How much energy do we need?
What kind of energy mixes are possible and sustainable?
How much will they cost?
What kind of jobs are made with each type?

The Cost of Energy
- national pricing
- local jobs

Dr. James Conca, Director
Center For Laboratory Science
RJLee Group, Pasco, WA

The National Conference of State Legislators
Chicago, IL
August 2012

http://blogs.forbes.com/jamesconca/
Global Energy Distribution

as indicated by nighttime electricity use
**United States**
35% coal
32% gas
19% nuclear
7% hydroelectric
4% biomass   3% other

**Washington**
11% coal
8% gas
10% nuclear
64% hydro
7% other

**Indiana**
94% coal
3% gas
0% nuclear
3% other

**Illinois**
48% coal
2% gas
48% nuclear
2% other

**European Union**
32% coal
18% gas
30% nuclear
11% hydroelectric
6% oil   3% other

**Korea**
10% coal
20% gas
0% oil
70% nuclear (GenIII/IV) by 2040

**China**
30% coal
20% gas
30% nuclear (GenIII/IV)
10% hydro
10% renewables
In order to address any of the environmental issues we seem to care about:

- Over 20 trillion kWhrs must be non-fossil fuel.
- The present fossil fuel contribution is 2/3 of the present total.

World presently at 15 trillion kWhrs/year
U.S. presently at 4 trillion kWhrs/year
1.6 billion people have no access to electricity, 80% of them in South Asia and sub-Saharan Africa.
2.4 billion people burn wood and manure as their main energy source.
3 billion more people will be born by 2040

Source: ©2005 Kay Chernush for the U.S. Department of State
80% of the world's population of over 6 billion people is below 0.8 on the U.N. Human Development Index (HDI).

Source: United Nations Development Program; McFarlane 2006
How much energy do we need by 2040? - what levels are needed to end poverty, war and terrorism, i.e., raise everyone up to 0.8 HDI?

<table>
<thead>
<tr>
<th>Subpopulation group</th>
<th>Energy/capita needed to raise HDI to &gt;0.8 or maintain at 0.9</th>
<th>Approximate subpopulation</th>
<th>Annual energy requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrialized world -</td>
<td>cut to 6,000 kWhrs/yr</td>
<td>1,000,000,000</td>
<td>6 tkW-hrs</td>
</tr>
<tr>
<td>Intermediate -</td>
<td>maintain 3,000 kWhrs/yr</td>
<td>1,000,000,000</td>
<td>3 tkW-hrs</td>
</tr>
<tr>
<td>Developing world -</td>
<td>increase to 3,000 kWhrs/yr</td>
<td>4,000,000,000</td>
<td>12 tkW-hrs</td>
</tr>
<tr>
<td>Those born by 2040 -</td>
<td>achieve 3,000 kWhrs/yr</td>
<td>3,000,000,000</td>
<td>9 tkW-hrs</td>
</tr>
</tbody>
</table>

**Total Annual Global Energy Requirement** 30 tkW-hrs
This requires renewables and nuclear worldwide to quadruple over what anyone is expecting by 2040: 4 million+ MW wind turbines; over 1,700 new nuclear reactors; a 100 bbl of biofuels; 3 tkWhrs from hydro; 4 tkWhrs from other.
Dramatic increase in natural gas in the developed world, coal in the developing world, and exploitation of unconventional fossil fuels.

The most likely scenario given the direction of present investment, development and policy and exploitation of unconventional fossil fuels.

**Present Energy Distribution (Power)**
- World (2010): 15 tkWhrs/yr
  - oil: 39%
  - coal: 17%
  - gas: 20%
  - nuclear: 15%
  - hydro: 8%
  - renewables: 1%

**Present Energy Distribution (Transportation)**
- World (2010)
  - petroleum: 95%
  - bio: 5%
  - other: 0%

**An Industry Energy Distribution by 2040 (Power)**
- World (2040): 30 tkWhrs/yr
  - oil: 40%
  - gas: 23%
  - nuclear: 15%
  - hydro: 12%
  - renewables (geo+solar+wind): 3%

**An Industry Energy Distribution by 2040 (Transportation)**
- Petroleum fuels (including H for fuel cells)
- Coal to gasoline
- Biofuels and others
- Unconventional fossil (oil shale, tar sands, heavy oils)
U.S. Target → a Third, a Third and a Third - 1/3 fossil fuel, 1/3 renewables and 1/3 nuclear

This requires: 364 new natural gas plants; 125 new coal plants; 137 new GenIII nuclear reactors; 300 bkWhrs/yr from hydro; ($3.4 trillion in capital over 30 years)

500,000 MW wind turbines; 4,000 hundred-MW solar arrays; 10 bbl/yr of biofuels
Levelized Energy Costs for Power – short term pricing

Cost per kW-hour

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>9-11¢</td>
</tr>
<tr>
<td>Gas</td>
<td>6-11¢</td>
</tr>
<tr>
<td>Nuclear</td>
<td>11¢</td>
</tr>
<tr>
<td>Biomass</td>
<td>11¢</td>
</tr>
<tr>
<td>Geothermal</td>
<td>10¢</td>
</tr>
<tr>
<td>Wind on-shore</td>
<td>10¢</td>
</tr>
<tr>
<td>Wind off-shore</td>
<td>25¢</td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>8¢</td>
</tr>
<tr>
<td>Solar</td>
<td>32¢</td>
</tr>
</tbody>
</table>

- Coal: 9-11¢
- Gas: 6-11¢
- Nuclear: 11¢
- Biomass: 11¢
- Geothermal: 10¢
- Wind on-shore: 10¢
- Wind off-shore: 25¢
- Hydroelectric: 8¢
- Solar: 32¢
Actual Production Costs for Power – from existing units

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Cost per kW-hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>4¢</td>
</tr>
<tr>
<td>Gas</td>
<td>6¢</td>
</tr>
<tr>
<td>Nuclear</td>
<td>2¢</td>
</tr>
<tr>
<td>Biomass</td>
<td>5¢</td>
</tr>
<tr>
<td>Geothermal</td>
<td>5¢</td>
</tr>
<tr>
<td>Wind</td>
<td>10¢</td>
</tr>
<tr>
<td>Hydroelectric</td>
<td>4¢</td>
</tr>
<tr>
<td>Solar</td>
<td>10¢</td>
</tr>
</tbody>
</table>
Energy Returned On Investment – 5 to 10 yr return relative to 1 (similar to the value EROEI)

(After: Cleveland et al., 1984, 1999; ASPO 2006)
How much does it cost to build a unit/farm/array that will produce 469 billion kWhrs over its lifespan?

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>0.71</td>
<td>40</td>
<td>90% local</td>
<td>$2.5 billion</td>
<td>Nevada Energy</td>
</tr>
<tr>
<td>$40</td>
<td></td>
<td></td>
<td>$40</td>
<td></td>
<td>90% local</td>
</tr>
<tr>
<td>$16</td>
<td></td>
<td></td>
<td>$16</td>
<td></td>
<td>5-6 years</td>
</tr>
<tr>
<td>$12</td>
<td></td>
<td></td>
<td>$12</td>
<td></td>
<td>4-5 years</td>
</tr>
<tr>
<td>$8</td>
<td></td>
<td></td>
<td>$8</td>
<td></td>
<td>2 years</td>
</tr>
<tr>
<td>$4</td>
<td></td>
<td></td>
<td>$4</td>
<td></td>
<td>&lt; ¼ local</td>
</tr>
<tr>
<td>$2</td>
<td></td>
<td></td>
<td>$2</td>
<td></td>
<td>3 years</td>
</tr>
</tbody>
</table>

Key assumptions for different energy systems from recent builds and buys

- Coal: 0.71, 40 years, 90% local, MW, $2.5 billion, Nevada Energy, 90% local (1 to 6 years)
- Gas: 0.42, 40 years, 5-6 years, MW, $0.82 billion, TVA, 5-6 years
- Nuclear: 0.92, 60 years, 960 MW, $7 billion, Westinghouse, 90% local (5-6 years)
- Wind: ~ half local, 1 year, 1 MW, $0.0015 billion, Shell Wind Division, < ¼ local (2 years)
- Solar: 0.20, 25 years, 92 MW, $0.3 billion, NRG Energy, 90% local (5-6 years)
- Hydro: 0.44, 80 years, 600 MW, $3 billion, Susitna Hydro Project, 90% local (5-6 years)

2011($) Construction Costs to produce similar power (469 bkWhrs)

- Gas: cf = 42%, $3.2 billion
- Coal: 0.71, 40 years, $2.5 billion
- Nuclear: 0.92, 60 years, $7 billion
- Wind: ~ half local, 1 year, $0.0015 billion
- Solar: 0.20, 25 years, $0.3 billion
- Hydro: 0.44, 80 years, $3 billion

These costs produce good-paying, but short-term jobs (1 to 6 years), more local jobs for the baseload sources.

Reference spot prices:
- Oil: $70/b
- Coal: $40/t
- NG: $4/mcf
- Steel: $500/t
- Copper: $2.50/lb
- Cement: $70/t
These costs produce almost no local jobs (unless you’re a fuel supplier)

2011($) Fuel Costs per kWhr Produced
- Coal: $40/t, cf = 71%, 2¢
- NG (Natural Gas): $4/mcf, cf = 42%, 4¢
- U (Uranium): $100/lb yellowcake, cf = 92%, 0.6¢
- Nuclear: cf = 92%, 0¢
- Wind: cf = 27%, 0¢
- Solar: cf = 20%, 0¢
- Hydro: cf = 44%, 0¢

These costs produce almost no local jobs (unless you’re a fuel supplier)
Cents per kWhr

2011($) O&M Costs per kWhr Produced

- **Nuclear**: cf = 92%, 1.3¢
- **Wind**: cf = 27%, 1.0¢
- **Solar**: cf = 20%, 0.1¢
- **Gas**: cf = 42%, 0.5¢
- **Coal**: cf = 71%, 0.6¢
- **Hydro**: cf = 44%, 0.8¢

These costs produce good-paying, long-term local jobs (20 to 60 years) longer-term for the baseload sources.
Jobs Created for Operating Energy Plants

Jobs per 1,000-megawatts of capacity

- Nuclear: 500
- Coal: 220
- Wind: 90
- Natural Gas: 60

Sources: Ventyx and U.S. Department of Energy
But to produce 6.5 tkWhrs/year by mid-century in the United States with the $\frac{1}{2}$ - $\frac{1}{3}$ - $\frac{1}{3}$ mix will cost about $7.4$ trillion of which $3.4$ trillion is capital investment. However, this mix uses half of the fossil fuel (saves 2 billion tons CO$_2$/yr) and the health care savings alone (~$3$ trillion) more than pays for the extra investment.

2011($) Actual Costs per kWhr Produced

- **Coal**: cf = 71%, $4.1¢$
- **Gas**: cf = 42%, $5.1¢$
- **Nuclear**: cf = 92%, $3.5¢$
- **Wind**: cf = 27%, $4.3¢$
- **Solar**: cf = 20%, $7.7¢$
- **Hydro**: cf = 44%, $3.3¢$
The materials, resource and capital needs:

- the price of oil
- the price of natural gas
- the price of steel
- the price of concrete
- the price of copper

The most sensitive to these prices is wind energy, followed by coal, then gas. The least affected is nuclear.

Concrete + steel + copper are > 98% of construction inputs, and become more expensive in a carbon-constrained economy.
So It All Comes Down To Financing 2 to 3 trillion dollars

Must develop financial mechanisms that provide long-term strategies while allowing market forces to function as desired – for small or individual projects (<250k):

innovative financing approaches for energy efficiency and alternative energy installation (offered by utilities, ESCO or local government):

• on-bill financing
  • 0% interest loan – no upfront costs
  • No fees or loan costs
  • Convenient loan repayment through your monthly utility bill

• performance contracting
  • Partner with an ESCO to evaluate strategies/improvements whose savings will fully fund the improvements
    • new lighting technologies, boilers and chillers, energy management controls, swimming pool covers, etc.

• property assisted energy financing
  • Low-interest collateralized loans based on the improved property value paid back to the local government through the property tax bill
So It All Comes Down To Financing 2 to 3 trillion dollars

Must develop financial mechanisms that provide long-term strategies while allowing market forces to function as desired – for big projects, we think government incentives

(Billions of 2010 Dollars)

Source: Management Information Services, Washington D.C.
Work Force Development

According to ANS, Oxford Economics and NEI, a 1,000 MW nuclear reactor results in:

~ 5,000 construction jobs for 5-6 years
~ 1,000 permanent jobs for the life of the plant (60 years)
~ 2,000 indirect jobs in the community for the life of the plant
~ 500 related services such as enrichment, fuel, waste handling, etc.

Energy Efficiency easiest and most locally lucrative path

According to UC Berkeley, energy efficiency standards in California since 1980 resulted in:

~ 1.4 million jobs created
~ per Capita annual energy use dropped from 12,000 to 8,000 kWhrs/yr
~ $44 billion in net savings to households (~ $200/household/yr)
Total Life Cycle Costs (¢/kWhr) for each energy over 60 years

<table>
<thead>
<tr>
<th>Energy</th>
<th>cf</th>
<th>Actual Cost per kWhr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>27%</td>
<td>3.5¢</td>
</tr>
<tr>
<td>Wind</td>
<td>20%</td>
<td>4.3¢</td>
</tr>
<tr>
<td>Solar</td>
<td>44%</td>
<td>7.7¢</td>
</tr>
<tr>
<td>Coal</td>
<td>71%</td>
<td>4.1¢</td>
</tr>
<tr>
<td>Gas</td>
<td>42%</td>
<td>5.1¢</td>
</tr>
<tr>
<td>Hydro</td>
<td></td>
<td>3.3¢</td>
</tr>
</tbody>
</table>

2011($) Actual Costs per kWhr Produced
Environmental and Health Costs

Externalities (other non-direct costs) not included in these costs but may be reflected in upcoming legislation such as Cap & Trade or C-Tax, and Footprint costs. Possible legislation has carbon costs up to $15/ton CO₂ emitted.

The EU has assigned about $100/acre for simple footprint costs.

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>CF (%)</th>
<th>Cost (¢ per kWhr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>92%</td>
<td>0.02¢</td>
</tr>
<tr>
<td>Wind</td>
<td>27%</td>
<td>0.02¢</td>
</tr>
<tr>
<td>Solar</td>
<td>20%</td>
<td>0.08¢</td>
</tr>
<tr>
<td>Gas</td>
<td>42%</td>
<td>0.90¢</td>
</tr>
<tr>
<td>Coal</td>
<td>71%</td>
<td>1.46¢</td>
</tr>
<tr>
<td>CO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydro</td>
<td>44%</td>
<td>0.14¢</td>
</tr>
</tbody>
</table>

\[ 1 \text{ mile}^2 = 36 \text{ miles}^2 
10x = 1.25¢, 1.50¢, 1.75¢, 2.00¢, 1.00¢, 0.75¢, 0.50¢, 0.25¢, 24 \text{ miles}^2 \]

<table>
<thead>
<tr>
<th>Fuel Source</th>
<th>CF (%)</th>
<th>CO₂</th>
<th>Area (sq miles) to produce 1 billion kWhrs/yr</th>
<th>Deaths per 10¹² kWhrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>92%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>27%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar</td>
<td>20%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>42%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>71%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8 grams CO₂ per kWhr

40 deaths per 10¹² kWhr
<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Mortality Rate (deaths per trillion kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal – global average</td>
<td>100,000 (50% of global electricity)</td>
</tr>
<tr>
<td>Coal – China</td>
<td>170,000 (75% of China’s electricity)</td>
</tr>
<tr>
<td>Coal – U.S.</td>
<td>15,000 (44% of U.S. electricity)</td>
</tr>
<tr>
<td>Oil</td>
<td>36,000 (8% of global electricity)</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>4,000 (&lt;0.1% of global electricity)</td>
</tr>
<tr>
<td>Biofuel/Biomass</td>
<td>24,000 (21% of global energy)</td>
</tr>
<tr>
<td>Solar (rooftop)</td>
<td>440 (&lt; 1% of global electricity)</td>
</tr>
<tr>
<td>Wind</td>
<td>150 (~1% of global electricity)</td>
</tr>
<tr>
<td>Hydro – global average</td>
<td>1,400 (15% of global electricity, 171,000 Banqiao dead)</td>
</tr>
<tr>
<td>Nuclear – global average</td>
<td>40 (17% of global electricity w/Chernobyl&amp;Fukushima)</td>
</tr>
<tr>
<td>Nuclear – U.S.</td>
<td>0 (20% of U.S. electricity)</td>
</tr>
</tbody>
</table>

Because the United States takes environmental and health regulations more seriously than most nations, only about 500 people have to die in the U.S. each year to keep the lights on when the electricity is generated from nuclear. But no one than has to die in the U.S. from keeping the lights on in New York, but over 5,000 people have to die each year to keep the lights on in Beijing.
Social - risks facing Americans over the past 5 years

alcohol consumption
automobile driving
coal industry
construction
murder
mining
iatrogenic
nuclear industry
food poisoning
police work
smoking tobacco

The average citizen thinks that smoking and the nuclear power industry are the most dangerous activities in America.
<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of Deaths in U.S. over the past 5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>iatrogenic (medicine gone wrong)</td>
<td>950,000</td>
</tr>
<tr>
<td>smoking</td>
<td>760,000</td>
</tr>
<tr>
<td>alcohol</td>
<td>500,000</td>
</tr>
<tr>
<td>automobile accidents</td>
<td>250,000</td>
</tr>
<tr>
<td>coal use (~50% of U.S. power)</td>
<td>60,000</td>
</tr>
<tr>
<td>murder</td>
<td>80,000</td>
</tr>
<tr>
<td>food poisoning</td>
<td>25,000</td>
</tr>
<tr>
<td>construction</td>
<td>5,000</td>
</tr>
<tr>
<td>police work</td>
<td>800</td>
</tr>
<tr>
<td>mining</td>
<td>360</td>
</tr>
<tr>
<td>nuclear industry (~20% of U.S. power)</td>
<td>0</td>
</tr>
<tr>
<td>Activity</td>
<td>Number of Deaths in U.S. Normalized to Sub-Population</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>1) smoking (43.4 million smokers)</td>
<td>760,000</td>
</tr>
<tr>
<td>2) alcohol (60 million impacted Americans)</td>
<td>500,000</td>
</tr>
<tr>
<td>3) iatrogenic (180 million receive medical treatment per/yr)</td>
<td>950,000</td>
</tr>
<tr>
<td>4) automobile accidents (190 million drivers)</td>
<td>250,000</td>
</tr>
<tr>
<td>5) police work (680,000 police officers)</td>
<td>800</td>
</tr>
<tr>
<td>6) mining (350,000 miners)</td>
<td>360</td>
</tr>
<tr>
<td>7) construction (7.7 million workers)</td>
<td>5,000</td>
</tr>
<tr>
<td>8) murder (300 million impacted)</td>
<td>80,000</td>
</tr>
<tr>
<td>9) coal use (~ 50% of U.S. power) (240 million impacted)</td>
<td>60,000</td>
</tr>
<tr>
<td>10) food poisoning (304 million)</td>
<td>25,000</td>
</tr>
<tr>
<td>11) nuclear industry (~ 20% of U.S. power) (60 million)</td>
<td>0</td>
</tr>
</tbody>
</table>
Even non-lethal routine accidents are dramatically lower in the nuclear industry than in any other industry.
Why is Everyone So Afraid of Nuclear Energy?

1) Incorrect, but intentional, association with nuclear weapons during the Cold War - 1945

2) Inaccurate and overly simplistic modeling of health effects of low radiation doses (LNT) - 1959

3) Misunderstanding of the nature and amount of nuclear power waste - 1976
   • not much of it (< 1 km$^3$ worldwide)
     - over 20,000 km$^3$ of direct solid coal waste
   • we know what to do with it - 1999

Because we told them to be!
Unknown to most, nuclear waste (bomb waste) has been disposed of in massive salt as planned, in the Waste Isolation Pilot Plant. WIPP has shown that geologic disposal of nuclear waste is safe and cost-effective.

Only Defense-generated TRU waste presently permitted between 100 nCi/g and 23 Ci/L of alpha-emitting $^{239}$Pu equivalents.

16 miles$^2$ set aside in the 1992 Land Withdrawal Act - when WIPP is full, only 1/2 mile$^2$ will have been used.
Waste Isolation Pilot Plant

U.S. Department of Energy facility
Designed for permanent disposal of transuranic radioactive waste
2,150 feet deep
At the 2000 lbs/inch² pressure at this depth, the salt exhibits significant creep closure, i.e., the salt completely closes all fractures and openings, even micropores, making the salt extremely tight, such that water cannot move even an inch in a billion years.

13 years of operation – 90,000 cubic meters of TRU waste disposed
430,000 fifty-five gallon drum equivalents
21 storage sites cleaned of legacy waste
zero releases to the environment
zero contaminated personnel
Carbon Footprints
The President’s Blue Ribbon Commission on America’s Nuclear future

Can not pick HLW site but can pick a strategy

Re-iterated that deep geologic disposal is best for nuclear waste disposal

Recommends interim storage for spent nuclear fuel

Recommends a quasi-government entity to execute disposal and storage program - with control of the NWF

Senate Energy and Water Appropriations Subcommittee

April 25 – directs DOE to find a interim site

Salt Provinces in the United States

- Area Underlain by Rock Salt
- Area of Salt Domes or Salt Anticlines
- Delaware – Basin
- least tectonically deformed, thickest, most optimal depths
Some specific policy actions needed:

New Mexico, Washington, South Carolina, ID, TN and NY should form a multi-state compact on their own

Support the formation of a quasi-government entity to execute disposal and storage program as recommended
  - give it full control of the Nuclear Waste Fund

Support interim storage for spent nuclear fuel

Support resumption of the site selection process for a second repository

Support the completion of the Yucca Mt. license review

Make the minor changes necessary to the NWPAct of 1982 and the LWAct of 1992 that will make all of this happen

Begin with defense HLW
  - co-mingle HLW with SNF *in space but not time*
Caution to State Legislatures – don’t legislate ahead of science

- remember the corn ethanol debacle – the worst choice for a biofuel
  - no significant carbon emissions benefit
  - overall damage to the environment
  - adverse affects to the cost of food and to international food supplies to poor countries – 220 million people not fed last year
  - yet state mandates keep growing

- carbon capture and sequestration
  - unlikely to be viable – ever
  - subsurface injection causes geologic instabilities
  - volumes are too large – transmission too difficult
  - costs are too high – not 3¢/kWhr, more like 12¢/kWhr

- Renewable Portfolio Standards –
  - assumes tax credits and subsidies will last forever
  - not considering load-balancing by fossil fuels nor transmission hurdles
  - legislating hydro as not a renewable (!?) - pits renewable against renewable
  - not considering the future mix in siting renewable facilities

- nuclear build moratorium until waste issue solved – bad idea
  - political, not technical issue – we know where to put it, how much it will cost
  - The President’s BRC has set a path forward – very simple and cheap