

Hydrogen--Your Freedom Fuel

Only Zero Pollution Chemical
Energy Carrier

CNG -- Your BEST Fuel

Cleanest, Safest and Least
Expensive Low-Carbon Energy
Carrier




Low-Carbon Energy Carriers

- Electricity
- Carbon-Neutral Bio-Fuels
- Methane
- Hydrogen



"Let me explainify the war against Iraq a little bit in Texas terminologragy."

We  not  Saddam Hussein for his actions.

We will  ize to meet this threat in the Persian  until an  ble solution is reached.

Our plan is to  **repared.**

Failing that, we  ming to kick his ass.

ALL THE ENERGY COMPANIES
CARE ABOUT IS MONEY! THEY
MANIPULATE THE PRICES, THEY POLLUTE
THE ENVIRONMENT, THEY KEEP US
ADDICTED TO OIL AND GAS, THEY MAKE
RECORD PROFITS AND STILL DEMAND
GIGANTIC TAX BREAKS!

YEAH!
AND WE NEED
TO LET THEM
DO MORE
DRILLING!



ad Grain to
Rocky Mtn.
News 4-11-83

Hydrogen Prime Movers

- PEM Fuel Cells (FC)
- Microturbines
- Internal Combustion Engines (ICE)

Ford H₂ ICE Shuttle Van



03.30.2005 07:58

ISER Thor H2 ICE HEV Bus



03.30.2005 07:56

Munich Airport H2 ICE Bus





Honda PEM FC





Daimler Chrysler PEM FC





Toyota PEM FC



03.30.2005 07:58



Hydrogen--Your Freedom Fuel

- Only Zero Pollution Chemical Energy Carrier
- Store & Distribute Renewable Energy
- Cleans Up Fossil Fuels if Carbon is Sequestered

CNG --Your BEST Motor Fuel

- Pathway to Zero Pollution H2 & Electricity
- Abundant Domestic Production
- Safest Transportation Fuel
- Ultra-Clean & Efficient
- Economical – IF -- Policy Supports Use
- Your Freedom Fuel is Ready -- NOW!

Hydrogen Production Technologies

- Steam Methane Reforming
- Chemical By-Product
- Pyrolysis / Gasification
- Electrolysis

- Plasma Arc Gasification

What Works Today for H2

- H2 Delivery by Truck – CH2 or LH2
- Electrolysis with Grid Electricity
- Reform Natural Gas
- Distributed Combined Heat, Power & Transportation Fuels

Renewable Hydrogen Energy Sources in Florida

- Woody Biomass
- Algae Biomass
- Solar
- Wind
- Ocean

Hydrogen Production: Florida's Renewable Fuel

- Biomass Gasification
- Electrolysis from Offshore Wind
- Electrolysis from PV
- Electrolysis from Ocean Currents
- Photo-Electrochemical
- Photo-Biological

Hydrogen Production: Fossil Fuels

- On-Site Natural Gas Reforming
- Central with CARBON SEQUESTRATION
 - Coal Gasification
 - Tar Sands & Oil Shale Gasification

Onsite Reforming of Natural Gas

- Most Cost-Effective for HFCEVs
- Lowest Life-Cycle GHG Emissions of all Fossil Options

Hydrogen Distribution

- Pipeline – Compressed H₂
- Barge – Liquid H₂
- Rail – Liquid H₂
- Truck – Liquid H₂ & Compressed H₂

Co-Fired Hydrogen - Cleans Up Natural Gas Electricity

- Gas Turbines < 1 to 3 ppm NOx
- Piston Engines < 1 ppm NOx
- Zero-Carbon H2 Reduces Carbon

H-CNG Motor Fuels

- 30% to 50% Lower Carbon Emissions
- Ultra-Low Tailpipe Emissions
- H-CNG Cost-Effective when made with:
 - Pipeline Natural Gas
 - Onsite Renewable Hydrogen

Hythane is a Blend of H₂ & NG









NGVs – Pathway to Hydrogen

TECHNOLOGY BREAKTHROUGHS –NOT

SUPPLIES ARE ABUNDANT

THERE IS NO STORAGE PROBLEM

MASS PRODUCTION = LOWER COSTS

BEST Price 4/8/09 v 4/8/08 ?

- CNG -- \$0.41/gge to \$1.12/gge
(\$3.50/mmbtu to \$9.56/mmbtu)
- H-CNG -- @ \$2/gge to \$4/gge
- Diesel (15ppm) -- \$1.50 - \$3.58
- Gasoline CARBOB -- \$1.60 to \$3.00



ALTERNATIVE ENERGY SOLUTIONS

CLEANPOWER
ENGINEERING







Natural Gas and Hydrogen Our Freedom Fuels

Hydrogen is the Only Zero Pollution
Chemical Energy Carrier

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Florida Hydrogen Energy Technology Act

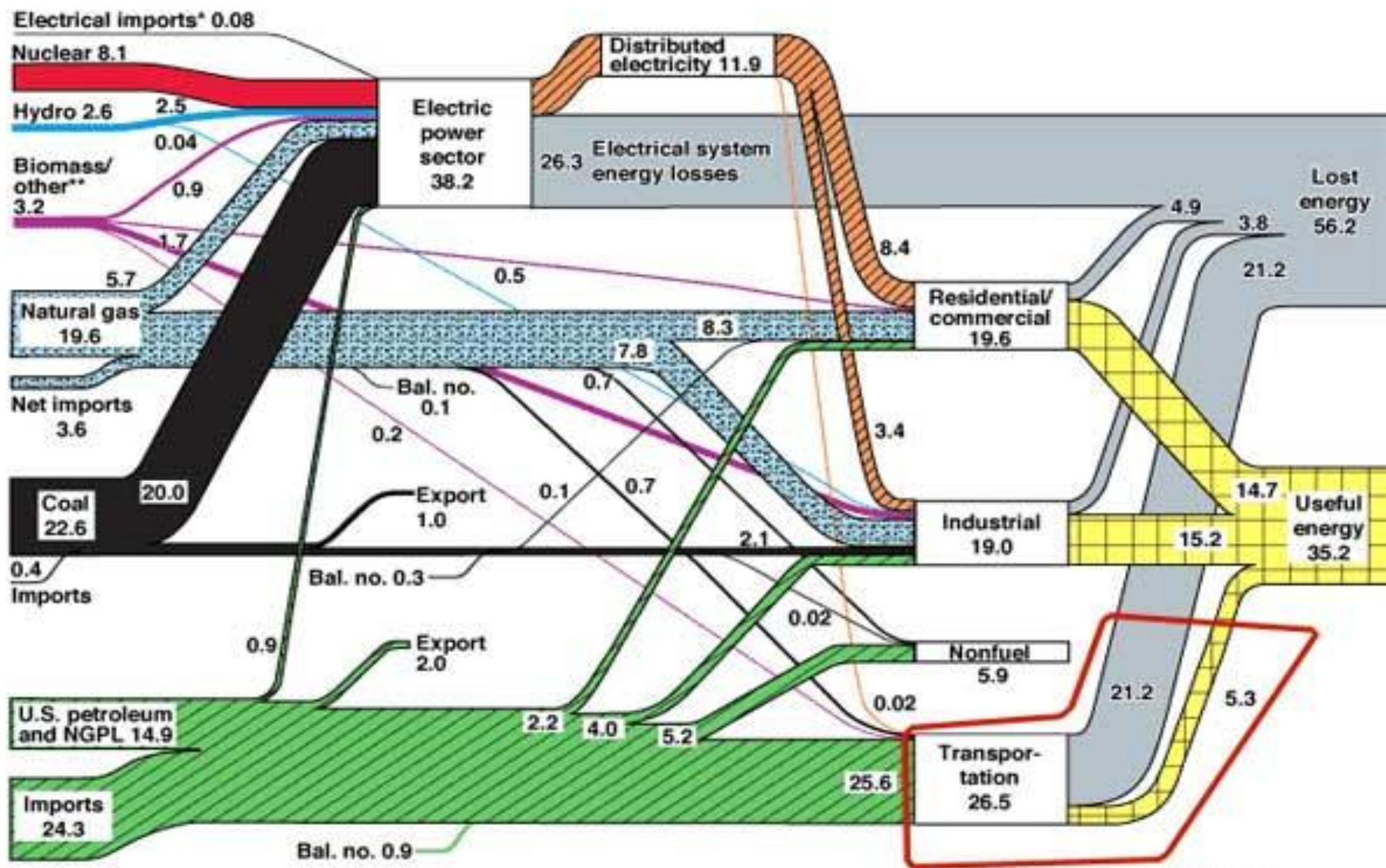
- Corporate Income Tax Credit
- 100% Sales Tax Exemption
- Grant Program
- Uniform Codes & Standards
- Incentives for Utility Investments

Corporate Income Tax Credits

- Process Must be Qualified by FDEP
- Deduct 75% of All Investment
- No Cap – Sunsets in 2009

U.S. Energy Flow Trends – 2002

Net Primary Resource Consumption ~97 Quads



Source: Production and end-use data from Energy Information Administration, *Annual Energy Review 2002*.

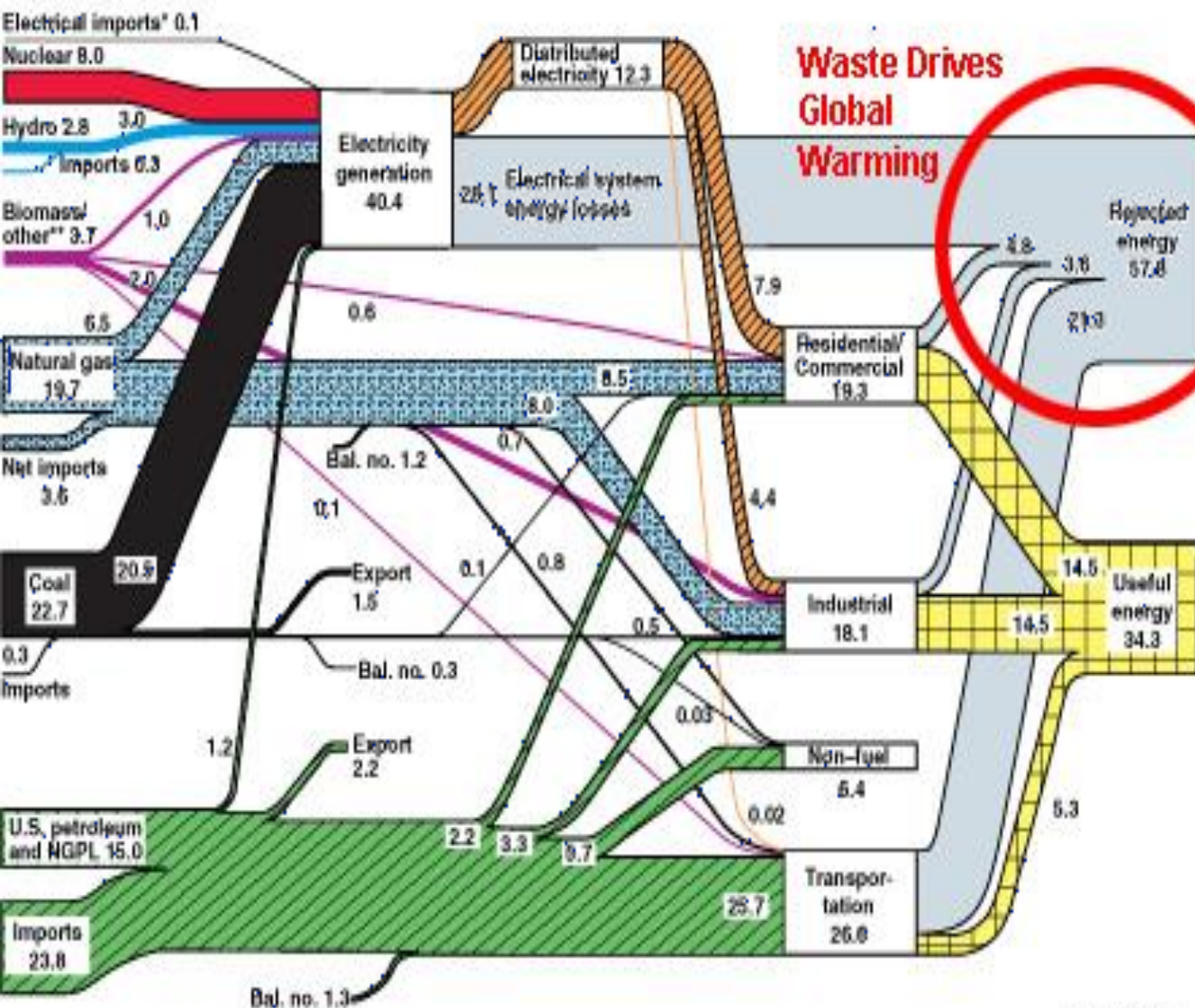
*Net fossil-fuel electrical imports.

**Biomass/other includes wood, waste, alcohol, geothermal, solar, and wind.

June 2004
Lawrence Livermore
National Laboratory
<http://eed.llnl.gov/flow>

U.S. Energy Flow Trends – 2000

Net Primary Resource Consumption 98.5 Quads



**Waste Drives
Global
Warming**



It costs less to move less

Profit Potential

Preempt waste
Efficiency from 20% to 70%
Capture profits
Locally collected & used



On-demand mobility
People and cargo

Source: Production and end-use data from Energy Information Administration, Annual Energy Review 2000

*Net fossil-fuel electrical imports

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December 2001
Lawrence Livermore
National Laboratory