



ROLE OF SERVICE COMPANIES IN ASSURING A SUSTAINABLE ENERGY FUTURE

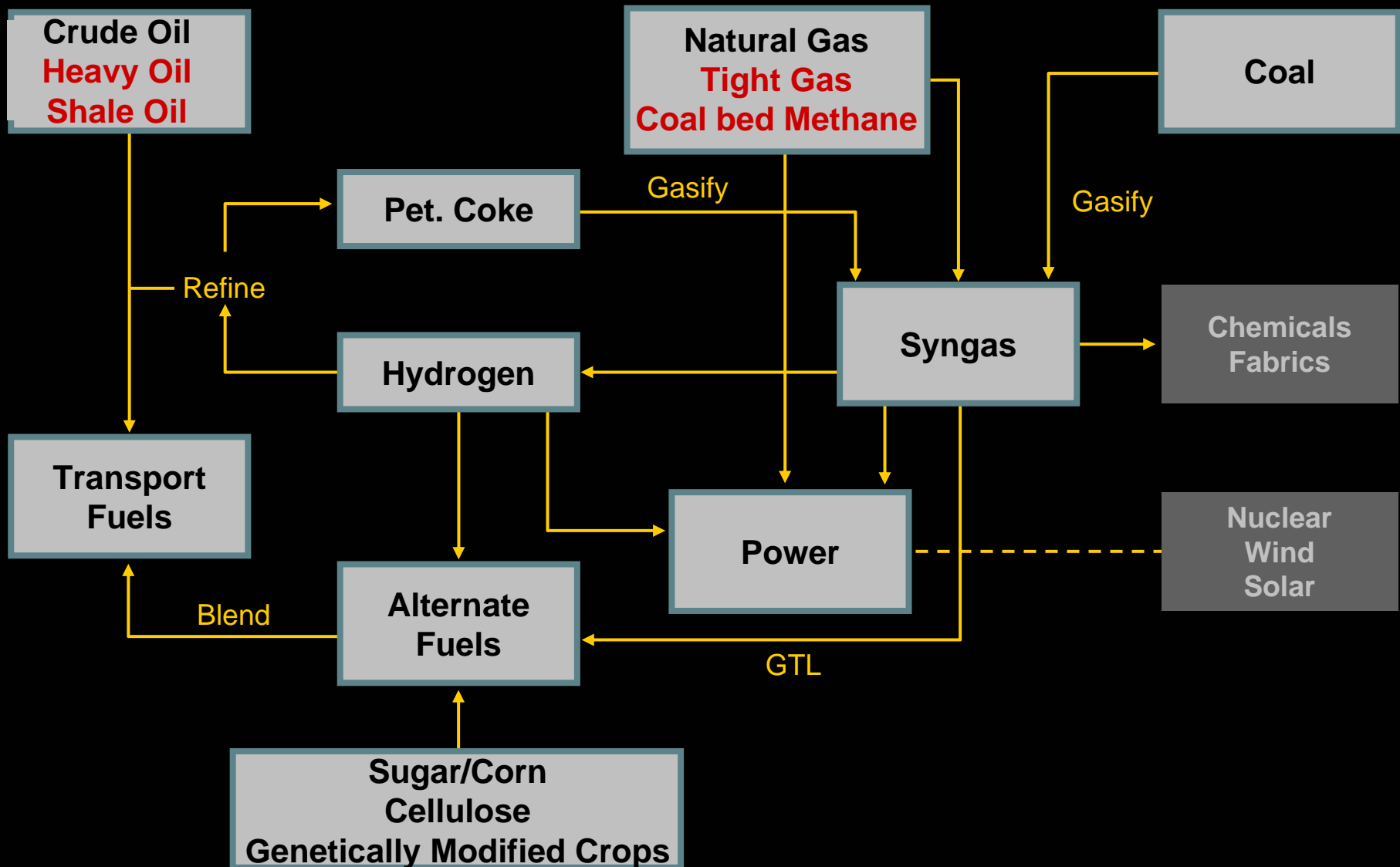
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November 27, 2007

The Energy Future

- Robust but complicated
 - today: discuss only transport fluids
- Conventional sources will not serve demand in 20 years
 - Different drivers for NOC's and IOC's
 - Alternative fuels: important, but small factor
- Technology will be a key in selecting winners

The Energy Landscape



Trends in Petroleum Industry

- **Increasing net recovery from new and existing reservoirs**
 - 10% increase: additional trillion BOE
- **Unconventional hydrocarbons**
 - Heavy Oil
 - Tight Gas
 - Coal Bed Methane
 - Shale Oil
- **Deep water**
 - Deeper waters and deeper horizons



New Technologies Required

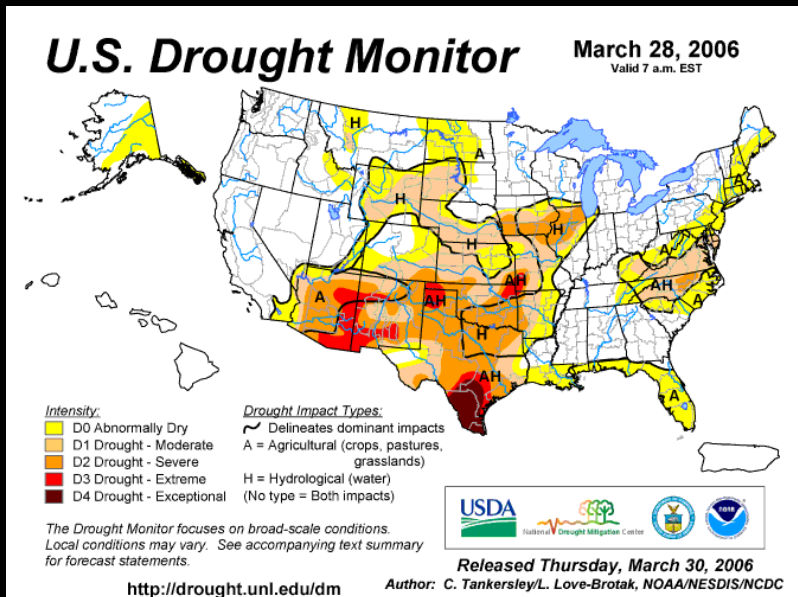
- Reservoir Illumination: deep sensing
 - Nano sensing
- Improved Drainage Architectures: well placement and managed production
- Deep Horizons: cost effective drilling and completions
 - Jack and Tupi: special challenges
- Biochemistry: could be important weapon
- Heavy Oil: nano catalysts and gasification of petroleum coke

New Technologies Required

- Tight Gas: reservoir illumination and sustained conductivity
 - Definition, special challenges
- CBM: improved production rates and water disposition
 - Water comes first
- Environmental: CO₂ sequestration and water conservation

Water Conservation

Produced Water Usage Secures Our Future



Fracturing industry uses as much as 5 Billion BBL of fresh water per year.

50% world's fresh water is currently used for mankind consumption.

In 25 years that would be up to 90%

- **Treatment must be fit for purpose**
 - **industrial use**
 - **agriculture**
 - **potable**

Produced Water

- Global: 80 billion barrels per year
- US: 24 billion barrels per year
- Reference: 32 billion barrels of oil per year
- Quality variable
 - salinity increases with depth
 - bacteria
 - Coal bed methane water unique
- Currently re-injected at cost of over \$1 per barrel

Future Transport Fluids Will Be Sourced From a Mix

- Conventional Petroleum
- Heavy Oil
 - Plus petroleum coke to syngas and liquids
- Coal to syngas and liquids
- Natural gas to liquids
- Biofuels

Advances in Technology will decide the mix
Service companies must anticipate, and influence,
the outcome