BOARD ON EARTH SCIENCE AND RESOURCES

25TH ANNIVERSARY

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PROBABLY THE GAUDIEST COVER ON A NATIONAL ACADEMY PRESS PUBLICATION
THE REVOLUTION IN U. S. ENERGY

BECOMING A NET ENERGY EXPORTER
Primary Energy Production
(Quadrillion Btu)
By Source, 1949–2012

Coal
Natural Gas
Crude Oil and NGPL
Renewable Energy
Nuclear Electric Power
U.S. ENERGY PRODUCTION (QUADS)
NATURAL GAS AT TOP
EIA OCTOBER 2013

By Source, July 2013

- Natural Gas: 2.123
- Coal: 1.812
- Crude Oil and NGPL: 1.637
- Renewable Energy: 0.807
- Nuclear Electric Power: 0.738
U. S. ENERGY CONSUMPTION (QUADS)
EIA (OCTOBER 2013)

By Source, July 2013

- Petroleum: 3.022
- Natural Gas: 1.949
- Coal: 1.727
- Renewable Energy: 0.804
- Nuclear Electric Power: 0.738
Global Natural Gas Prices (U.S. dollars/million British thermal units)

Source: Bloomberg data as of 6/30/2013
CARBON DIOXIDE EMISSIONS FROM ENERGY CONSUMPTION AND SOURCE

COAL AND PETROLEUM DOWN BECAUSE WE ARE USING LESS

BUT MORE NATURAL GAS

EIA (OCTOBER 2013)
U.S. expected to be largest producer of petroleum and natural gas hydrocarbons in 2013
SHALE OIL IS NOT CHEAP

WTI BREAKEVEN PRICE (FOR A 20% BEFORE TAX ROR--$/BB) AVERAGE ABOUT $72/BBL MODIFIED FROM KEYBANC (2013)
U.S. Energy Deficit: Consumption – Production (quadrillion British thermal units)

Source: U.S. Energy Information Administration, Annual Energy Outlook 2013
While dependence on imported oil & gas rises in many countries, the United States swims against the tide.
ENTERING THE METHANE ECONOMY WITH A SHALE BOOST

CLEAN FUEL USING LESS OIL AND MUCH LESS COAL SUBSTANTIALLY REDUCING EMISSIONS
GLOBAL ABUNDANCE SOURCE OF HYDROGEN FOR THE EVENTUAL CARBON-FREE HYDROGEN ECONOMY
RATIO OF HYDROGEN (H) TO CARBON (C) FOR GLOBAL PRIMARY ENERGY CONSUMPTION SINCE 1860 & PROJECTIONS FOR THE FUTURE

Methane: H/C = 4
Oil: H/C = 2
Coal: H/C = 1
Wood: H/C = 0.1

1935 (midpoint of process)
\( \Delta t = 300 \) years (length of process)

Ausubel (1996)
A PLAUSIBLE 100 YEAR GLOBAL ENERGY PROJECTION
BASED ON HISTORICAL TRAJECTORY OF ENERGY MIX, POPULATION OF 8 BILLION, 3%
ANNUAL ECONOMIC GROWTH, AND 2% ANNUAL INCREASE IN ENERGY EFFICIENCY