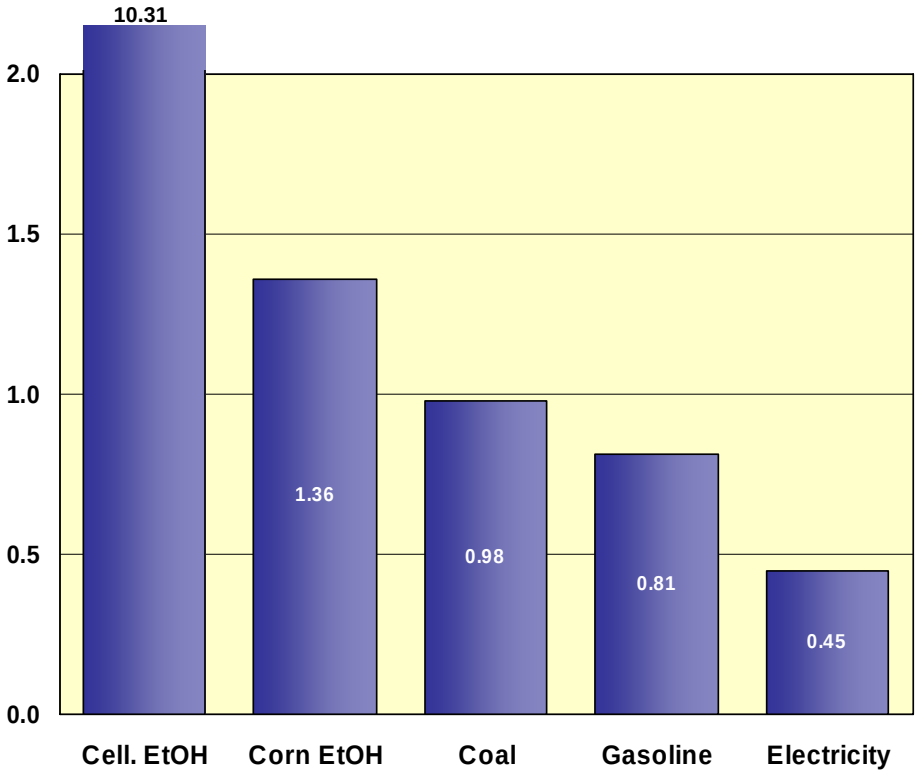
# Even Though Electricity Has a Large Negative Net Energy Balance, There Is No Substitute for Its Main Uses

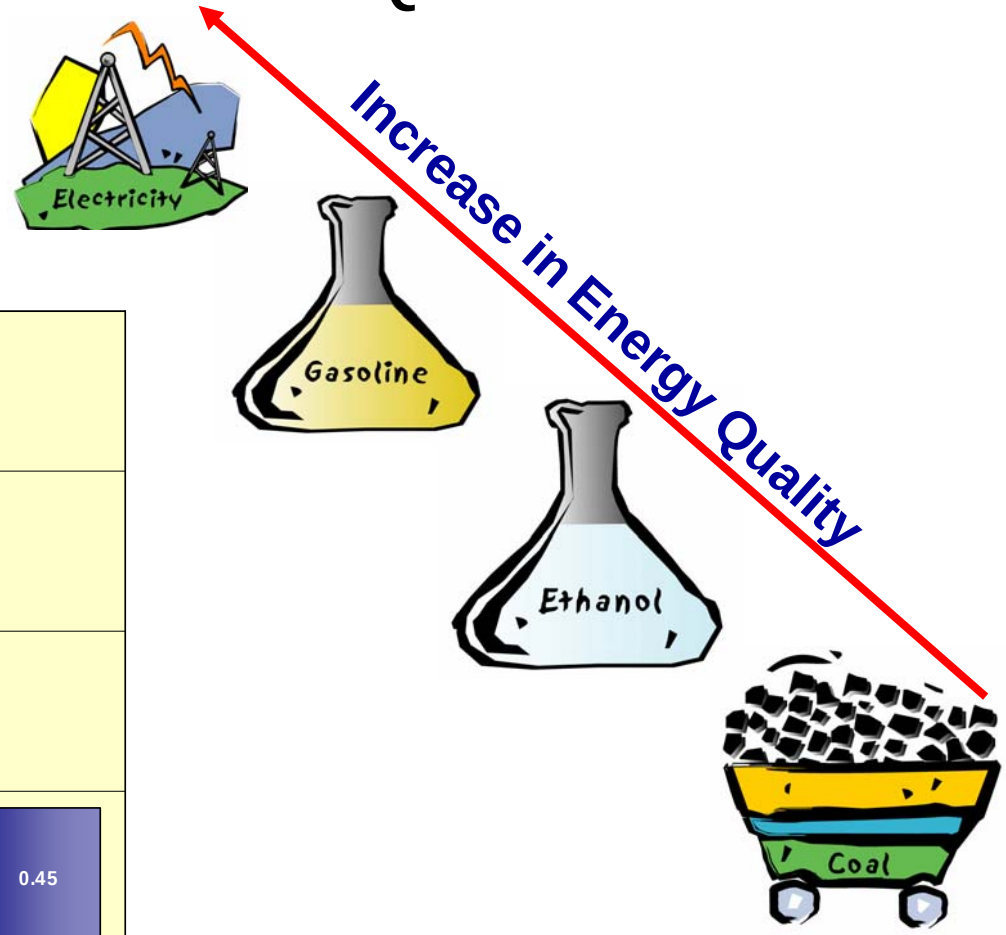



**U.S. Electricity Generation:**
**2.34 mm Btu Fossil Energy Input**
**for each 1.00 mm Btu Electricity Output**

# Energy in Different Fuels Can Have Very Different Qualities

**Fossil Energy Ratio (FER) = energy in fuel/fossil energy input**



# Conclusions

- Energy balance value for a given energy product alone is not meaningful in evaluating its benefit
- Any type of biofuel helps substantially reduce fossil energy and petroleum use, relative to petroleum gasoline
- Corn-based fuel ethanol achieves moderate reductions in GHG emissions
- Cellulosic ethanol and biodiesel can achieve much greater energy and GHG benefits

# There is still substantial fossil fuel but decisions must be made soon

New requirements and markets **globally** because of long lead times required

Decisions will determine not only where we go

But how we get there.