



SMR - Financial Perspectives

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Plenary I - SMR Business Case

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Insight in Economics™

Disclaimer



The slides that follow do not provide a complete record of this presentation and discussion.

The views expressed in this presentation and discussion are mine and may not be the same as those held by my clients or my colleagues.

Many small/innovative reactors



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ARC-100 **RITM-200** **HTTR** **MRX** **VBER-300** **LSPR**
SMART **VK-300** **GT-HTR** **VBER-150** **NP-300** **Rapid-L**
CAREM **Traveling Wave Reactor** **NHR-200** **AHTR**
SVBR-10 **mPower** **PBMR** **THTR**
KLT-40S **NuScale** **SVBR-75/100**
HTR-10 **PRISM** **ALLEGRO**
LFTR **Hyperion** **HTR-PM** **AVR**
EM² **4S** **Antares** **MIPS**
Fuji MSR **PHWRs** **MTSPNR** **STAR-H2**
Encapsulated Nuclear Heat Source **IRIS** **VKT-12** **STAR-LM**
BREST **Flexblue** **ABV** **SSTAR**
TRIGA

Great press coverage



“factory built” ***“additional modules could be added fairly quickly”***
“less financial risk” ***“could replace existing coal-fired power plants”***
“faster and cheaper” ***“safe, clean, sustainable, and cost-efficient”***
“45% thermal efficiency” ***“good choice for third-world countries”***
“automatic load following” ***“dramatically reduces siting costs”***
“fail-safe and totally automatic” ***“clean, safe, secure carbon-free”***
“could use a variety of [nuclear] fuel” ***“safer, smaller and cheaper”***
“process heat for industrial applications” ***“paradigm shift for power”***
“small enough to be shipped on a railcar” ***“lower risk for the buyer”***
“built faster and cheaper than bigger reactors” ***“mass production”***
“as cheap or cheaper than existing nuclear plants” ***“built in America”***

Fits public technology paradigm



- **Public view driven by consumer electronics**
 - Moore's Law is dominant technology paradigm
 - Larger number of transistors on silicon chips
 - More capability in smaller & cheaper devices
- **Why not smaller/cheaper nuclear plants?**
 - Moore's Law may not apply to power generation
 - Large power plants and large transmission wires
 - Scale and scope economies remain important

Solving large LWR issues



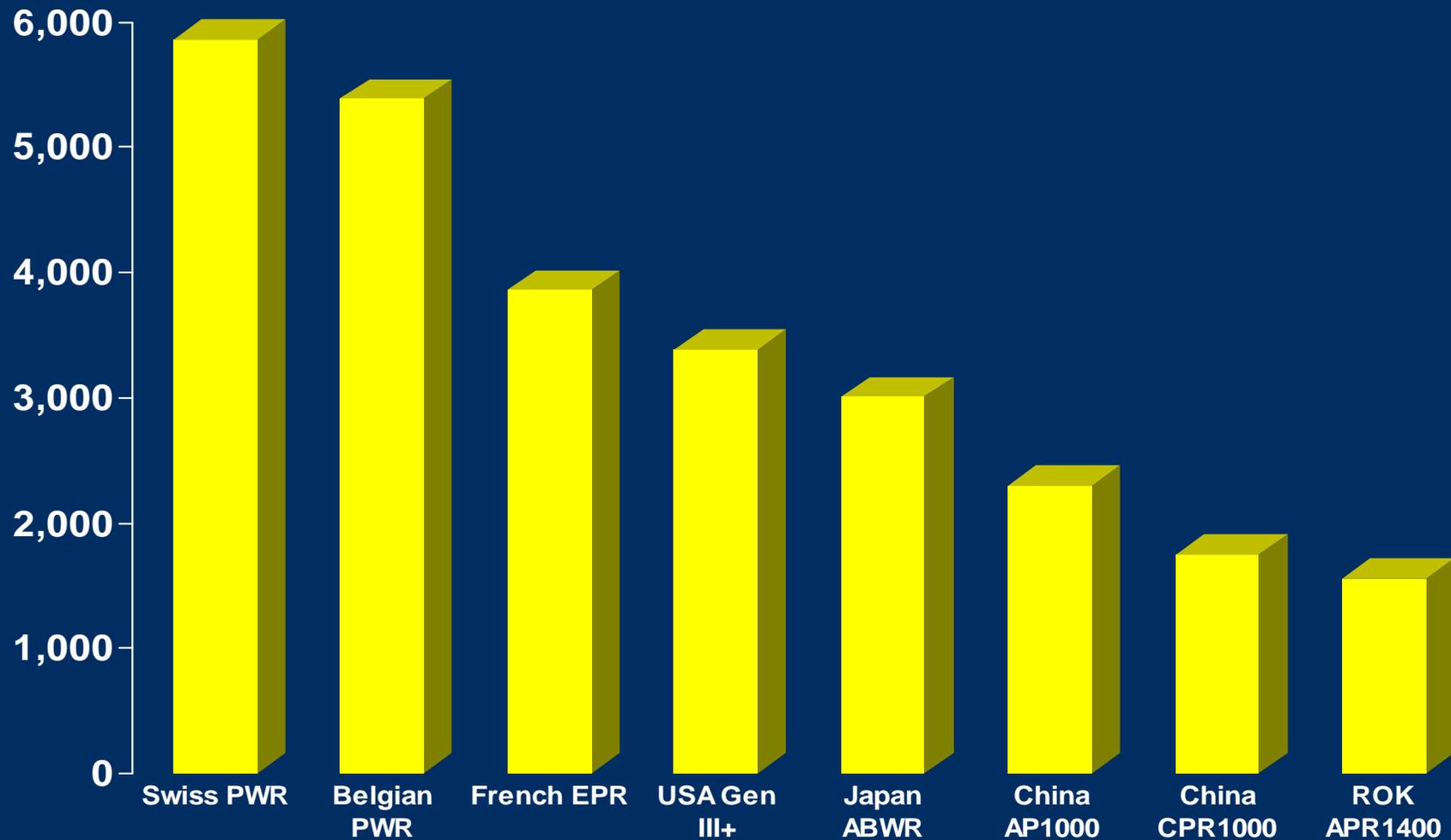
- Large total capital cost; difficult to fund
- Large increment of capacity; single shaft risk
- Hard to fit into small electricity systems
- Long time to develop and construct
- Significant business risk
- Potential reactor safety issues

...but compared to which large LWR?

Large LWR cost benchmark?



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Source: OECD 2010, Table 3.7a, overnight capital costs in US\$/kWe

Market may be confused



- What is an SMR?
- Different reactors & business models lumped together (SMR + Gen IV + ?)
- Press coverage creates high expectations
 - Near-term alternative to large LWR
 - Timing and maturity
 - Economics
 - Regulatory issues diminished

- I have recently worked with several countries considering a new nuclear power plant (the first one in some engagements)
- This work touched on SMR options
- Sampling of views:
 - “No FOAK”
 - “Option for future”
 - “Need nuclear power fast”

“No FOAK”



- A lot of risk for any nuclear plant due to political / regulatory / public opinion / economic issues
- No desire for added technology / design risk
- Only consider proven designs, where construction and operation are complete for reference plant
 - Few large LWR options are suitable now
 - SMR options off the table in near term

“Option for Future”



- Nuclear is option in about 2030
- Required crystal ball gazing:
 - Which large LWR options will survive?
 - Which SMR options will become commercial?
- LCOE analysis starting 20+ years in future (comparing nuclear and non-nuclear options)
 - Estimates of costs and features
 - Ranges to reflect uncertainty

“Need nuclear power fast”



- Large and fast nuclear power build program
- Best mix of large and small reactors?
- Different strategies
 - Large LWR = investment for power generation
 - SMR = R&D / Technology Development investment
 - Long and uncertain path to power generation
 - More uncertainty may mean more opportunity
 - Small investment to control company (Fluor example)

- Private funding of new reactor designs difficult
 - Large amounts of money over long time period
 - Uncertain outcome and timing
 - Limited exit strategies for early investors

- Government funding is important
 - Difficult in US context (DOE budget is example)
 - Chinese building prototypes now
 - Sovereign funds?

Summary



- Market confused about small reactors
- Public expectations may not be met
 - Failure to deliver (soon) – seen as failure of concept
 - Entire segment publicly linked to a few companies
- Focus on R&D and Technology Development
- Too early to compete with existing power options
- Government role will be important



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