

# Unconventional Fossil Fuels: A Strategic U.S. Energy Resource

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(HTR) Technology  
Washington D.C.***

**October 1, 2008**

# Energy Security Challenge

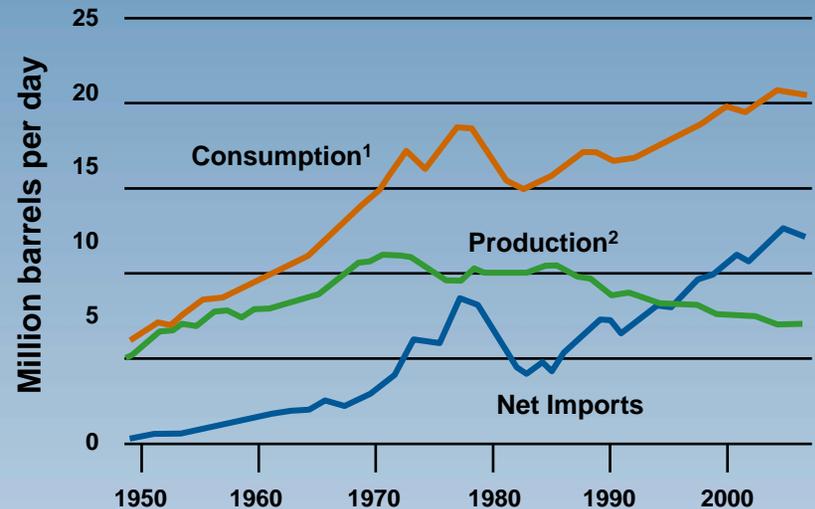
- The United States faces an unprecedented threat to its energy security due to its dependence on foreign oil and gas, in particular transportation fuel derived from geopolitically unstable or “unfriendly” countries.

## “Energy Security” Defined:

- **Supply Security**
- **Economic Stability**
- **Environmental Sustainability**

- This is a situation that diminishes our country’s strength, and given demand trends, will only worsen.

- In this context, carbon energy sources will continue to supply most of the world’s energy needs for the foreseeable future.

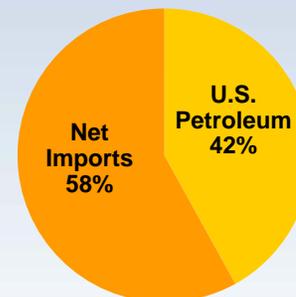


<sup>1</sup>Petroleum products supplied is used as an approximation for consumption

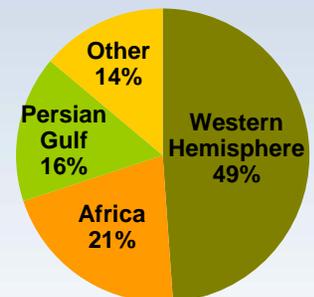
<sup>2</sup>Crude oil and natural gas plant liquids production

Source: Energy Information Administration, *Annual Energy Review 2007* – Table 5.1. (June 2006)

Net Imports And Domestic Petroleum as Shares of U.S. Demand (2007)



Sources of U.S. Petroleum Imports (2007)



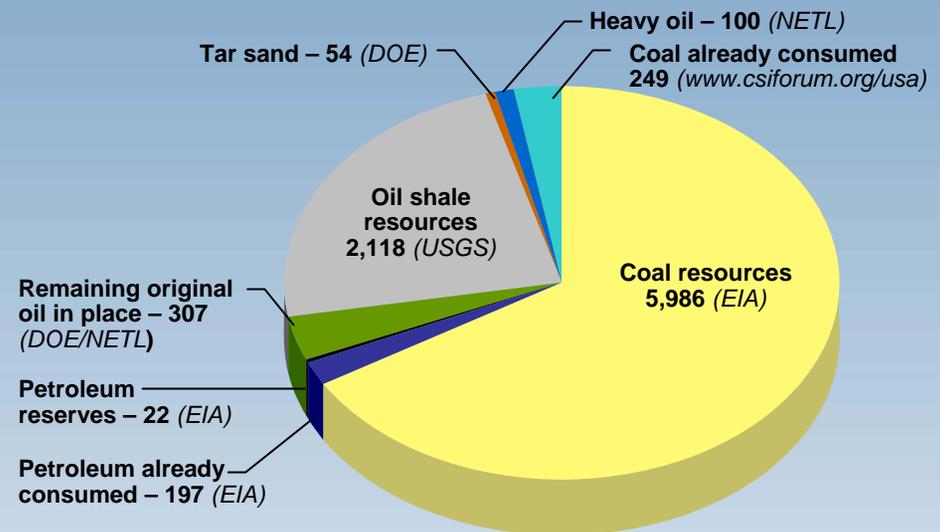
Source: Energy Information Administration



# The Opportunity: Utilizing America's Endowment of Unconventional Solid and Liquid Fuels Resources\*

- **Oil Shale.** 800 billion barrels of oil equivalent could be recoverable, exceeding 2.5 million barrels/day within 30 years
- **Coal to Liquids.** U.S. proven coal reserves exceed 267 billion short tons; Coal liquids production could reach 2.6 million barrels/day by 2025
- **Heavy Oil.** Estimates of U.S. heavy oil resources in place range from 60 to 100 billion barrels, of which 2 billion barrels are proved reserves and another 20 billion barrels could ultimately be recoverable
- **Tar Sands.** Resources in place are estimated to be 54 billion barrels, about 11 billion barrels of which could be recoverable.
- **Enhanced Oil Recovery.** Current EOR by CO<sub>2</sub> is 237,000 million barrels per day. With economic viability could add 2.7 – 2.9 billion barrels of reserves and 350-400 thousand barrels per day of oil production over the period 2010 to 2030

**U.S. Solid and Liquid fuels Resources**  
(Total Endowment 9,033 Billions Oil Equivalent\*)



\*no including energy losses in transformation to liquid fuel  
Units are in Billion bbl-oil-equivalent coal-10K BTU/lb; oil-6M BTU/bbl

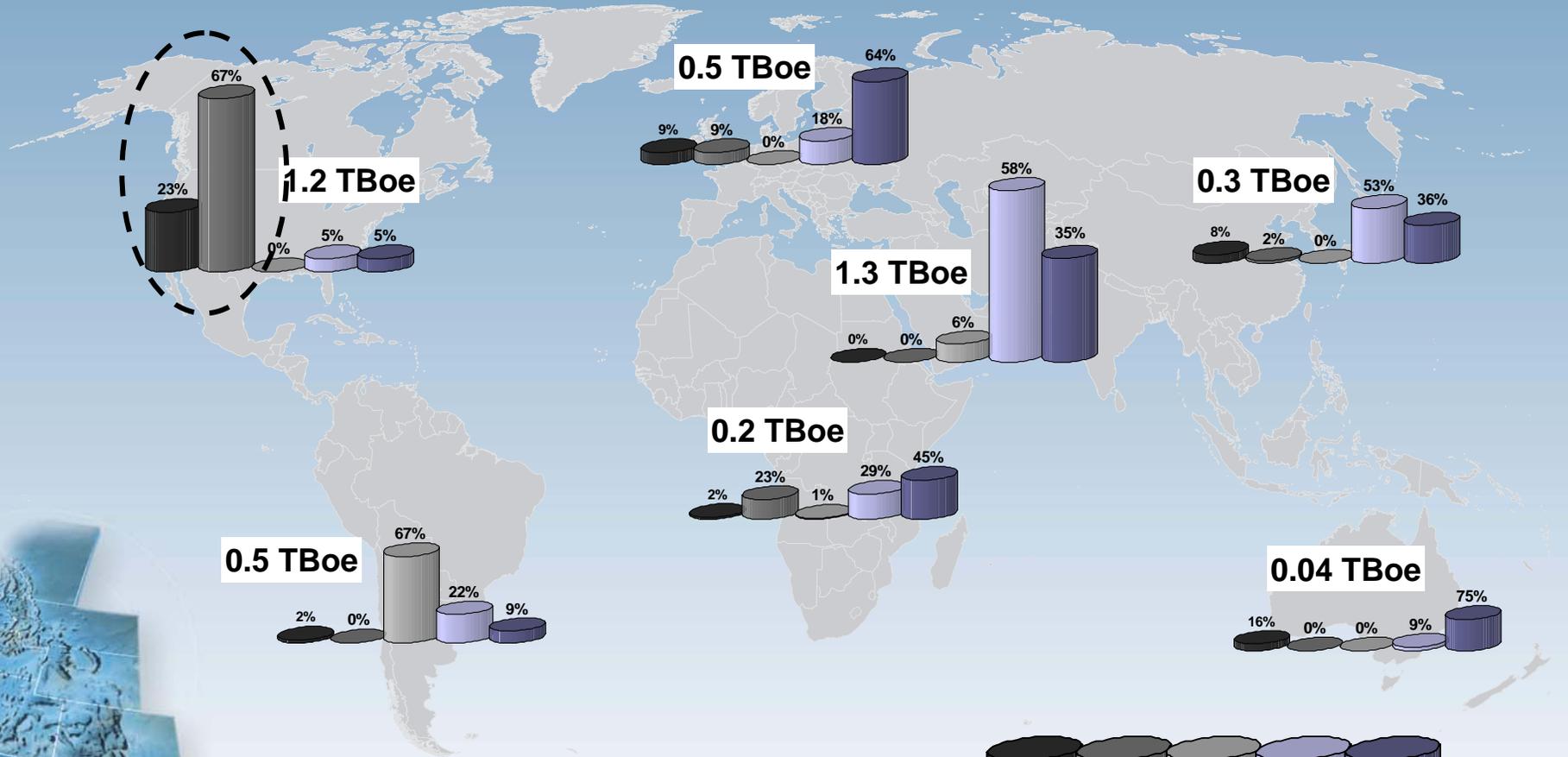
**Source: Unconventional Fuels Task Force Report:  
Development of America's Strategic  
Unconventional Resources – Sep 2006 ; A.  
Dammer DOE, 2008**

**“We should expand oil production  
by tapping into the extraordinary  
potential of oil shale.....”. President  
George W. Bush, June 18, 2008**

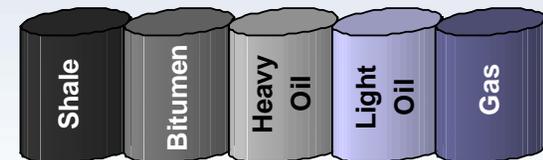


# Estimated Amounts of Global Recoverable Hydrocarbon Resources (excludes coal)

TBoe = trillions of barrel equivalent



Source: Compiled from Bernstein: World Economic Council Statistical Review, USGS: "Heavy Oil and Natural Bitumen – Strategic Petroleum Resources" and Bernstein Estimates



# The “Western Inland Energy Corridor” Can Contribute Significantly to U.S. Energy Security

- The Energy Corridor contains **world-class** conventional and unconventional fossil energy reserves complemented by significant **renewable** resources and energy infrastructure
- The Canadian portion of corridor is of great importance to U.S. energy security
- Innovative development, stewardship and environmental management approaches must be applied to secure these resources



*The Energy Corridor contains energy resources strategic in meeting N. America's energy security challenges*



# Selected World Class Energy Corridor Resources: A Bi-National Regional Perspective

## Alberta Oil Sands

- 174 Billion Barrels (proven); Bitumen production >1 million barrels/day; 2.7 million barrels/day by 2015

## Coal Basins

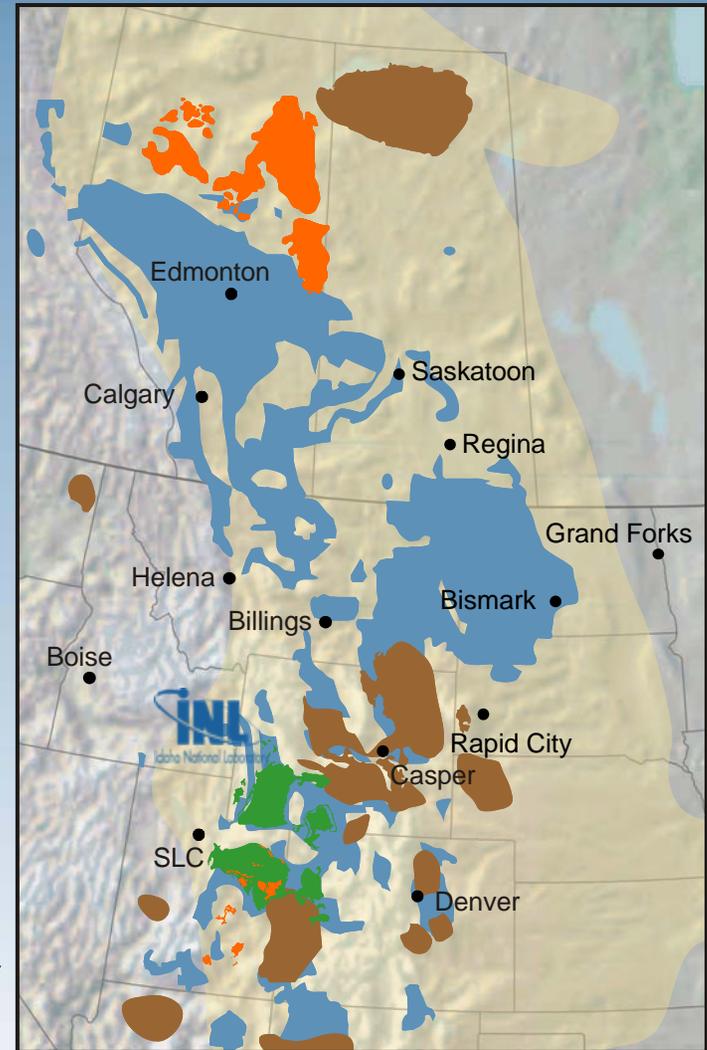
- The assessed coal in the U.S. Northern Rockies and Great Plains represents a total of about 660 billion short tons; Alberta holds estimated 33.5 billion metric tons in reserves (6,200 billion metric tons ultimate potential)

## Oil shale

- May contain in place the equivalent of 1.5 trillion barrels of oil
- Sustained production estimated at 2.5 million barrels per day (in 30 years)

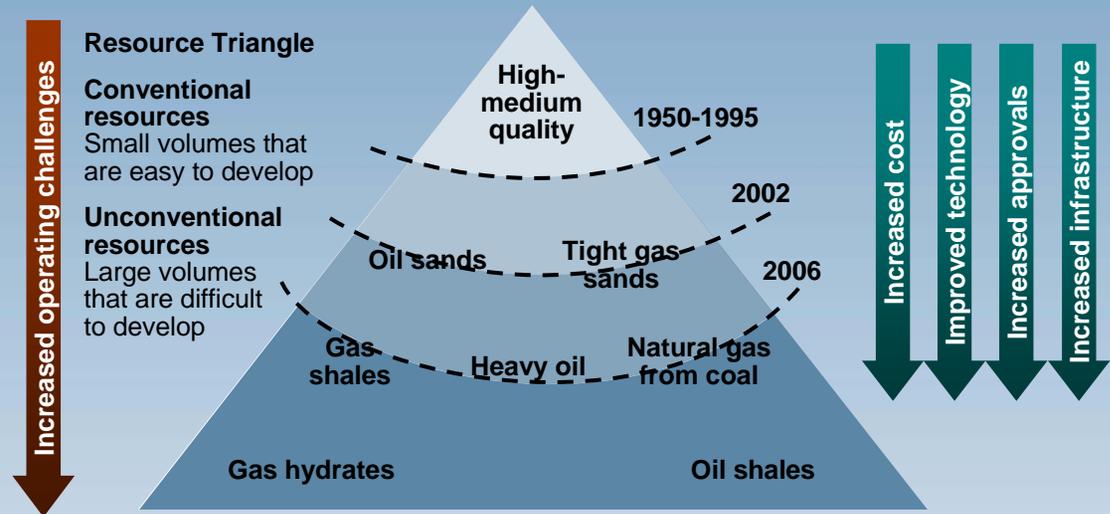
## Saskatchewan uranium

- World's richest concentration
- 25-30% of world production



# Selected Energy Corridor Trends Relative to Unconventional Fossil Energy Resources

- Increasing economic viability and interest in exploiting unconventional fossil energy resources
- Increasing interest by President and Congress to increase domestic production
- Increasing need for supporting bi-national regional energy infrastructure; desire to move up the value chain
- Increased development challenges/concerns related to water, CO<sub>2</sub>, land degradation
- Emerging uncertainties on development costs, materials, workers



Source of image: Canadian Society for Unconventional Gas Submission to Council of Energy Ministers, September 2003

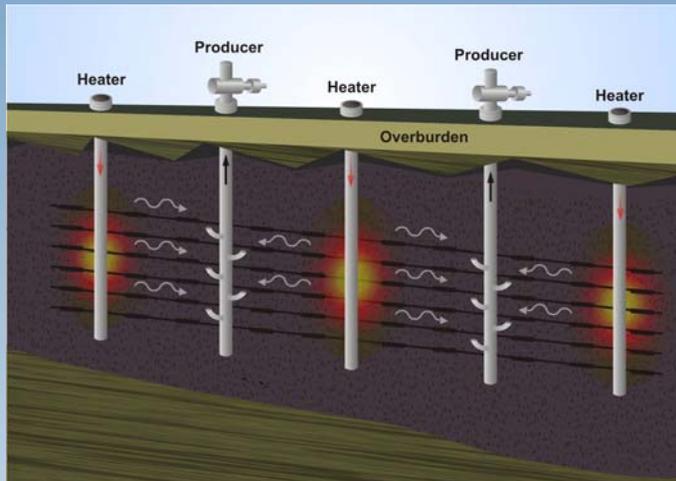
**Development of unconventional fossil energy resources comes with greater challenges and costs; but there are vast quantities potentially available**

- Emerging DoD interest in implementing energy innovation in energy corridor bases
- Emerging interest in integrating nuclear and renewable energy into regional electricity and fuels production

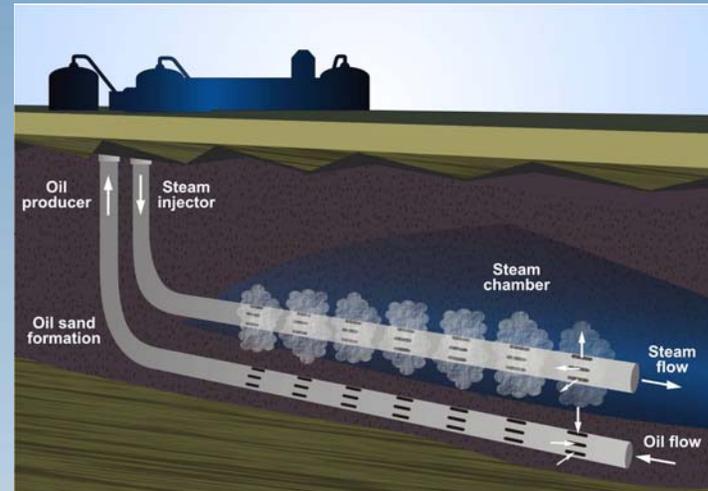


# Examples of Process Technology Profiles

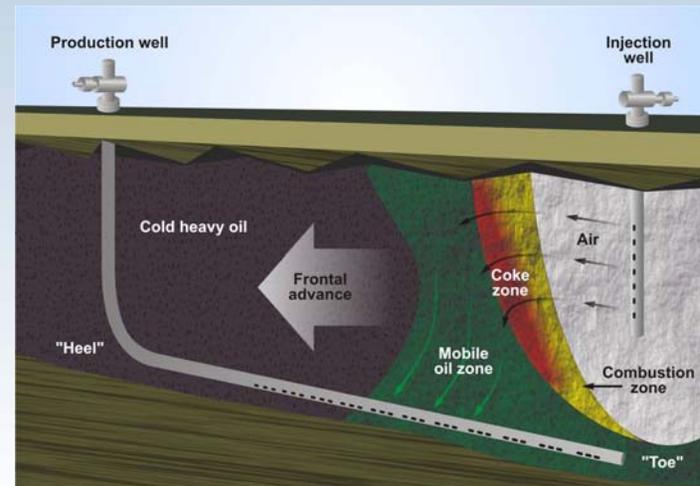
*Shell In-Situ Heating of Oil Shales In Demonstration Phase*



*Steam Assisted Gravity Drainage Technology at Alberta Oil Sands*



*Toe to Heel Injection Process for Oil Sands*



*Utilizing in situ heating processes is a growing trend for recovering heavier, unconventional, fossil energy resources. Key challenges associated with these processes is the amount of energy required, water use and CO2 emissions*



# The Importance of Canada and Unconventional Fossil Energy

- Canada is U.S. #1 supplier of oil and gas imports; 16% of U.S gas consumption; 12% of U.S. petroleum consumption
- Canada is a long-term sustainable and geopolitically stable strategic source of energy for the U.S.
- There is Increasing interdependency of cross border energy infrastructure and policy
- AB and SK are providing leadership in technology for recovery, CO2 capture and storage projects
- “Lessons learned partner”, applicable to development of unconventional fossil energy resources (Sec. 369 US EPA Act, 2005)



*“Energy Border Blurred”, Relative to oil sands environmental concerns “..... it’s also an energy security question and it could be a fundamental question in Canada-U.S. relations”, Daniel Yergin, Cambridge Energy Research Associates,*

*Reuters News Sep 2008*



GOING FOR GOLD

**Prairie Atoms:  
The Opportunities and  
Challenges of Nuclear  
Power in Alberta and  
Saskatchewan**

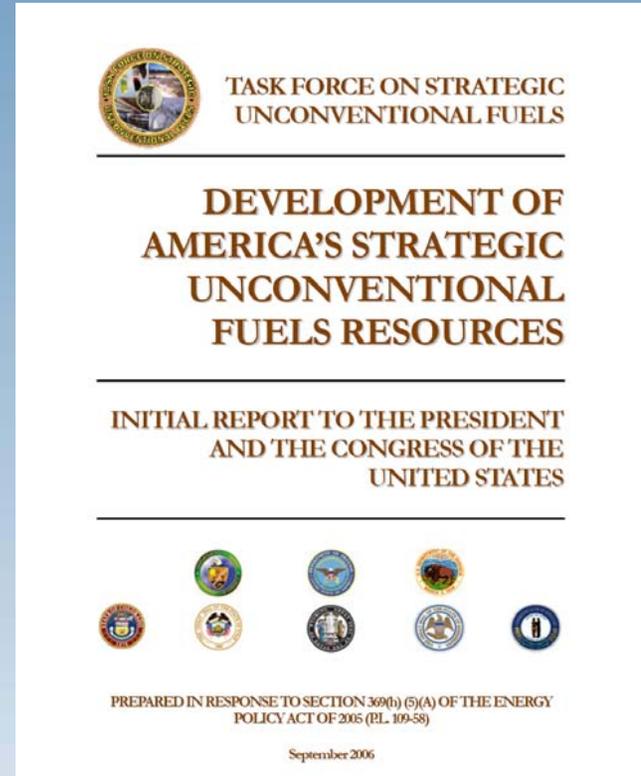
September 2008 Duane Bratt, PhD

*Alberta and Saskatchewan are energy leaders that have a growing interest in nuclear energy integration*



# U.S. DOE and Unconventional Fossil Fuels

- DOE is mandated by U.S. EAct 2005 to *coordinate the creation and implementation of a commercial strategic fuels development program, derived from domestic unconventional fuels resources. “including, but not limited to oil shale and tar sands, in an integrated manner”*
- DOE FE’s Office of Naval Petroleum and Oil Shale Reserves is currently finalizing an implementation strategy, built around the U.S. portion of the Western Inland Energy Corridor
- Alberta (and other parts of Canada) institutions, as per the EAct 2005, have been invited to participate
- In parallel, a number of relevant research efforts are underway in other parts of FE, but also there is an opportunity to integrate DOE NE and EERE innovation

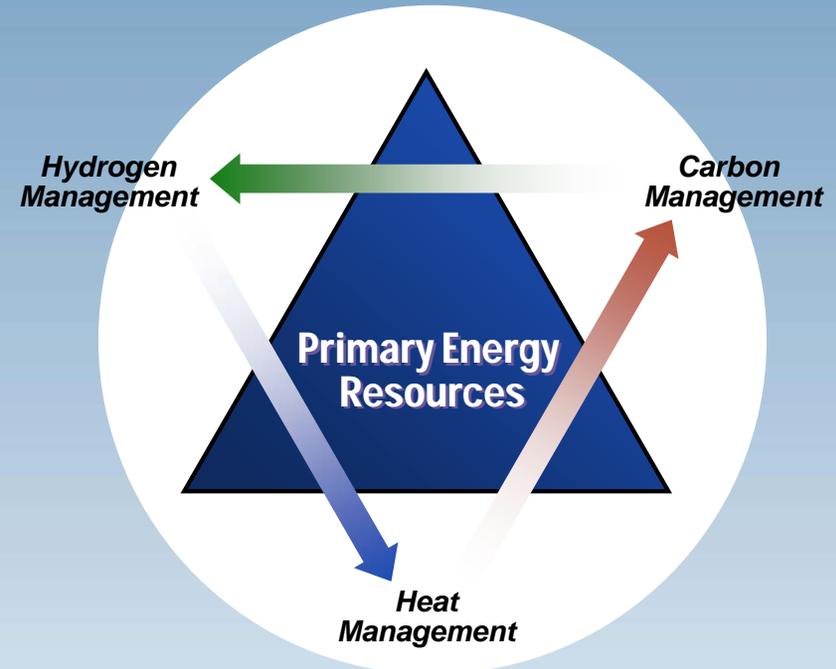


***“The Nation is substantially at risk, from an economic and security perspective, to warrant development of an unconventional fuels program with attendant policies and government actions to promote and accelerate industry development”***



# Innovation is Required for Long-term Development and Stewardship of the Energy Corridor

- Development of these resources will require integrating and optimizing a diverse set of regional energy resources (at multiple scales), interconnected by a dependable delivery infrastructure, and developed in an environmentally responsible manner
- There is growing interest in applying nuclear energy (heat) to the recovery and upgrading/conversion of critical unconventional fossil energy resources
- Nuclear energy can potentially play a role and has regional fossil energy development implications, including
  - Reducing CO2 footprint
  - Reducing use of natural gas
  - Extending life of other primary resources
  - Providing for flexibility
  - Other benefits?



***The energy corridor contains a unique and rich base of carbon, hydrogen, heat sources and primary energy sources to create fuels, electricity and other products***



# Idaho National Laboratory

Energy security leadership  
for the 21<sup>st</sup> century



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