Can the U.S. Dominate Energy?

September 7, 2017
AADE/IADC, Houston Tx.

J.M. Leimkuhler
Vice President Drilling
LLOG Exploration L.L.C.
Can the US Dominate Energy?

- **US Energy Overview** – Where do we get our energy, where does energy go?
- Review the Trump Administration’s Energy Goals & Strategy – what does it mean to “DOMINATE” energy?
- **SWOT Analysis** – Strengths, Weaknesses, Opportunities & Threats - America’s ability to “DOMINATE” energy.
- **Answer the question, Can the US dominate Energy?**
  - In Depth Look at each sector: Oil, Gas, Coal, Nuclear, & “Renewables” (Hydro/Geo, Bio-Fuels, Wind, Solar)
USA 2016 – Energy Flow - Sources

<table>
<thead>
<tr>
<th>Energy Sources</th>
<th>BTUs - Quadrillion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>0.59</td>
</tr>
<tr>
<td>Wind</td>
<td>2.11</td>
</tr>
<tr>
<td>BioFuels</td>
<td>2.28</td>
</tr>
<tr>
<td>Wood/Waste</td>
<td>2.48</td>
</tr>
<tr>
<td>Hydro/Geo</td>
<td>2.70</td>
</tr>
<tr>
<td>Nuclear</td>
<td>8.42</td>
</tr>
<tr>
<td>Coal</td>
<td>14.58</td>
</tr>
<tr>
<td>Nat Gas</td>
<td>27.41</td>
</tr>
<tr>
<td>Oil</td>
<td>23.32</td>
</tr>
<tr>
<td>Oil-Import</td>
<td>23.68</td>
</tr>
<tr>
<td>Misc HC Imports</td>
<td>3.70</td>
</tr>
</tbody>
</table>

“Conventional” Energy: 95.5%

“Subsidy” Energy: 4.5%

111.2 Quads

http://www.eia.gov/totalenergy/
USA 2016 – Energy Flow – Sources & Utilization

Energy
- Enables our Industries
- Allows us and our products to move
- Provides safe comfortable environments to live and work.

Energy Sources
- Solar
- Wind
- BioFuels
- Wood/Waste
- Hydro/Geo
- Nuclear
- Coal
- Nat Gas
- Oil
- Oil-Import
- Misc HC Imports

Energy Utilization
- Industry
- Transport
- Residential
- Commercial
- Exports – Coal & NGL
- Exports – Crude Oil

HC Exports = 50.5% of Imports

http://www.eia.gov/totalenergy/
Can the US Dominate Energy?

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- SWOT Analysis – Strengths, Weaknesses, Opportunities & Threats Analysis - an Overview of America’s ability to “DOMINATE” energy.

- Answer the question, Can the US dominate Energy?
  - Look at each sector: Oil, Gas, Coal, Oil, Nuclear, Hydro/Geo, Bio-Fuels, Wind, Solar
“We’re here today to usher in a new American energy policy,…. not only focusing on “energy independence,” but also “energy dominance.”” 6/29/17 Whitehouse.GOV

Focus Areas:

• First, we will begin to **revive and expand our nuclear energy sector**...A complete review of U.S. nuclear energy policy will help us find new ways to revitalize this crucial energy resource.

• Second, the Department of the Treasury will address financing barriers for efficient overseas coal plants. Goal – **increase US Coal Exports**.

• Third, approved construction of a new petroleum pipeline to Mexico, which will further **boost American Energy Exports**. US crude has qualities attractive to the international market.

• Fourth, **globally market American natural gas**. DOE approved additional applications to export LNG from Louisiana.

Finally, in order to unlock more energy from the 94 percent of offshore land closed to development under the previous administration, we **are creating a new offshore Oil and Gas Leasing program**. America will be allowed to access the vast energy wealth located right off our shores.”

“Our country will no longer be vulnerable to foreign regimes that use energy as an economic weapon; American families will have access to cheaper energy, allowing them to keep more of their hard-earned dollars; and our workers will have access to more jobs and opportunities.”

6/29/17 Whitehouse.GOV
Trump Cabinet secretaries — Rick Perry - Energy, , Scott Pruitt – EPA, & Ryan Zinke - Interior:

- “Dominance” means being a “self-reliant and secure nation, free from the geopolitical turmoil of other nations that seek to use energy as an economic weapon.”
- “An energy-dominant America will export to markets around the world, increasing our global leadership and influence,”
- “For the first time in four decades, the energy story in the United States is about becoming an energy exporter and no longer about peak resources or being beholden to foreign powers,”
- “For years, Washington stood in the way of our energy dominance,” …… “That changes now.”

Using the Trump Administration definition/understanding of Dominance, the US will dominate in energy sectors where we can achieve two objectives:

(1) Meet all of our domestic demand/needs.
(2) Export to markets around the world at a level where we can “influence the market”.

- In the 1980’s, and 1990’s ….OPEC dominated oil on a global basis.
  - Australia and Indonesia currently Dominate Coal
  - Australia & Qatar Dominates Natural Gas (LNG)
  - Where can America “Dominate”?
Can the US Dominate Energy?

• US Energy Overview – Where do we get our energy, where does energy go?

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• SWOT Analysis – Strengths, Weaknesses, Opportunities & Threats Analysis - an Overview of America’s ability to “DOMINATE” energy.

• Answer the question, Can the US dominate Energy?
  – Look at each sector: Oil, Gas, Coal, Oil, Nuclear, Hydro/Geo, Bio-Fuels, Wind, Solar
American Energy Dominance SWOT Review

**Strengths**
- **Strong resource positions** in hydrocarbons, Coal, Gas, Oil.
- **World Class Technology** in resource extraction – Onshore & Offshore.
- **Entrepreneurial society** – responds relatively quickly to market forces able to quickly uptake new technology.
- **Largest Energy consuming Economy** in the world.
- **Strongest existing energy distribution network** in the world, energy transport, & energy refining.
- Access to the worlds financial resources & markets.
- **Mature, generally effective regulatory environment.**

**Weaknesses**
- **Existing & Prior Federal policy** focused on higher cost less reliable energy production, while discouraging low cost reliable HC based energy production.
- Regulatory environment historically underestimates costs and over estimates benefits…especially relative to “renewable energy.
- **Energy commodity markets** are not primarily driven by market forces. Too much instability generated by computerized commodity trading ca ~80%

**Opportunities**
- **Efficiency gains** – the worlds largest energy consuming economy also has the greatest potential to increase efficiency……for the right reason.
- **Fully understanding our energy resources**…we do not live in a physical world of scarcity. Do we even “know what we don’t know?”
- **How would our foreign policy and the cost of that policy change if we were fully energy independent?** Upside far exceeds the downside.

**Threats**
- **US society is relatively technologically illiterate,** ….and the trend is in the wrong direction….can the public understand and support an energy policy that considers all the +/- of each energy source…..esp nuclear & HC based energy?
- Regulatory Environment under increasing political influence….both ways.
- **Cost trends** may make US energy non-competitive. – we are not the low cost producer in oil, & nuclear.
- **Coastal states** have or are likely to enact policies discouraging export of American HC based energy.
Can America Dominate Oil?

- Do we meet our current domestic demand?
- Do we have the reserves to dominate?
- How much excess capacity do we have to generate exports?
- Do we have the mechanisms and policies to enable exports?
From whom do we Import “Oil” and who takes our Exports?

**Import: Canada & Mexico (47%) > OPEC 35%**

**Insights**

**OPEC, Canada & Mexico = 82% of Imports**

**Exports**

- Canada & Mexico (29%)
- Carib, C&S America (29%)
- Europe / Africa 18%
- Asia 24%
Can the US Meet Domestic “Oil” Demand?

US Oil & Oil Products – Imports & Exports 2000 - 2017

- Imports
- Exports
- Crude Exp

13.2 Mil BOPD Net Imports

From 2007-2017
‘Net Imports have dropped 65%

2017 Avg.
4.6 Mil BOPD Net Imports

Crude Oil Export
Refined Products Export
Fracking Condensate Export

Net Imports have dropped 65%
**Where are the World’s Proven Oil Reserves**

<table>
<thead>
<tr>
<th>Country - Region</th>
<th>Bln Bbls Proved Reserves</th>
<th>Share %</th>
<th>R/P</th>
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</thead>
<tbody>
<tr>
<td>Venezuela</td>
<td>72.7</td>
<td>87.3</td>
<td>300.9</td>
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<td>Saudi Arabia</td>
<td>261.4</td>
<td>264.3</td>
<td>266.6</td>
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<td>Canada</td>
<td>48.9</td>
<td>179.4</td>
<td>171.5</td>
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<td>Iran</td>
<td>92.6</td>
<td>138.4</td>
<td>158.4</td>
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<td>Kuwait</td>
<td>96.5</td>
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<td>United A.E</td>
<td>97.8</td>
<td>97.8</td>
<td>97.8</td>
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<td>Libya</td>
<td>29.5</td>
<td>41.5</td>
<td>48.4</td>
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<td>USA</td>
<td>29.8</td>
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<td>48.0</td>
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<tr>
<td>Nigeria</td>
<td>20.8</td>
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<td>Kazakhstan</td>
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<td>4.5</td>
<td>8.0</td>
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<tr>
<td>Norway</td>
<td>11.7</td>
<td>8.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Other(34)</td>
<td>62.9</td>
<td>77.0</td>
<td>74.6</td>
</tr>
<tr>
<td><strong>Total World</strong></td>
<td><strong>1148.8</strong></td>
<td><strong>1388.3</strong></td>
<td><strong>1691.5</strong></td>
</tr>
</tbody>
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**Source:** BP Statistical Review of World Energy 2017

- Vast majority of reserves need to be blended with light weight crudes, definitely an opportunity for the US to increase exports.
- Low R/P for a country that aspires to dominate Long term.
Do the latest Global Oil & Gas reserves fully account for the “Fracking” revolution?

- Ans: No. What is the impact if the Pioneer Permian Basin reserve est is correct? The USA gains 135 Bln BOE in reserves.

"The Midland and Delaware basins hold the largest number of undrilled, low-cost tight oil locations in the Lower 48. No other region comes close." – Wood Mackenzie

"U.S. now holds more oil reserves than Saudi Arabia" – Rystad Energy, July 4, 2016

Source: Pioneer Natural Resources via: Oilandgas360.com
## What if US “Permian Shale Oil” = Ghawar

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<td>5.3</td>
<td>9.0</td>
<td>30.0</td>
</tr>
<tr>
<td>China</td>
<td>16.4</td>
<td>20.2</td>
<td>25.7</td>
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<tr>
<td>Qatar</td>
<td>3.7</td>
<td>27.4</td>
<td>25.2</td>
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<tr>
<td>Brazil</td>
<td>6.7</td>
<td>12.2</td>
<td>13.0</td>
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<td>10.8</td>
<td>12.3</td>
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<tr>
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<td>9.0</td>
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<td>8.0</td>
</tr>
<tr>
<td>Ecuador</td>
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<td>4.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Norway</td>
<td>11.7</td>
<td>8.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Other(34)</td>
<td>62.9</td>
<td>77.0</td>
<td>74.6</td>
</tr>
<tr>
<td>Total World</td>
<td>1,149</td>
<td>1,388</td>
<td>1,692</td>
</tr>
</tbody>
</table>

Source: BP Statistical Review of World Energy 2017

The US & Canadian proved reserves rival or exceed Saudi Arabia.

The US & Canadian R/P ratio is competitive with the Middle East.
In terms of Oil resources the US is a lot like Venezuela – we have the resources.

But do we really have the reserves?

Resources \neq Reserves

Resource is what is physically there,

Reserves are the portion of the Resource that can be economically produced.

Resources are only the first step to dominance, in the end Reserves are what really matter.

Does the US only have “Big” reserves intermittently in high price environments?

Or, can US Shale Oil compete at lower prices…… and how low, is low?
The “Average Joe” Oil Price
Inflation Adjusted Average Oil Price over the last 40 yrs =?

Answer = $50-$55/Bbl

Adjust our Cost Structure to Fit a $40-$50 Bbl World and Move on.
Can the US Oil Shale Play Complete @ $40-$50/Bbls

ANSWER - Yes, we can.
Initial or Flush Production from Shale wells is very impressive. However, the drop from the peak is quite fast and dramatic. The long term “Tail” production is typically only a fraction of the initial Flush production.
Fracking CW – Why The Flush Production – Then Decline?

- In Oil Shale deposits the rock has a low permeability.
- Over millions of years the rock is stressed & cracks.
- Oil seeps into cracks, but the oil has not migrated out of the shale rock layer.

Horizontal wells drilled & fracked along the shale layers, connect the fractures & produce the “fracture oil” very well. Once the “flush oil” from the fractures is depleted, the oil in the shale itself flows out very slow. ….thus a rapid drop in production..... and the long production tail.
So what is the real return on an Oil Shale Well...is there a real and significant production tail?

If these productivity gains can be sustained and represent additional oil reserves....then the US can and will DOMINATE Shale oil on a global basis.
So what is the real return on an Oil Shale Well...is there a real and significant production tail?

Huge gains in 2016 and sustained in 2017, but have we reached a maximum?

More importantly are we adding new reserves or simply accelerating oil forward in time?

If these productivity gains can be sustained and represent additional oil reserves....then the US can and will DOMINATE Shale oil on a global basis.

Source: Department of Energy, US EIA
US Oil Production Trends 1920 - 2017

Can the US Oil resurgence continue in $40-$50 oil?

Apr 2015– Re-Peak US Oil Production 9.69 Mil Bbls/Day

Nov 1970 – Peak US Oil Production 10.07 Mil Bbls/Day

Dropping rig count onshore exposed the dependence on initial flush oil production. Will the fall = the rise?

The “Fracking Impact” – Horizontal Fracs in “Tight Oil” Reservoirs

Hurricanes Katrina & Ike

Bbls/Day (1000) - Monthly Avg

- 2000 4000 6000 8000 10000 12000

Yes the US surge in oil continues, as the US Offshore reaches record production, and the US shale, led by the Permian Basin remains economic at $40-$50 oil

8/8/17 EIA Projection for 2018 = 9.91 MM BOPD
Natural Fractures Add Little to Shale Gas Reservoir Productivity

Natural fractures are widely and intuitively believed to enhance the productivity of shale gas reservoirs significantly, but new findings show that the fractures add little to reservoir productivity and may actually be detrimental. Read more...
America’s Energy Resources & Dominance

111.2 Quads

Energy Sources

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Can America Dominate Oil?

Do we meet our current domestic demand?

Do we have the reserves to dominate?

How much excess capacity do we have to generate exports?

Do we have the mechanisms and policies to enable exports?

YES

Not yet, but we are on course to be a net exporter in ~5 yrs

Yes if we can sustain our record offshore production and grow onshore oil @ $40-$50/bbl oil.

Under some scenarios equal to any nation.

Yes, Obama Admin removal of the crude oil export ban is a big enabler of American exports.
America’s Natural Gas Resource & Dominance

Can America Dominate Natural Gas?

Do we meet our current domestic demand?

Do we have the reserves to dominate?

How much excess capacity do we have to generate exports?

Do we have the mechanisms and policies to enable exports?
Global Production & Consumption of Natural Gas

- The US is the global leader in Natural Gas production and consumption – meeting all domestic demand.
- ~2005-2009 the US moved from preparing Gulf Coast ports to import LNG to export LNG

### GLOBAL NATURAL GAS PRODUCTION

<table>
<thead>
<tr>
<th>Country</th>
<th>BCM /Yr- Nat Gas Prod</th>
<th>Yr-Yr Growth</th>
<th>10 Yr Growth</th>
<th>% Growth</th>
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</thead>
<tbody>
<tr>
<td>USA</td>
<td>685 733 766 749</td>
<td>-2.5%</td>
<td>4.1%</td>
<td>21.1%</td>
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<tr>
<td>Russia</td>
<td>605 582 575 579</td>
<td>0.5%</td>
<td>-0.1%</td>
<td>16.3%</td>
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<tr>
<td>Iran</td>
<td>167 186 189 202</td>
<td>6.6%</td>
<td>6.4%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Qatar</td>
<td>178 174 179 181</td>
<td>1.3%</td>
<td>14.6%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Canada</td>
<td>141 147 149 152</td>
<td>1.7%</td>
<td>-1.3%</td>
<td>4.3%</td>
</tr>
<tr>
<td>China</td>
<td>122 132 136 138</td>
<td>-0.7%</td>
<td>1.4%</td>
<td>10.3%</td>
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<tr>
<td>Norway</td>
<td>109 109 117 117</td>
<td>0.4%</td>
<td>3.2%</td>
<td>3.3%</td>
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<tr>
<td>Saudi</td>
<td>100 102 105 109</td>
<td>4.4%</td>
<td>3.9%</td>
<td>3.1%</td>
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<tr>
<td>Algeria</td>
<td>82 83 85 91</td>
<td>7.6%</td>
<td>-0.4%</td>
<td>2.6%</td>
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<tr>
<td>Australia</td>
<td>59 64 73 91</td>
<td>25.2%</td>
<td>7.0%</td>
<td>2.6%</td>
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<tr>
<td>Malaysia</td>
<td>67 68 71 74</td>
<td>3.4%</td>
<td>1.1%</td>
<td>2.1%</td>
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<tr>
<td>Indonesia</td>
<td>77 75 75 70</td>
<td>-7.4%</td>
<td>5.0%</td>
<td>2.0%</td>
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<tr>
<td>Others (&lt;2%)</td>
<td>1,012 1,011 1,011 997</td>
<td>0.3%</td>
<td>2.4%</td>
<td>28.4%</td>
</tr>
<tr>
<td>Total</td>
<td>3,404 3,466 3,531 3,552</td>
<td>0.3%</td>
<td>2.4%</td>
<td>100.0%</td>
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</table>

Source: BP Statistical Review of World Energy 2017
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<tbody>
<tr>
<td></td>
<td>2013</td>
<td>2014</td>
<td>2015</td>
</tr>
<tr>
<td>Iran</td>
<td>813</td>
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<td>Russia</td>
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</tr>
<tr>
<td>Iraq</td>
<td>120</td>
<td>113</td>
<td>131</td>
</tr>
<tr>
<td>Australia</td>
<td>46</td>
<td>81</td>
<td>124</td>
</tr>
<tr>
<td>Indonesia</td>
<td>71</td>
<td>92</td>
<td>99</td>
</tr>
<tr>
<td>Canada</td>
<td>67</td>
<td>57</td>
<td>78</td>
</tr>
<tr>
<td>Other (&lt;1%)</td>
<td>704</td>
<td>941</td>
<td>789</td>
</tr>
<tr>
<td>Total World</td>
<td>4,934</td>
<td>6,522</td>
<td>7,353</td>
</tr>
</tbody>
</table>

- **USA** Reserves have increased close to 100% from 2013 to 2015.
- **No reserve increase in 2016.**
- **Factors driving low to no reserve additions:**
  1. Low Nat gas prices and a historic low gas-rig count.
  2. The oil/gas price spread favors oil
  3. Increased productivity of the tight oil fracs, especially in the Permian basin.

Raw Data Source: BP Statistical Review of World Energy 2017
On the global stage the US plays a minor role in LNG exports. Exports would have to increase 20 fold for the US to “dominate” the global LNG markets.

To compete the US will have to increase reserves at the lowest cost, to offset the relatively high US LNG transport and handling cost.
Natural Gas – LNG Process Cost Overview

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquefaction/Storage</td>
<td>$1.50</td>
<td>$2.00</td>
</tr>
<tr>
<td>Transport</td>
<td>$0.50</td>
<td>$1.20</td>
</tr>
<tr>
<td>Unload &amp; Storage</td>
<td>$0.30</td>
<td>$0.40</td>
</tr>
<tr>
<td><strong>Total LNG Cycle Cost</strong></td>
<td><strong>$2.30</strong></td>
<td><strong>$3.60</strong></td>
</tr>
</tbody>
</table>

Source: Society of Petroleum Engineers - Petrowiki
Global Natural Gas Prices – The US needs to be the Global low cost producer

Can the US produce, liquefy and transport gas to global markets.

The market forces of fracking, keep gas prices in the US low.
Projected LNG Cost Spreads Vs Market Gas Prices

Long Term Projection:
The US is best positioned to compete in Asia Vs Europe

World Bank Natural Gas Price Forecast
nominal US dollars ($/mmbtu)

- US Henry Hub Gas Prices
- Asian Gas $: $3.60, $2.30
- European Gas$: $2.75, $1.75
Louisiana Manufacturing is Booming

- Fueled by $3 / MMBtu natural gas, over $60B in ongoing developments, $42.2 B in LNG export Terminals.
Can America Dominate Natural Gas?

- **Do we meet our current domestic demand?**
  - Yes and Exports are increasing significantly

- **Do we have the reserves to dominate?**
  - Possibly not, but the uncertainty is huge

- **How much excess capacity do we have to generate exports?**
  - Short Term 5-7 yrs - Yes
  - Long Term ????

- **Do we have the mechanisms and policies to enable exports?**
  - Yes, and if we project forward typical US Upstream Industry Optimization and Efficiency
  - The US could be a global player
America’s Energy Resources & Dominance

Can America Dominate Coal?

Do we meet our current domestic demand?

Do we have the reserves to dominate?

How much excess capacity do we have to generate exports?

Do we have the mechanisms and policies to enable exports?
Coal Production Trends - Top 7 Global Producers

2016 Global Coal Production Down 9% From Peak

2013 Global Coal Production Peaks

From 2013 - 2016, the USA and China = 100% of the drop in Coal production.
China – Economic Downturn & Air Pollution Concerns.
USA – Competition form Nat Gas and the Federal “War on Coal”

- COAL PRODUCTION (Millions Tons BOE)

China
USA
Australia
India
Indonesia
Russia
S Africa

Can the USA “Dominate Coal”?  

- Domestically? Yes the US supplies 100% of US demand and even exports some coal.  
- Internationally? Yes.....if.........and it is a big if.

- The US can compete in the export coal market.  
  - The reserves are there.  
  - US has the largest coal reserves in the world, capable of meeting US demand for 381 yrs.
  - China is a close #2 in reserves , but China only supplies 88% of their internal demand and is an importer of coal.
  - Can the US compete in the Global Coal Marketplace, and export significantly more coal?

<table>
<thead>
<tr>
<th>Country</th>
<th>Anthracite &amp; Bituminous</th>
<th>Sub-Bit &amp; Lignite</th>
<th>Total Coal (Mil Tons)</th>
<th>Global %</th>
<th>R/P</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>221,400</td>
<td>30,182</td>
<td>251,582</td>
<td>22.1%</td>
<td>381</td>
</tr>
<tr>
<td>China</td>
<td>230,004</td>
<td>14,006</td>
<td>244,010</td>
<td>21.4%</td>
<td>72</td>
</tr>
<tr>
<td>Russian Fed</td>
<td>69,634</td>
<td>90,730</td>
<td>160,364</td>
<td>14.1%</td>
<td>417</td>
</tr>
<tr>
<td>Australia</td>
<td>68,310</td>
<td>76,508</td>
<td>144,818</td>
<td>12.7%</td>
<td>294</td>
</tr>
<tr>
<td>India</td>
<td>89,782</td>
<td>4,987</td>
<td>94,769</td>
<td>8.3%</td>
<td>137</td>
</tr>
<tr>
<td>Germany</td>
<td>12</td>
<td>36,200</td>
<td>36,212</td>
<td>3.2%</td>
<td>206</td>
</tr>
<tr>
<td>Ukraine</td>
<td>32,039</td>
<td>2,336</td>
<td>34,375</td>
<td>3.0%</td>
<td>*</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>25,605</td>
<td>-</td>
<td>25,605</td>
<td>2.2%</td>
<td>250</td>
</tr>
<tr>
<td>Indonesia</td>
<td>17,326</td>
<td>8,247</td>
<td>25,573</td>
<td>2.2%</td>
<td>59</td>
</tr>
<tr>
<td>Poland</td>
<td>18,700</td>
<td>5,461</td>
<td>24,161</td>
<td>2.1%</td>
<td>184</td>
</tr>
<tr>
<td>Turkey</td>
<td>378</td>
<td>10,975</td>
<td>11,353</td>
<td>1.0%</td>
<td>163</td>
</tr>
<tr>
<td>Reamining (27 &lt;1%)</td>
<td>41,240</td>
<td>43,461</td>
<td>84,701</td>
<td>7.7%</td>
<td>127</td>
</tr>
<tr>
<td>Global Totals</td>
<td>816,214</td>
<td>323,117</td>
<td>1,139,331</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

Source: BP Statistical Review of World Energy 2017
## Global Coal - Production, Consumption, Imports & Exports

<table>
<thead>
<tr>
<th>Country</th>
<th>2016 Prod</th>
<th>2016 Comsump</th>
<th>Import/Export</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1,686</td>
<td>1,888</td>
<td>202</td>
</tr>
<tr>
<td>United States</td>
<td>365</td>
<td>358</td>
<td>(6)</td>
</tr>
<tr>
<td>Australia</td>
<td>299</td>
<td>44</td>
<td>(256)</td>
</tr>
<tr>
<td>India</td>
<td>289</td>
<td>412</td>
<td>123</td>
</tr>
<tr>
<td>Indonesia</td>
<td>256</td>
<td>63</td>
<td>(193)</td>
</tr>
<tr>
<td>Russian Fed</td>
<td>193</td>
<td>87</td>
<td>(106)</td>
</tr>
<tr>
<td>South Africa</td>
<td>142</td>
<td>85</td>
<td>(57)</td>
</tr>
<tr>
<td>Poland</td>
<td>52</td>
<td>49</td>
<td>(4)</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>44</td>
<td>36</td>
<td>(9)</td>
</tr>
<tr>
<td>Germany</td>
<td>40</td>
<td>75</td>
<td>35</td>
</tr>
<tr>
<td>Ukraine</td>
<td>17</td>
<td>32</td>
<td>14</td>
</tr>
<tr>
<td>Turkey</td>
<td>15</td>
<td>38</td>
<td>23</td>
</tr>
<tr>
<td>Japan</td>
<td>0.7</td>
<td>119</td>
<td>118</td>
</tr>
<tr>
<td>Taiwan</td>
<td>-</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>South Korea</td>
<td>0.8</td>
<td>82</td>
<td>81</td>
</tr>
<tr>
<td>Remaining Countries (&lt;1%)</td>
<td>259</td>
<td>326</td>
<td>68</td>
</tr>
<tr>
<td><strong>Global Totals</strong></td>
<td><strong>3,656</strong></td>
<td><strong>3,732</strong></td>
<td><strong>74</strong></td>
</tr>
</tbody>
</table>

1. ASIA is the largest current importer of Coal and will remain so going forward.
2. Australia & Asia are also the largest global exporters of Coal.
3. The US? US Coal Exports are on par with Poland.
4. Can the US market coal to the Far East and compete?
### 2015 State Coal Production

<table>
<thead>
<tr>
<th></th>
<th># Mines</th>
<th>Production ST x1000</th>
<th>%</th>
<th>Capacity ST x1000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wyoming</strong></td>
<td>16</td>
<td>375,773</td>
<td>42%</td>
<td>474,040</td>
</tr>
<tr>
<td><strong>West Virginia Total</strong></td>
<td>151</td>
<td>95,633</td>
<td>11%</td>
<td>122,298</td>
</tr>
<tr>
<td><strong>Kentucky Total</strong></td>
<td>210</td>
<td>61,425</td>
<td>7%</td>
<td>78,518</td>
</tr>
<tr>
<td><strong>Illinois</strong></td>
<td>23</td>
<td>56,101</td>
<td>6%</td>
<td>77,365</td>
</tr>
<tr>
<td><strong>Pennsylvania Total</strong></td>
<td>195</td>
<td>50,031</td>
<td>6%</td>
<td>61,849</td>
</tr>
<tr>
<td><strong>Montana</strong></td>
<td>6</td>
<td>41,864</td>
<td>5%</td>
<td>51,900</td>
</tr>
<tr>
<td>Other States &quot;East&quot; (18) &lt;5%</td>
<td>206</td>
<td>89,050</td>
<td>10%</td>
<td>139,604</td>
</tr>
<tr>
<td>Other States &quot;West&quot; (11) &lt;5%</td>
<td>27</td>
<td>125,679</td>
<td>14%</td>
<td>159,315</td>
</tr>
<tr>
<td><strong>Total US</strong></td>
<td>834</td>
<td><strong>895,556</strong></td>
<td>100%</td>
<td><strong>1,164,889</strong></td>
</tr>
</tbody>
</table>

- US Coal Mines Excess Capacity: ~270 Mil Tons/Yr.
- US Excess Capacity = Total Exports of Australia the world's largest exporter
- >60% of US Coal Reserves are in the Western US, dominated by Wyo. Mt. & N Dakota.
Does the US have the “Mechanisms” to Export Coal?

US Coal Transport – 98% Domestic, 2% Global Export

- Wyoming Coal – “consumed in Wyo” 7% - Exported to other states & countries 93%
- 2% exported West, 98% consumed or sent East.
**Coal Price Vs Production Cost Spread**

**Global Spot Market Coal Prices**

- **US - Appl**
- **US - Wyo**
- **Europe**
- **Japan**
- **China**

**US Coal** – High BTU Eastern Coal & Lower BTU ( & low S) Wyoming Coal – Consistently the lowest priced coal

- ~$5-$10 per Ton “Export Profit”
- ~$44 – Est Value of Wyo Coal in Asia
- $35.00
- $23.00
- $11.25

Raw Data Source: BP Statistical Review of World Energy 2017
Increased US Coal Exports:
- Asia is the prize market.
- Lowest Cost export path for Wyoming Coal is via US West Coast ports.
- Ca. Wa. & Or. state policy/politics is preventing Wyoming coal from accessing the Asian Markets
Increased US Coal Exports:
- Asia is the prize market.
- Lowest Cost export path for Wyoming Coal is via US West Coast ports.
- Ca. Wa. & Or. state policy/politics is preventing Wyoming coal from accessing the Asian Markets
Can America Dominate Coal?

Do we meet our current domestic demand?

Do we have the reserves to dominate?

Do we have excess capacity do we have to generate exports?

Do we have the mechanisms and policies to enable exports?

Yes > Current largest exporter

We have the ports, we need the export policies.
America’s Energy Resources & Dominance

Can America Dominate Nuclear Energy?

- Do we meet our current domestic demand?
- What is the status of our “Nuclear reserves”?
- Do we have the capability/capacity to generate “nuclear electricity” to export to the N. American grid?
What is the “role/status” of US nuclear energy?

### Global Nuclear Energy Production* - Levels/Trends

<table>
<thead>
<tr>
<th>Country</th>
<th>2006</th>
<th>2016</th>
<th>Change ‘05-‘15</th>
<th>'16 Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>187.5</td>
<td>191.8</td>
<td>2.3%</td>
<td>32.4%</td>
</tr>
<tr>
<td>France</td>
<td>101.9</td>
<td>91.2</td>
<td>-10.5%</td>
<td>15.4%</td>
</tr>
<tr>
<td>China</td>
<td>12.4</td>
<td>48.2</td>
<td>288.7%</td>
<td>8.1%</td>
</tr>
<tr>
<td>Russian Fed</td>
<td>35.4</td>
<td>44.5</td>
<td>25.7%</td>
<td>7.5%</td>
</tr>
<tr>
<td>S Korea</td>
<td>33.7</td>
<td>37.3</td>
<td>10.7%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Canada</td>
<td>22.0</td>
<td>23.2</td>
<td>5.5%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Germany</td>
<td>37.9</td>
<td>19.1</td>
<td>-49.6%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Ukraine</td>
<td>20.4</td>
<td>18.3</td>
<td>-10.3%</td>
<td>3.1%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>17.1</td>
<td>16.2</td>
<td>-5.3%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Sweden</td>
<td>15.2</td>
<td>14.2</td>
<td>-6.6%</td>
<td>2.4%</td>
</tr>
<tr>
<td>Spain</td>
<td>13.6</td>
<td>13.3</td>
<td>-2.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Belgium</td>
<td>10.6</td>
<td>9.8</td>
<td>-7.5%</td>
<td>1.7%</td>
</tr>
<tr>
<td>India</td>
<td>4.0</td>
<td>8.6</td>
<td>115.0%</td>
<td>1.4%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>9.0</td>
<td>7.2</td>
<td>-20.0%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Czech</td>
<td>5.9</td>
<td>5.5</td>
<td>-6.8%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Finland</td>
<td>5.2</td>
<td>5.3</td>
<td>1.9%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>6.3</td>
<td>4.8</td>
<td>-23.8%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Japan</td>
<td>69.0</td>
<td>4.0</td>
<td>-94.2%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Countries &lt;5</td>
<td>28.1</td>
<td>30.0</td>
<td>6.8%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Global</td>
<td>635.2</td>
<td>592.5</td>
<td>-6.7%</td>
<td>100%</td>
</tr>
</tbody>
</table>

* Million Tons of BOE/Yr

**TREND**

<table>
<thead>
<tr>
<th>10 Yr TREND</th>
<th>&gt;=+20%</th>
<th>+10-20%</th>
<th>+0-10%</th>
<th>-0-10%</th>
<th>-10-20%</th>
<th>&lt;=-20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>France</td>
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<tr>
<td>China</td>
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<td>Russian Fed</td>
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<td>S Korea</td>
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<td>Canada</td>
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<tr>
<td>Germany</td>
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<tr>
<td>Ukraine</td>
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<tr>
<td>United Kingdom</td>
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<tr>
<td>Sweden</td>
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<tr>
<td>Spain</td>
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<tr>
<td>Belgium</td>
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<tr>
<td>India</td>
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<td>Taiwan</td>
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<tr>
<td>Czech</td>
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<td>Finland</td>
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<td>Switzerland</td>
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<tr>
<td>Japan</td>
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</tr>
<tr>
<td>Countries &lt;5</td>
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</tr>
<tr>
<td>Global</td>
<td></td>
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</tr>
</tbody>
</table>

USA is the Global Leader in Total Nuclear Energy Prod. @ 32%….

……..but on a per capita basis lags many countries.

Green movement in Germany & Fukushima in Japan, & “has led to significant output declines in Nuclear Energy.

China, India & Russia have shown the strongest growth rates in Nuclear Energy in the last 10 yrs..

Raw Data Source: BP Statistical Review of World Energy 2017
**US Nuclear Fuel Sources, Production and Capacity/Reserves**

**US Uranium Sources (2016 – EIA)**

- USA, 11%
- Kazakhstan, 24
- Australia, 20
- Russia, 14
- Canada, 25
- Africa, 10
- Uzbekistan, 4
- Others, 2

The US imports 89% of the Uranium used in Domestic Nuclear Fuel.

**Our Domestic Production is the same as 1940- Early 1950s**

- **6 Mines, 5 Wyo, 1 Neb**

**U.S. uranium production is near historic low as imports continue to fuel U.S. reactors**

**Raw Data Source:**
America’s Energy Resources & Dominance

Can America Dominate Nuclear Energy?

- Do we meet our current domestic demand?
- What is the status of our “Nuclear Fuel reserves”?
- Do we have the capability/capacity to generate “nuclear electricity” to export to the N. American grid?

No

Energy Sources

111.2 Quads

- Solar
- Wind
- BioFuels
- Wood/Waste
- Hydro/Geo
- Nuclear
- Coal
- Nat Gas
- Oil
- Oil-Import
- Misc HC Imports

Can America Dominate Nuclear Energy?

No, in terms of the fuel resource.

Minimal on a global scale & trends are all down.

No, unless we can ramp up the approval and construction processes.
America’s Energy Resources & Dominance

Can America Dominate Renewable Energy?

- Do we meet our current domestic demand?
- What are the impact of renewable energy impacts?
- Do we have the capability/capacity to generate “renewable electricity” to export to the N. American grid?

No, Domestic “demand” for renewables is a “marketing manufactured” demand.

Energy Sources

- Solar
- Wind
- BioFuels
- Wood/Waste
- Hydro/Geo
- Nuclear
- Coal
- Nat Gas
- Oil
- Oil-Import
- Misc HC Imports

111.2 Quads
Renewable Energy Impacts

Visual Effects
- **Hydro Electric** – Close to maximized – more dams are not tolerated and efficiency gains often can not justify the cost to replace inefficient turbines.
- **Wind** turbines must be in exposed areas = highly visible. They are considered unsightly by many people, and concerns have increased with the larger size of new generation turbines.

Noise
- **Wind turbines produce aerodynamic noise**, from air passing over the blades and mechanical noise from the moving parts of the turbine, especially the gearbox. Better designs have reduced noise, and research continues. Wind farms developed far from highly populated areas are, by definition, less offensive....to the people who do not live there.

Electromagnetic Interference
- Wind turbines may scatter electromagnetic signals causing interference to communication systems. Appropriate siting (avoiding military zones or airports) can minimize this impact.

Gulf of Mexico Hypoxia Zones

Bird Impacts
- Birds get killed when they collide with the rotating blades of a turbine. Migratory species are at higher risk than resident species. Siting the turbines away from migratory routes reduces the impact. What would happen if “Big Wind” were treated like “Big Oil”?
Record Hypoxia = F(Temps, Weather & “Plankton Food”)

As we generate more “renewable ethanol” we also generate more “Hypoxia Food” that leads to increased size Dead Zones in the Gulf of Mexico.

Do we really want to add “nutrients” to our oceans to adsorb CO2 and increase the size of our dead zones?

New Jersey-Size 'Dead Zone' Is Largest Ever in Gulf of Mexico

Scientists report the latest data from the Upper Gulf of Mexico, and the results aren’t good.
Perception: Oil and Gas operations are not held to tough environmental standards

Reality: We are held to tough environmental as should all industries but other energy industries are treated differently, ex Wind Energy

**Exxon Mobil** agreed to pay $600,000 in penalties after approximately 85 migratory birds died of exposure to hydrocarbons at some of its natural gas facilities across the Midwest, over a 5 year span. The fine amounts to about $7,000 per dead bird.

*New York Times 4-13-09*

If the Wind Industry (operating in the same footprint) were held to the same standard, their 83,000 raptor fatalities each year would generate fines of 581 million $/yr, and the 573,000 total bird kill for 2012 would yield 4.01 billion $/yr.
Renewable Energy - Quick Look at Nirvana – The Elec Car!

- **Perception** – Electric Cars use less energy and have no emissions.
- **Perception** – if “critical production mass” and an adequate recharging network established Electric Cars will be the future.
- **What is the reality?**

I charge my car, pay the bill & drive with no CO2 emissions! Yeay!!

Where does the electricity come from? The wall outlet!

The power plant gets fuel from the well or the mine.

The wall outlet gets electricity from ….the power plant

Fossil Fuel or Nuclear

Refinery or Gas-to-Liq

So how is an Elec Car better in terms of CO2 or $ from my current car?
Let’s Look at the US Avg – Electric Vehicle CO2 “Budget”

For the average driver in the USA, Do I trade in my 35 MPG Accord for a Tesla Model 3 to reduce CO2?

If I believe I need to reduce my carbon footprint to “Save the planet” then I should focus on efficiency and not drive around in an electric car.

NO!
I will put more CO2 into the atmosphere,
Pay more in the total cost of ownership
And wait longer to “fuel” my vehicle.

How much CO2 will be generated to get those electrons (KWHrs) to my house or charging station? (IPCC & EIA)

For the average driver in the USA, Do I trade in my 35 MPG Accord for a Tesla Model 3 to reduce CO2?

For the average driver in the USA, Do I trade in my 35 MPG Accord for a Tesla Model 3 to reduce CO2?

The electricity that comes out of the wall in the USA averages 2.0 lbs of CO2 per KWH.

If I believe I need to reduce my carbon footprint to “Save the planet” then I should focus on efficiency and not drive around in an electric car.

@ 60 MPH Charge time = 2x Drive Time

Power mix assumptions. Maxed out on Nukes & Hydro.

New energy will come from both conventional & renewables (i.e. subsidies continue).

How much CO2 will be generated to get those electrons (KWHrs) to my house or charging station? (IPCC & EIA)
Impact to Consumers – The High Cost Road to Renewables

Should the USA “Dominate” an energy source that is costly, inefficient, and poses surge, transfer and load shedding issues that result in the actual power supplied equal to only a fraction of the “name plate capacity”?

ANSWER: NO, Be a strategic follower not a leader in renewables


Calif = 18.3 C/KWh
Disclosure: I am a unconventional energy user

I have solar water heat (pool) and solar panels for electricity.

Solar water heater for the pool = No brainer.

Solar Electricity Panels in forested South Louisiana = Total Looser

Solar Panels – Payout – 21 yrs. even with an 80% discounted after tax cost.

✓ I firmly support unconventional/”green” energy where it works on it’s own merits without any subsidies.
✓ But thanks to all the taxpayers in the room for my subsidies.
Renewable Energy / “CO₂ Fear” – Dominated by Media/Advertising

To survive long term, renewables simply need to compete on the open energy market.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Mass Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>H</td>
<td>6.478%</td>
</tr>
<tr>
<td>Carbon</td>
<td>C</td>
<td>42.106%</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O</td>
<td>51.415%</td>
</tr>
</tbody>
</table>

WOW! Domino is marketing sugar with no carbon, leaving only Hydrogen and Oxygen ……powdered water?
Can the US Dominate Energy?

• US Energy Overview – Where do we get energy, how do we use energy?

• Review the Trump Administrations Energy Goals & Strategy – to date.

• What does it mean to “DOMINATE” energy?

• SWOT Analysis – Strengths, Weaknesses, Opportunities & Threats Analysis of America’s ability to “DOMINATE” energy.

• Answer the question, Can the US dominate Energy for each source, Oil, Natural Gas, Coal, Nuclear, Renewables.
The USA should not dominate “Subsidy Energy” unless the energy is cost effective without government subsidy and competes based on the full life cycle cost/benefits.

- **Short & Long Term – NO.**
  - **Wind**
  - **BioFuels**
  - **Wood/Waste**

- **Short & Long Term – No, Limited New Sites & Cost**
  - **Hydro/Geo**

- **Short Term – No, Long Term – No, Fuel Reserve Issues**
  - **Nuclear**

- **Short Term – No, US can’t export, Long Term - Yes**
  - **Coal**

- **Short Term – Yes, if the US can export, Long Term - ?**
  - **Nat Gas**

- **Yes** – but the “tight oil” or shale oil fracking play needs to be real, sustained and supported

- **Oil-Import**

- **Misc HC Imports**

---

**Energy Sources:**

- Solar
- Wind
- BioFuels
- Wood/Waste
- Hydro/Geo
- Nuclear
- Coal
- Nat Gas
- Oil
- Oil-Import
- Misc HC Imports
USA Energy DOMINANCE?

Yes....... If all energy competes in open markets.
BACK-Up Slides
## Why can’t we all “be like California”? 

### California Energy Budgets Estimates 2015

<table>
<thead>
<tr>
<th>Category</th>
<th>Form</th>
<th>Use</th>
<th>Production</th>
<th>Consumption</th>
<th>Imported %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>Hydro-Carbon</td>
<td></td>
<td>0.00</td>
<td>31.00</td>
<td>100%</td>
</tr>
<tr>
<td>Crude Oil</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>1,150.70</td>
<td>3,054.60</td>
<td>62%</td>
</tr>
<tr>
<td>Motor Gasoline excl. Ethanol</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>1,684.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distillate Fuel Oil</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>566.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>637.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>48.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Fuel</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>116.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Petroleum</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renewable Energy</td>
<td></td>
<td></td>
<td>743.40</td>
<td>727.10</td>
<td>-2%</td>
</tr>
<tr>
<td>Biomass</td>
<td>Hydro-Carbon</td>
<td>Trans Fuel</td>
<td>27.80</td>
<td>288.50</td>
<td></td>
</tr>
<tr>
<td>Other Renewables</td>
<td>Solar, Wind, Geo</td>
<td>Elec</td>
<td>586.90</td>
<td>438.60</td>
<td></td>
</tr>
<tr>
<td>Hydroelectric Power</td>
<td>Hydro-Elec</td>
<td>Elec</td>
<td>128.70</td>
<td>128.70</td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Hydro-Carbon</td>
<td>Elec</td>
<td>265.20</td>
<td>2,381.70</td>
<td>89%</td>
</tr>
<tr>
<td>Nuclear Electric Power</td>
<td>Nuclear</td>
<td>Elec</td>
<td>193.50</td>
<td>193.50</td>
<td>0%</td>
</tr>
<tr>
<td>Net Interstate Flow of Electricity</td>
<td>Hydro-Carbon</td>
<td>Elec</td>
<td>805.60</td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td><strong>Total Energy Budget</strong></td>
<td></td>
<td></td>
<td><strong>2,352.80</strong></td>
<td><strong>7,193.50</strong></td>
<td><strong>67.3%</strong></td>
</tr>
</tbody>
</table>

65.1% Imported Hydrocarbons
Coal, Crude, Gas.

70.3% Imported Elec.

Source: EIA [http://www.eia.gov/state/?sid=CA](http://www.eia.gov/state/?sid=CA)

### Answer

Every State cannot “import” 2/3 of their energy.
California enjoys a very high % of Electricity from Solar & Wind & also has one of the highest cost of electricity, close to double the cost per KWh in Louisiana.
Federal Energy “Tax Breaks”

Costs of Energy-Related Tax Preferences, by Type of Fuel or Technology, 1985 to 2015

Billions of 2015 Dollars

Counting only Tax policies unique to Oil & Gas (the Revenue based depletion allowance) – Fossil Fuel Federal Subsidies = ~10.8% of the total Federal Energy “Tax Breaks”

3.5 Bln Fossil Fuel "Tax Breaks"

- Pollution Control
- Clean Coal, Nat Gas, G&G
- Intang Drilling T.C.
- Depletion Expense
Let’s Look at the Calif – Electric Vehicle CO₂ & $ “Budget”

If we use more electricity in our cars where will those electrons come from?
- Import more coal - Y
- More Nat Gas - Y
- More renewables - ~OK

How much CO₂ will be generated to get those electrons (KWHrs) to my house or charging station? (IPCC & EIA)

Do I trade in my 35 MPG Accord for a Tesla Model 3 in Calif. to reduce CO₂?

Info from Tesla Website, My Tesla Model 3 needs 16.6 KWH of electricity to go 50 miles.

To get that 16.6 KWH in Ca 21.6 Lbs of CO₂ will be produced.

The electricity that comes out of the wall in Ca adds 1.3 lbs of CO₂ per KWH?

If I can get 35 MPG in my Honda Accord I will use 1.4 gal of gas and put 28 lbs of CO₂ into the air.

If I live in Ca and I want to reduce CO₂ then…..yes ….I trade in my Honda for a Tesla if I have the time and the $$. 

California Electricity Sources

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Ca In-State Gen (GWh)</th>
<th>In-State Gen % of Ca</th>
<th>Imported (GWh)</th>
<th>Ca Energy Mix (GWh)</th>
<th>Ca Power Mix (GWh)</th>
<th>Growth?</th>
<th>Used for Future Elec Vech?</th>
<th>Lbs CO₂/KWH</th>
<th>9% Incl Trans Loss</th>
<th>Wgtd Avg Lbs CO₂/KWH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal (HC)</td>
<td>324</td>
<td>0.2%</td>
<td>11,683</td>
<td>12,006</td>
<td>4.1%</td>
<td>Yes*</td>
<td>4.1%</td>
<td>3.03</td>
<td>3.31</td>
<td>0.170</td>
</tr>
<tr>
<td>Large Hydro</td>
<td>24,410</td>
<td>12.3%</td>
<td>5,271</td>
<td>29,681</td>
<td>10.2%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas (HC)</td>
<td>98,831</td>
<td>49.9%</td>
<td>7,161</td>
<td>105,992</td>
<td>36.5%</td>
<td>Yes</td>
<td>36.5%</td>
<td>1.21</td>
<td>1.32</td>
<td>0.598</td>
</tr>
<tr>
<td>Nuclear</td>
<td>18,931</td>
<td>9.6%</td>
<td>7,739</td>
<td>26,670</td>
<td>9.2%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil (HC)</td>
<td>37</td>
<td>0.0%</td>
<td>0</td>
<td>37</td>
<td>0.0%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td>2.38</td>
</tr>
<tr>
<td>Other - Petroleum (HC)</td>
<td>394</td>
<td>0.2%</td>
<td>0</td>
<td>394</td>
<td>0.1%</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td>2.38</td>
</tr>
<tr>
<td>Renewables</td>
<td>55,300</td>
<td>27.9%</td>
<td>18,662</td>
<td>73,961</td>
<td>25.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biomass</td>
<td>5,868</td>
<td>3.0%</td>
<td>684</td>
<td>6,553</td>
<td>2.3%</td>
<td>Yes</td>
<td>2.3%</td>
<td>2.74</td>
<td>2.99</td>
<td>0.084</td>
</tr>
<tr>
<td>Geothermal</td>
<td>11,582</td>
<td>5.8%</td>
<td>1,134</td>
<td>12,717</td>
<td>4.4%</td>
<td>Yes</td>
<td>4.4%</td>
<td>1.21</td>
<td>1.32</td>
<td>0.008</td>
</tr>
<tr>
<td>Small Hydro</td>
<td>4,567</td>
<td>2.3%</td>
<td>230</td>
<td>4,796</td>
<td>1.7%</td>
<td>Yes</td>
<td>1.7%</td>
<td>0.09</td>
<td>0.10</td>
<td>0.002</td>
</tr>
<tr>
<td>Solar</td>
<td>19,783</td>
<td>10.0%</td>
<td>3,791</td>
<td>23,574</td>
<td>8.1%</td>
<td>Yes</td>
<td>8.1%</td>
<td>1.59</td>
<td>1.70</td>
<td>0.017</td>
</tr>
<tr>
<td>Wind</td>
<td>13,500</td>
<td>6.8%</td>
<td>12,822</td>
<td>26,321</td>
<td>9.1%</td>
<td>Yes</td>
<td>9.1%</td>
<td>1.21</td>
<td>1.32</td>
<td>0.005</td>
</tr>
<tr>
<td>Unspec Grid Sources (HC)</td>
<td>N/A</td>
<td>N/A</td>
<td>41,825</td>
<td>41,825</td>
<td>14.4%</td>
<td>Yes</td>
<td>14.4%</td>
<td>2.12</td>
<td>2.32</td>
<td>0.414</td>
</tr>
<tr>
<td>Total</td>
<td>198,227</td>
<td>100.0%</td>
<td>290,567</td>
<td>290,567</td>
<td>100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80.5%</td>
</tr>
</tbody>
</table>

Raw Data Source: US EIA Annual Energy Review 2016

Tesla 3 “Fuel” Lbs CO₂ Per KWH Gasoline 35 MPG 19.6 PPG % Less CO₂

<table>
<thead>
<tr>
<th>Miles Traveled</th>
<th>Charge Time (Hrs)</th>
<th>Tesla 3 &quot;Fuel&quot; kWh</th>
<th>Lbs CO₂ Per KWH</th>
<th>Gasoline 35 MPG 19.6 PPG</th>
<th>% Less CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1.7</td>
<td>1.7</td>
<td>16.6</td>
<td>21.6</td>
<td>28.0</td>
</tr>
<tr>
<td>100</td>
<td>3.5</td>
<td>3.5</td>
<td>33.3</td>
<td>43.3</td>
<td>56.0</td>
</tr>
<tr>
<td>150</td>
<td>5.2</td>
<td>5.2</td>
<td>49.9</td>
<td>64.9</td>
<td>84.0</td>
</tr>
<tr>
<td>200</td>
<td>6.9</td>
<td>6.9</td>
<td>66.6</td>
<td>86.5</td>
<td>112.0</td>
</tr>
<tr>
<td>250</td>
<td>8.7</td>
<td>8.7</td>
<td>83.2</td>
<td>108.2</td>
<td>140.0</td>
</tr>
<tr>
<td>300</td>
<td>10.4</td>
<td>10.4</td>
<td>99.8</td>
<td>129.8</td>
<td>168.0</td>
</tr>
</tbody>
</table>

@ 60 MPH Charge time = 2x Drive Time
Computerized Commodities

Automated trading is becoming more popular in markets like energy, metals and agriculture. That’s helping fuel investments into commodity trading advisors (CTAs), hedge funds that often use computer programs to bet on market trends.

*Share of futures trading that is automated*

- Foreign exchange: 80%
- Equities: 75%
- Interest rates: 70%
- Energy: 65%
- Metals: 60%
- Agriculture: 55%

*Investment flows*

- CTAs: $60 billion
- All hedge funds: $40 billion

Sources: CFTC (share); Preqin (investment flows)

THE WALL STREET JOURNAL.
EVs Vs MVs

• Disclaimer: I am a Space x and Tesla fan. Unlike normally funded government programs, Elon Musk has demonstrated that you can run a company entirely on government subsidies and actually produce something useful (but not for profit).

• Myth: Electric vehicles will overtake the motor vehicle market by 2030

• Truth: Data suggests that EVs are not yet competitive. We will use Tesla information because they are truly the EV market leader.

• Using Telsa’s website: https://www.tesla.com/charging. We can develop a table to more easily understand what the Model 3 claims, I adjusted a few variables to make this work for a 2017 Honda Accord Comparison

<table>
<thead>
<tr>
<th>Miles Traveled</th>
<th>Charge Time (min)</th>
<th>kWh</th>
<th>eCost</th>
<th>gCost</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>104</td>
<td>16.64</td>
<td>$ 2.00</td>
<td>$ 4.33</td>
</tr>
<tr>
<td>100</td>
<td>208</td>
<td>33.28</td>
<td>$ 3.99</td>
<td>$ 8.67</td>
</tr>
<tr>
<td>150</td>
<td>312</td>
<td>49.92</td>
<td>$ 5.99</td>
<td>$13.00</td>
</tr>
<tr>
<td>200</td>
<td>416</td>
<td>66.56</td>
<td>$ 7.99</td>
<td>$17.33</td>
</tr>
<tr>
<td>250</td>
<td>520</td>
<td>83.2</td>
<td>$ 9.98</td>
<td>$21.67</td>
</tr>
<tr>
<td>300</td>
<td>624</td>
<td>99.84</td>
<td>$11.98</td>
<td>$26.00</td>
</tr>
</tbody>
</table>
EVs Vs MVs

• At a first glance the data looks great! Tesla will save the average car driver at least 50% in energy cost!

• Lets take a look at life cycle cost. Side by side lowest Model 3 base vs Honda Accord base:

<table>
<thead>
<tr>
<th></th>
<th>2017 Honda Accord Sedan</th>
<th>Tesla Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSRP</td>
<td>$22,500.00</td>
<td>$35,000.00</td>
</tr>
<tr>
<td>mpg City</td>
<td>27</td>
<td>mpg City eq</td>
</tr>
<tr>
<td>Range miles</td>
<td>459</td>
<td>Range miles</td>
</tr>
<tr>
<td>Fill up time</td>
<td>15 min / 4.59 mile</td>
<td>Charge time</td>
</tr>
</tbody>
</table>

• mpg equivalence was calculated as follows:
  
  \[(\text{mpg Honda Accord}) \times (\text{gCost/eCost})\]

• Now we can do a NPV equivalence based solely on mileage. How many miles do I have to drive to a Tesla Model 3 to actually save money assuming I pay for either vehicle in full on day 1? Using an interest rate of 4% APR and driving an average of 88 miles a day or 30,000 miles per year.

362,500 miles before I Break Even
• Ok so I lose money. The Tesla is still cool and I still want one. Lets look at other stats:

• The base model S will take me 7 hours to charge from a full drain on my normal house charger. I could upgrade to the $45,000 model and get 300 miles per charge but that will take 10 hours.

• Supercharging stations exist in my state. This will come in handy, 30 minutes for 170 miles! Great improvement.

• Supercharging station density: 6 in Louisiana.

• There are at least 6 gas stations within 2 miles of my house. And I can get a beer there. I wish I had auto pilot but I can wait 2 miles to open it.
Deepwater is the most competitive in terms of profitability, but as per Wood MacKenzie is not as large as other opportunities. True or False?
Hydrocarbon Basics & the Value of US Light “Crudes”

“Crude Oil” is a crude mixture of hydrocarbon chains from Methane (1) to Tetraoctane (40)

- Methane $\text{CH}_4$
- Ethane $\text{C}_2\text{H}_6$
- Propane $\text{C}_3\text{H}_8$
- Butane $\text{C}_4\text{H}_{10}$
- Pentane $\text{C}_5\text{H}_{12}$

Light weight Crudes and Condensates are blended with Heavy Crudes for ease of transport, refining yields and overall utility of the final oil mixture.

US Crudes from the GOM along with condensates and the very light “Shale Oils” are ideal for blending with heavy crudes in Canada and S America.
What if.....the rest of the world starts Fracking?

- Potential US “dominance” in oil would be mitigated by similar shale oil developments on a global basis.
- Possible – Yes. Likely - No
Why the USA is the Fracking leader and is likely to continue.

- **The USA mineral rights/ownership model is unique in the world.** In virtually all countries around the world, the owner of the surface land – be it a house or farmland – has absolutely no rights with regards to mineral ownership.
- Not so in the US – Land Ownership – **61% of US Land & Minerals are privately held** and the landowner/mineral rights owner owns the minerals. The individual shares in the financial returns associated with oil and gas development.
- Canada has equally impressive shale oil/gas resources, however only 9% of the Canadian mineral rights are privately held.
- With little to no financial incentive to deal with the temporary surface impacts associated with drilling and production **outside the US**, there is also relatively **little global support for fracking** and oil and gas development.
- The mineral rights structure in the US supports a **diverse range of oil and gas companies** that work in competitive as well as a complimentary modes. Outside the US the oil and gas industry is dominated almost entirely by large corporations and national oil companies.
- The end result is the **US enjoys the most diverse, efficient and safe oil and gas industry in the world.**
- Rotary drilling on land & offshore drilling started and remain to a large degree US based*. The Fracking revolution will follow the same US led path.

Thus, a reserves position based on onshore fracking is likely to remain a globally competitive advantage for the US.
**Peak oil**, an event based on M. King Hubbert's theory, is the point in time when the maximum rate of extraction of petroleum is reached, after which it is expected to enter terminal decline. **Peak oil** theory is based on the observed rise, peak, fall, and depletion of aggregate production rate in oil fields over time.

The physics on a “field level”, works on a global level as well...........thus Peak Oil is a FACT.

However, in physics, boundary conditions are important.

Peak Oil only applies to a given Technology set applied to a defined or bounded Resource.
Peak Oil – FACT or FICTION?

1970
Conventional reservoir & conventional technology “PEAK OIL”

2XXX
UnConventional Reservoir & New Technology “PEAK OIL”
“We can only drill for what we can see, we can only produce what we can get to flow.”

Once we have maximized both we will then truly reach PEAK OIL.

What can we see? – as deep and as far as the seismic will allow – which is always changing.

What can we drill for?  
With rotary steerable computerized drilling tools and fully robotic state of the art rigs we can drill what we can see – to 40,000’. We can drill to the full range of the oil provinces in the earth.

What can we produce – with fracking technology we can produce significant oil from a range of resources, onshore and offshore.

ADD it all up and you have…..a different future.
As a nation we can
• be energy independent…
• reduce cash flow to hostile regions…..
• provide Increased job and career opportunity for our youth…..
• resulting in………..
Global Oil - Consumption & Prices 1980 - 2016

- North America
- Central & South America
- Europe
- Eurasia
- Middle East
- Africa
- Asia & Oceania
- World
- Avg Oil Price

FACT - For 30 Years Global Oil Consumption has Increased consistently by 1.5%/Yr

FACT - Only Global Recession has slowed the increase in Global Oil Consumption

In the current oil price "bust" can production continue to oversupply or even meet the demand? Probably Not

Whether you use a Time Weighted Avg Oil Price, or a Global Demand "Eyeball" Average Oil Prices over the long term should average $50-$70 $/Bbl
May 2016 – US Rig Count (Offshore & Onshore combined), reached record lows at ~ 404 383 – Land Rigs 21 - Offshore
US Offshore Rigs...Same Story...Lowest rig count in History

Offshore the Active Rig Count Decrease is even more dramatic
Only 20 – Offshore Rigs June ‘16

Which Company will drill the most new wells in the Offshore US in 2016? Answer: LLOG
NO – Working Rig Count has dropped dramatically, but production is steady to increasing….in fact.