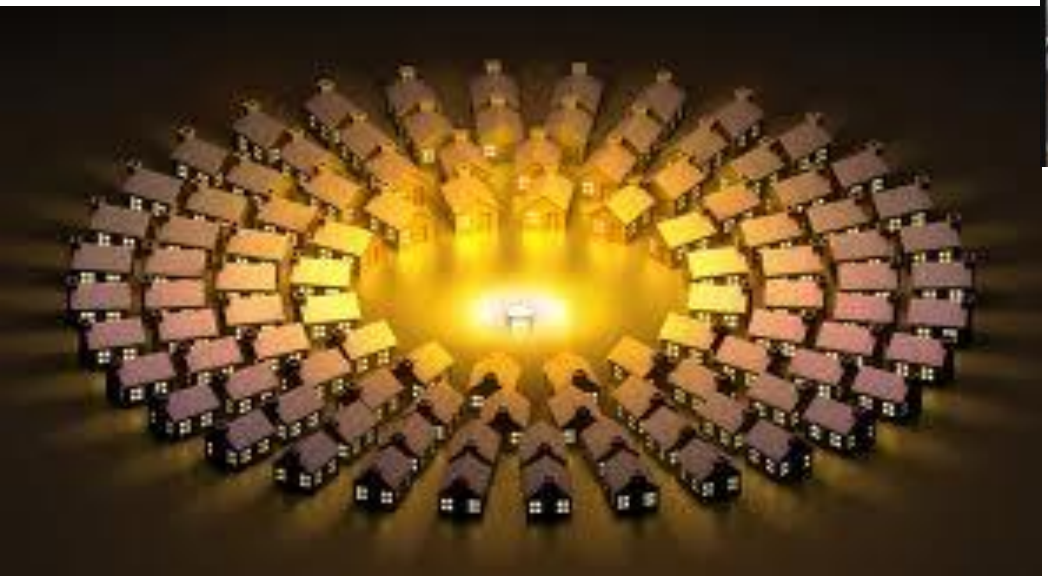
Future of Nuclear – Large or Small?
--Impact on Economic Development

Roundtable / Dinner



Nuclear Energy Insider
SMR *Conference*
--April 24, 2012

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The Nuclear Supply Chain

--What's the New Vision?

SRNL
SAVANNAH RIVER NATIONAL LABORATORY

generation mPower

CLEMSON UNIVERSITY
SOUTH CAROLINA
1889

HIGH BRIDGE ASSOCIATES, INC.

NuHub

Ogletree Deakins

GEN4 ENERGY

FLUOR

DCR

Shaw
a world of Solutions

HOLTEC INTERNATIONAL

UXC

NUSCALE POWER

Exelon

K&L GATES

U.S.NRC

ABS Consulting
AN ABS GROUP COMPANY

National Rural Electric Cooperative Association
A Touchstone Energy® Cooperative

Westinghouse

AAA REZAYAT GROUP

RWE The energy to lead

BTX

Luminant

GENERAL DYNAMICS
Electric Boat

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Why Are We Here?

- Knowledge exchange
  - Status of nuclear revival
  - Challenges for the Supply Chain
- Share insights / perspectives
  - Utilities (demand side)
  - Vendors & suppliers (supply side)
  - Advisors, associations & advocacy groups
- Timely issues with a lot of associated questions
  - Growing electricity demand
  - Natural gas prices
  - Financing issues
  - Fukushima
  - Quality requirements

Key Questions

- How has nuclear power driven economic development?
- How will SMRs impact development in the future?
  - Southeastern U.S.
  - Overall U.S.
  - China, India
  - Developing countries
- How might economic development occur differently in a world of many SMRs?
  - Major countries
  - Remote areas or island economies
- Where would the greatest differences occur?

Key Questions

- How would the generation mix and degree of electrification change?
- What are the competitive issues for SMRs Vs. full-scale reactors Vs. natural gas or coal?
- Could utility industry structure be affected? (REAs, Coops)
- How might huge electricity users be affected?
  - Aluminum
  - Oil sands
  - Desalination
- What will SMR supply chains look like?
- Where should SMRs be manufactured?

Overview

- Today we have 104 NPP plants in the U.S. and 320 in the R.O.W.
- Active New Build is in progress in
  - China, Russia, UK, U.S., U.A.E., Saudi, France, Finland, Poland, Turkey, Vietnam, others
- Economic impact to a region is significant
  - $400 – 500 million in annual O&M spending per year
  - Hundreds of millions to billions in capital spending upgrades
  - Tens of billions for new build
- Low cost, clean electricity provides tremendous stimulus for regional economic development
- Because nuclear provides baseload power, it will continue to have an important role in the future generation mix

Large Vs. Small Reactors

- While large NPPs offer many advantages, they are not suitable for many situations
  - Too large for some electric grids
  - Huge front end capital expenditures
- Small modular reactors
  - Offer smaller output
  - Incremental growth units
  - Lower capital investment
  - Factory-built – economies of mass production
  - May replace coal plants

Small Modular Reactors

- Different economic profile
  - Lower capital cost (spread over time)
  - Decentralized generation?
  - What about O&M expenditures?
  - Employment?
  - Lower transmission infrastructure cost?
  - Impact on “all in” electricity costs?
- SMR Factory
  - How large?
  - Capital expenditure
  - Output and economic value
  - Employment

SMR Future

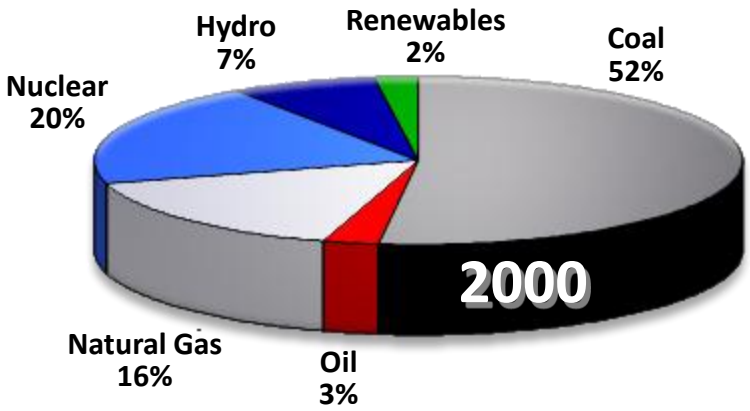
- What would a world of many SMRs look like?

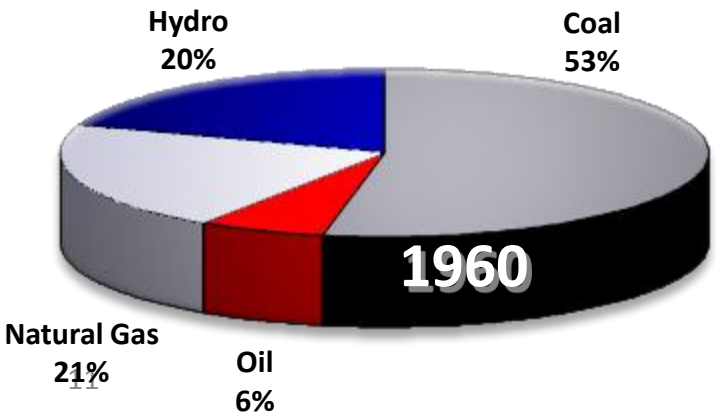
SMR Future

- How would the generation mix be affected?
  - Will there be more nuclear generation as a result?
  - Will having mass production lower capital costs?
  - Will having greater numbers of reactors lower operating costs?
- How would having more decentralized generation impact costs?

Future Generation Mix?

- U.S. Generation mix changes over time
- Nuclear share from zero to 20%
- Global growth expected





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SMRs for Military

- What are advantages – disadvantages?

SMR Impact on Utility Structure

- Considerations for REAs, Municipalities, Coops

SMRs for Industry

- Large Electricity Users
  - Aluminum
  - Oil sands (Canada)
  - Desalination
    - Use heat directly?
    - Use electricity?

Supply Chain Perspective

- What would be different for the SMR S-C?
  - Thousands of components, assemblies, devices, services
  - High barriers to entry: Nuclear Quality Requirements
    - NQA-1
    - Commercial Grade Dedication
- Sourcing
  - Local suppliers possible?
  - Limitations due to high quality requirements and specifications; local not always possible?
  - Examples from traditional large nuclear:
    - Forged reactor vessels from Japan Steel Works (JSW)
    - Software from Invensys (U.S.)
    - Pumps, valves, controls from Curtiss Wright (U.S.)

Manufacturing Locations

- U.S.
- Global

"xxx"

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Appendix

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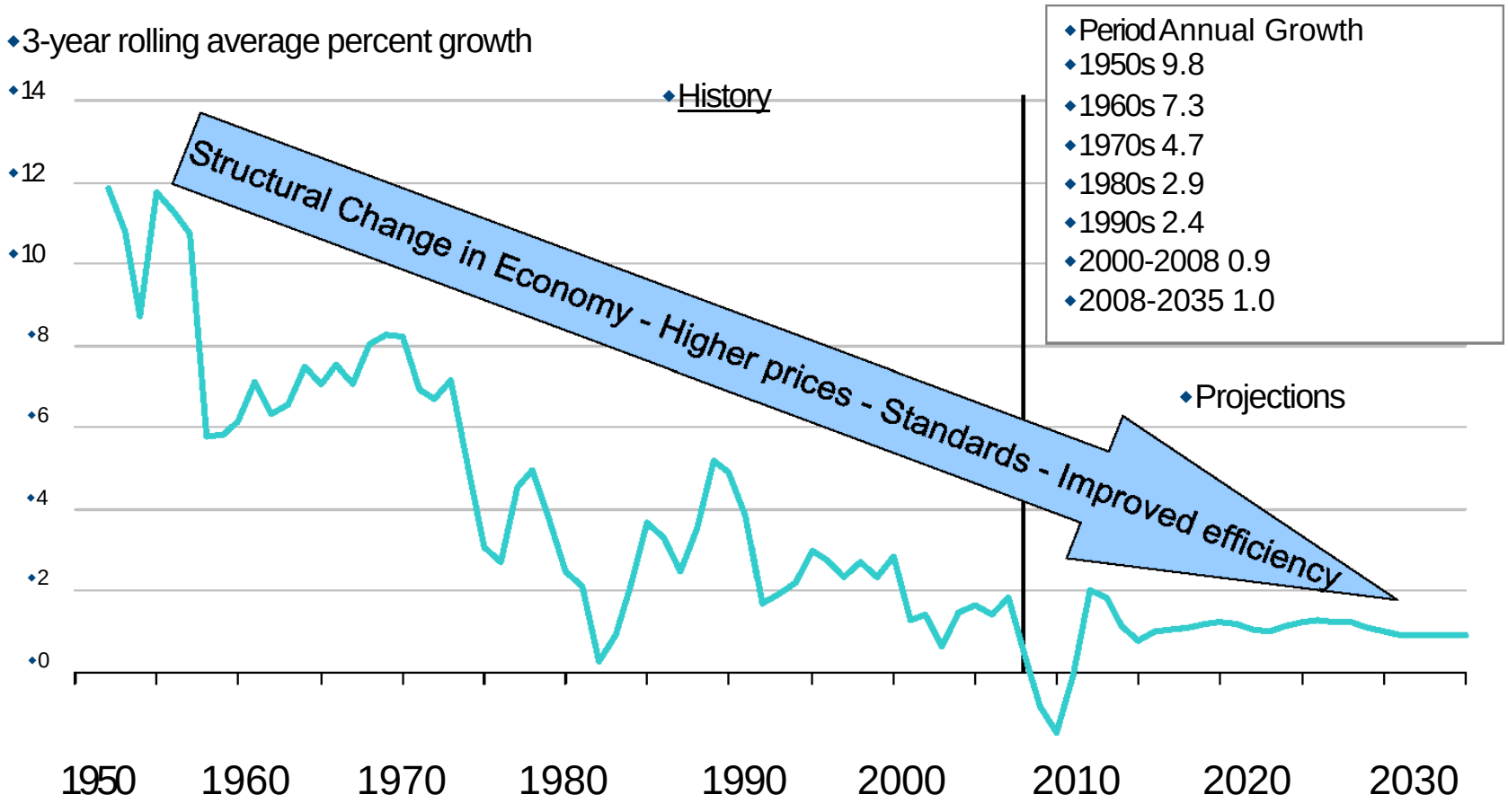
U.S. Electricity Use Growth – Slowing



Period	Annual Growth
1950s	9.8
1960s	7.3
1970s	4.7
1980s	2.9
1990s	2.4
2000-2008	0.9
2008-2035	1.0

John Conti, USDOE, April 6th, 2010Source: *Annual Energy Outlook 2010*

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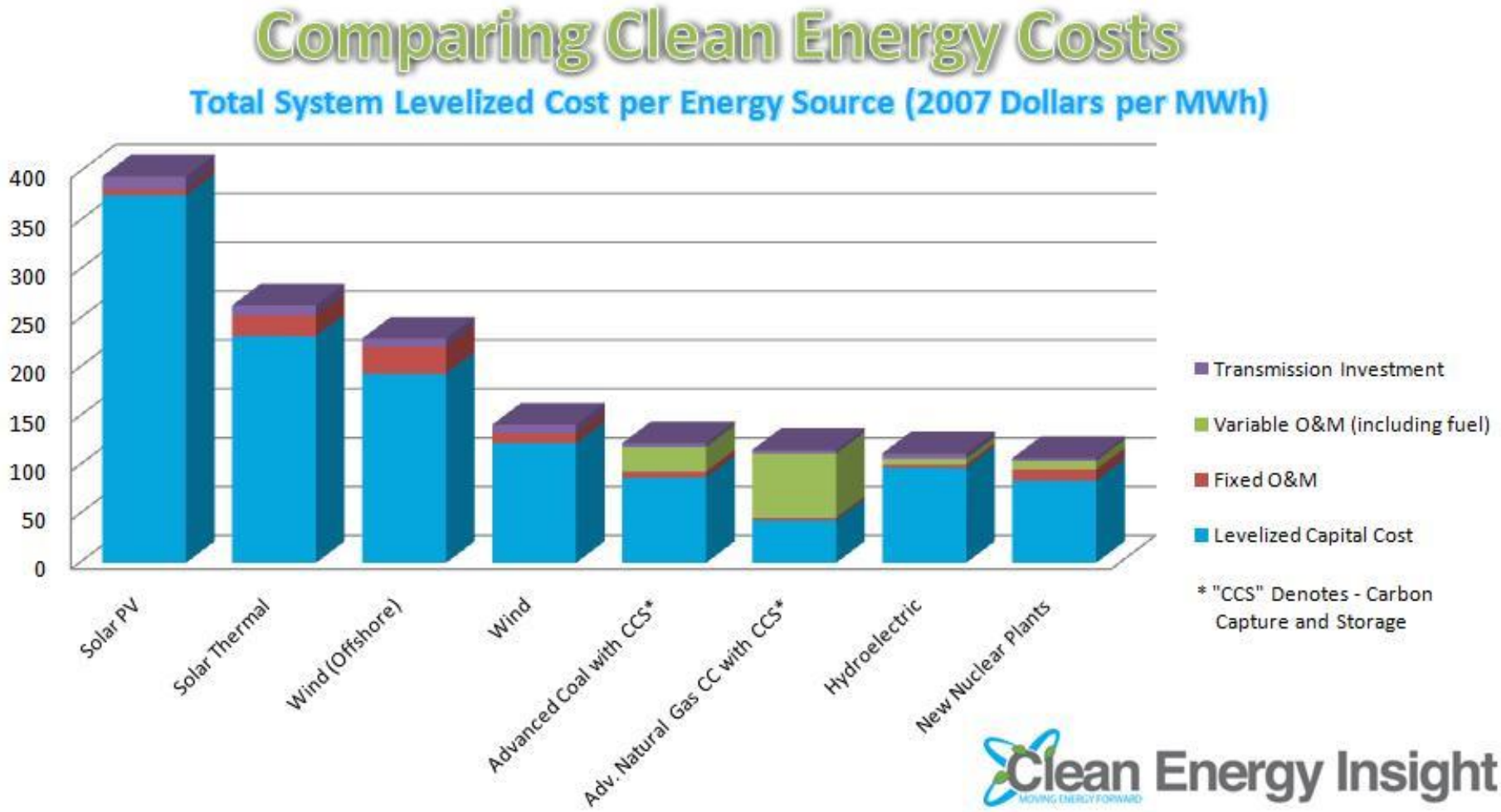
Comparing Generation Costs



Clean Energy Insight

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Global Growth is Likely

WNA NUCLEAR CENTURY OUTLOOK

MAJOR NUCLEAR PROGRAMMES*	2008	2030 Low	2030 High	2060 Low	2060 High	2100 Low	2100 High
Units - 1GWe							
Belarus	0	2	5	5	8	5	10
Belgium	6	6	8	8	10	8	22
Brazil	2	10	30	40	100	70	330
Bulgaria	2	4	7	5	7	5	7
Canada	13	20	30	25	40	30	85
China	9	35	100	150	750	500	2800
Czech Republic	3	5	7	5	12	5	15
Finland	3	5	7	8	10	8	11
France	63	65	75	80	110	80	130
Germany	20	20	50	40	80	80	175
Hungary	2	4	5	4	8	5	12
India	4	20	70	60	350	200	2750
Japan	48	55	70	80	140	80	200
Lithuania/ Latvia/ Estonia	1	4	6	5	8	5	8
Netherlands	1	1	5	7	20	10	35
Romania	1	4	10	5	20	10	25
Russia	22	30	70	75	180	100	200
Slovakia	2	3	4	4	5	5	7
Slovenia	1	1	1	1	2	1	2
South Korea (and North Korea)	18	25	50	45	80	70	145
Spain	7	8	20	20	50	25	60
Sweden	9	10	15	10	18	10	18
[illegible]					10	5	11

Source: World Nuclear Association Website

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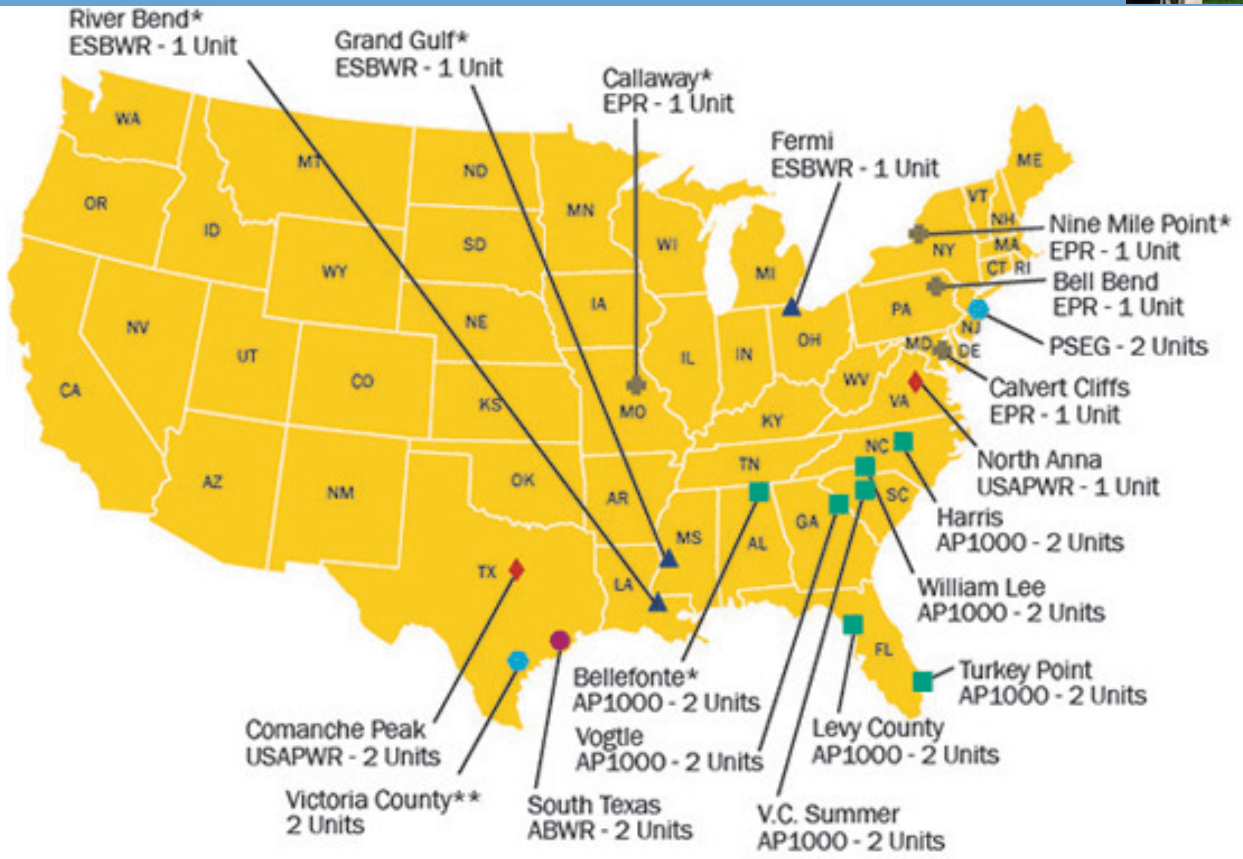
Scenarios for Nuclear Power

Proposed Reactors – How Many?



*Review Suspended by Applicant

** COL Application Amended by Applicant to ESP on 03/25/2010

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Scenarios for Nuclear Power

Proposed Reactors – How Many Likely 5 Years?

X = Significant Postponement (Linton Assessment)

ABWR ■ AP1000 ✚ EPR ▲ ESBWR ♦ USAPWR ▽ Design/Units - TBA ● ESP

*Review Suspended by Applicant

** COL Application Amended by Applicant to ESP on 03/25/2010

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Scenarios for Nuclear Power

Operating Reactors - 104

"Fukushima" upgrades to cost Billions?

"Operating plants spend $400 million for goods and services per year"

"It will cost Billions to fix Crystal River"

U.S. Commercial Nuclear Power Reactors—Years of Operation

Years of Commercial Operation	Number of Reactors
△ 0-9	0
▲ 10-19	10
▲ 20-29	42
▲ 30-39	52

Source: U.S. Nuclear Regulatory Commission

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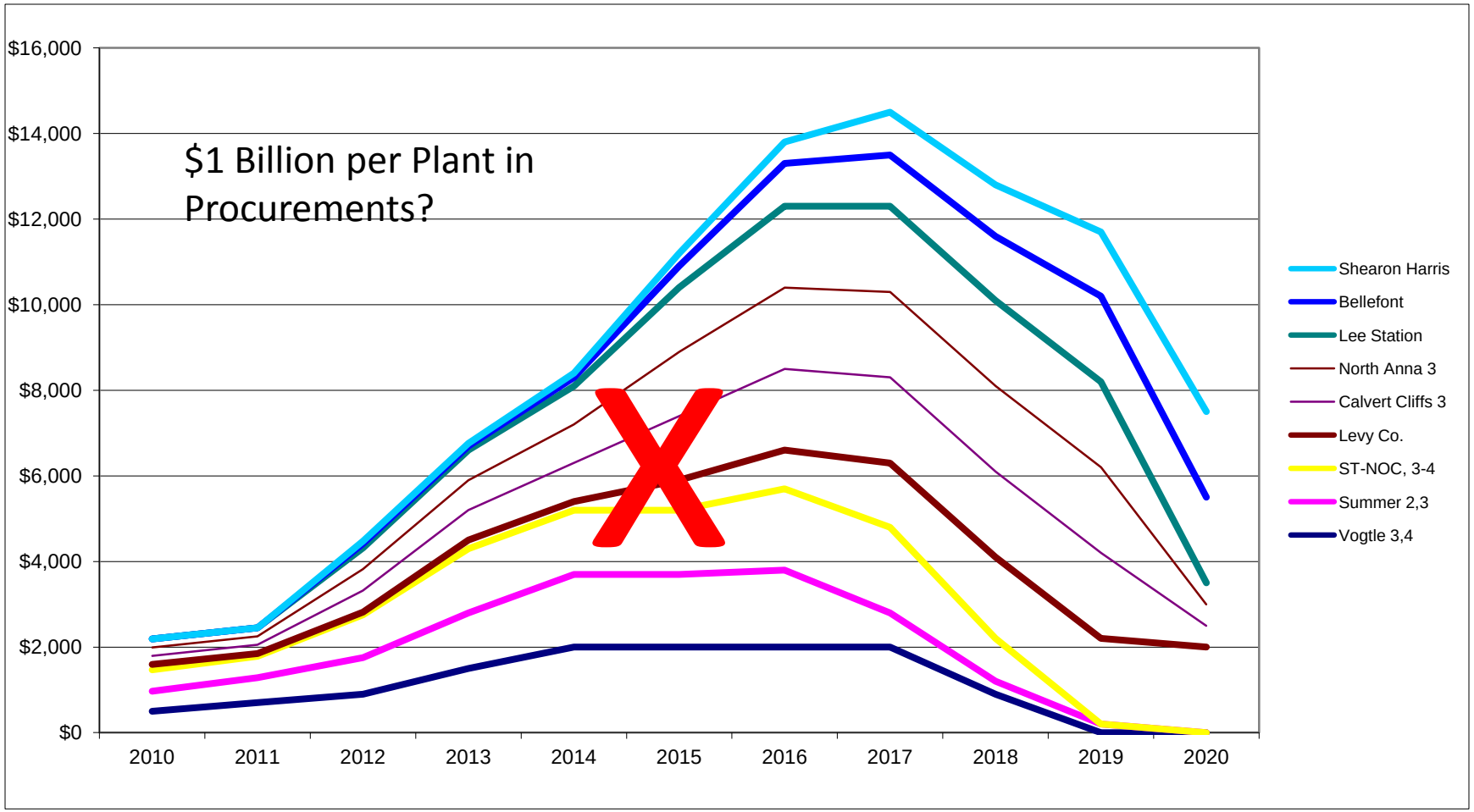
Nuclear Plant Capital Spending
$8 - 10B Supplier Market to 2020 ?



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U.S. Electricity Markets

- Regulated (especially in Southeast)
  - Traditional utilities, regulated monopolies
    - Southern, SCANA, DTE, Dominion, Duke, Progress, FPL
    - Exelon, Entergy (have both)
  - PUCs closely monitor & control
  - Can get LGs and CWIP (in favorable states)
- Unregulated, competitive (NE, MW, Texas)
  - Merchant companies, no guaranteed returns
    - Constellation
    - NRG
    - Exelon, Entergy (Have both)
  - Can't get CWIP; must have LGs

"Are we seeing the merchant market leading to short term decisions that are not in the public's best interest?"
--Utility Financial Officer

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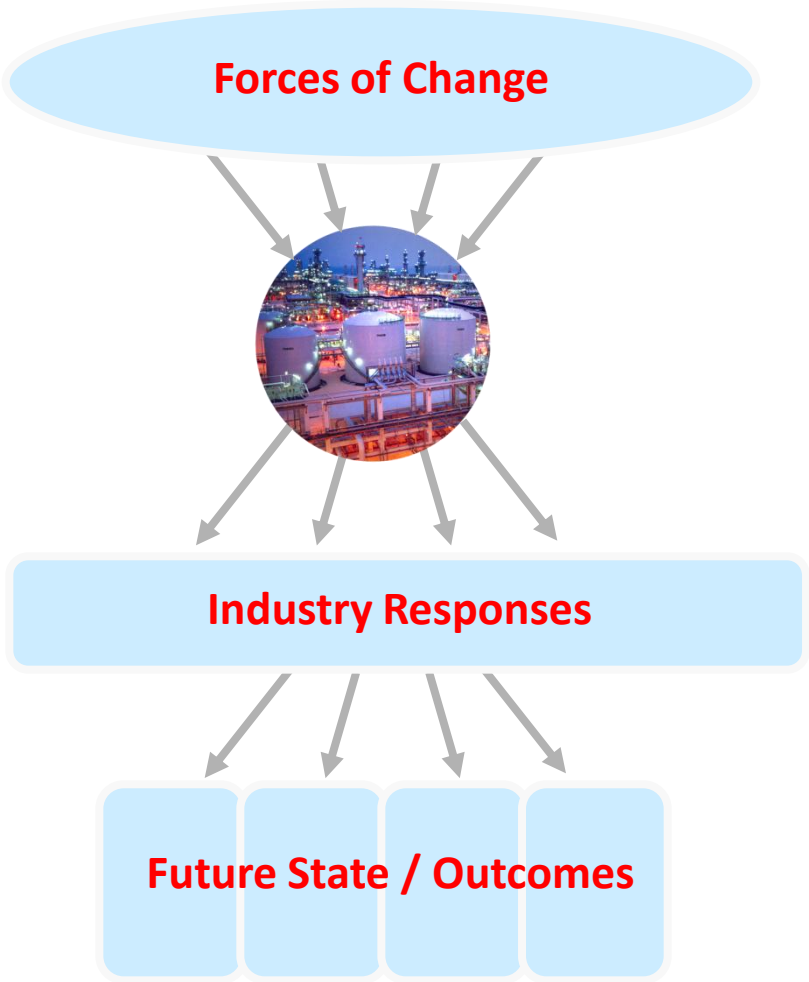
Insights for Industry and Government

Who Is Linton Consulting?

- A professional practice providing independent insights and advisory services to industry and government
- Focus: Energy, Power, Nuclear
- Business strategy, market development, diversification, trend analyses, scenarios and visioning
- Executive relationships and introductions
- Strategic View
  - Process develops high level insights on the future state
  - Ongoing analyses and executive interviews
  - *Strategic View* Nuclear out Q3 / 2012
- Services leading to sound business strategies, decisions, plans and implementation

What is *Strategic View*?

- Research model
  - Used 15 years; 5 in energy
  - Forces affecting the future of the energy industry
  - Industry responses
  - Where it is leading – the future state/outcomes
- Process
  - Interviews with executives and thought leaders
  - Research & analysis
  - Executive Roundtable
  - Follow up & plan integration



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Executive Roundtables

- Common purpose
  - Convene executives and thought leaders for knowledge exchange
  - Expand understanding
  - Share perspectives
  - Confirm/challenge paradigms
  - Advise leadership
  - Uncover ideas and opportunities for your organization
  - Explore Future – trends and challenges
  - Establish practical, realistic path forward

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