GEN4 ENERGY

NRC-DOE Presentation

Technology and Process Innovation in Advanced Reactors

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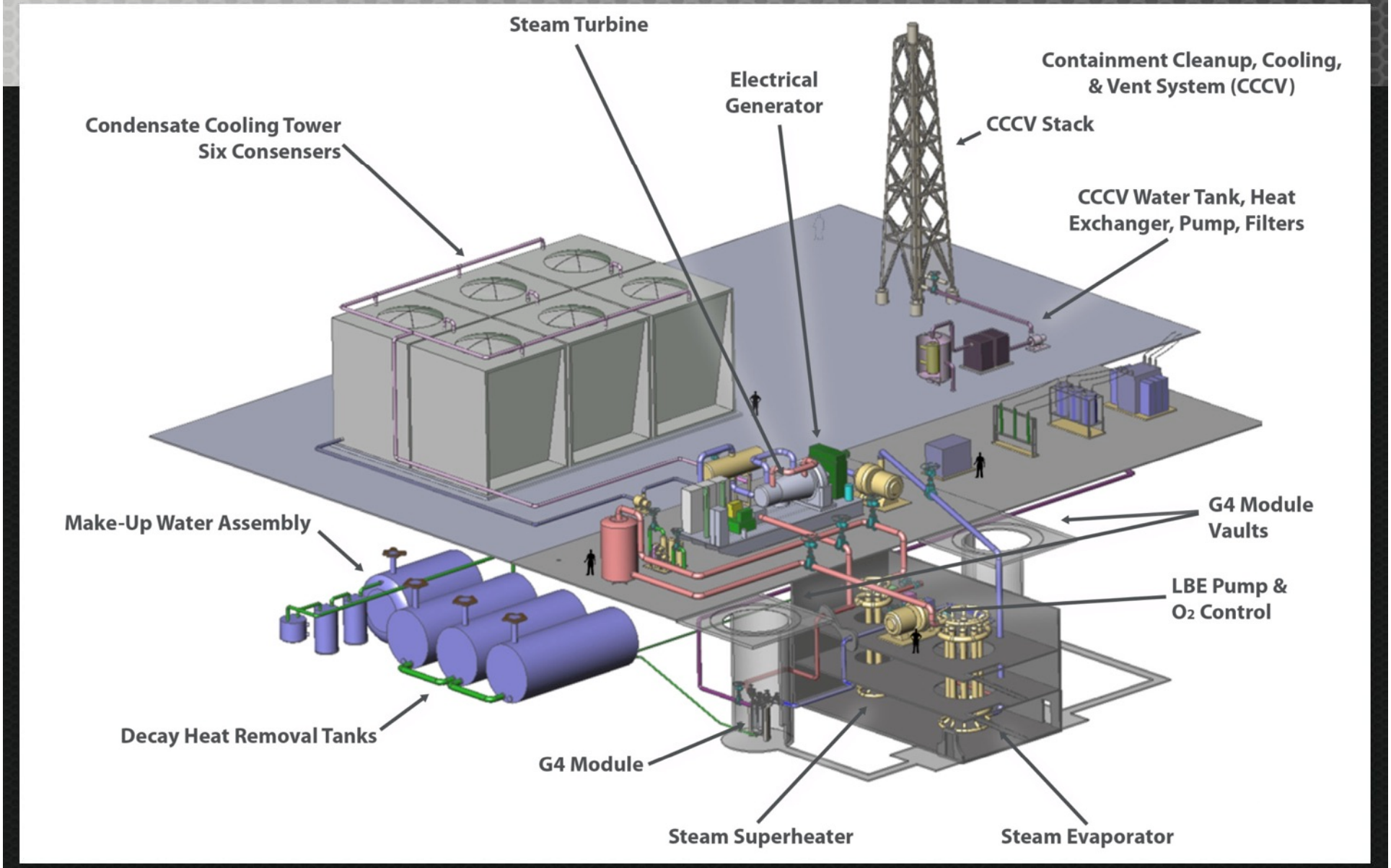
Why Advanced Reactors?

- Very low accident consequences
- Put zirconium metal—water reaction behind us
- Advanced fuels with much higher margin to core damage
- Advanced electronic controls…less manpower
- No adverse consequences from coolants under accident conditions
- Increased temperature so superheated steam or supercritical CO2 can enhance plant efficiency
- Security designed into the plant
- Proliferation resistance

Plant Configuration



Attributes of the Gen4 Reactor

- Very small
- 70 MW thermal
- Atmospheric pressure
- Higher temperature
- Very traditional approach to “defense in depth”
- Coolant not reactive with air or water.

GAPS: Time and Money

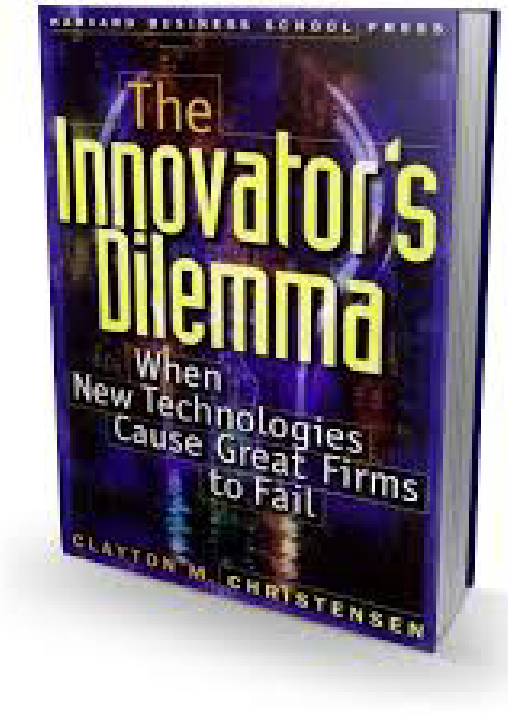
- The time to bring a reactor to market is too long
  - High overnight capital costs for today's reactors
  - Developmental uncertainty for new reactors
- Regulatory risk is perceived to be too high to attract private investors (VC or PE) or to list on public markets.
- First customers (i.e. Utilities) are unwilling to commit to products with unknown lead times.
- By default, applicants for DOE funding are dominated by larger companies.
- My experience has been, venture funds last a maximum of 10 years before money has to be returned to investors…. shorter than the nuclear development timeline.

Small Startup Reactor Companies?

Why should any funding go to small startup companies if large established nuclear suppliers have so much talent and capability?

The Innovators Dilemma

- In his book, Christen Clayton points out that is very difficult for large, established companies to innovate.
- There are many examples such as Sears, DEC, etc. They were all well-managed companies.



Regulatory Perspective…Gaps

- The United States has an excellent LWR licensing and regulatory system viewed as “Gold Standard” around the world
- Advanced Reactors expected to have new coolants, fuels and plant configurations
- Things to consider going forward:
  - NRC expectations for new/advanced fuel qualification
  - Design Basis and Beyond Design Basis Events
  - Role of Prototypes in the licensing process
  - Vendor Design Review. Early assessment of technical risk.

Financial Considerations…Gaps

- Private investors need assurance the Advanced Reactor development is real and enduring…not a passing fancy
- Long term investments like the current FOA should send a strong signal to the financial community regarding government intent
- A long range development plan with industry-led R&D FOAs, leading a 50/50 cost share for a licensing technical support contract (like current SMR's), will advance the licensing process and send the right signals to financial markets
- Constraints on cost sharing (80/20) make it difficult for small companies to bid on the research.

Industry-Led Advanced Reactor R&D (FOA-1, 2013)

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Gen4 Energy, a small business with less than $20 million invested to date, benefited from an award in the first round

Other winners were Westinghouse, General Electric, and General Atomics

Value: $990,000 (80/20 cost share) Duration: 2 years

Scope:

1. Thermal hydraulic modeling of natural circulation flow in an LBE-cooled reactor
2. Design of a scaled natural circulation test device

None of the FOA money goes to Gen4, nearly all of it is invested in National Laboratory and University research

UNIVERSITY OF SOUTH CAROLINA

Los Alamos NATIONAL LABORATORY

Massachusetts Institute of Technology

URS

SRS-USA

INL Idaho National Laboratory

Final Thoughts

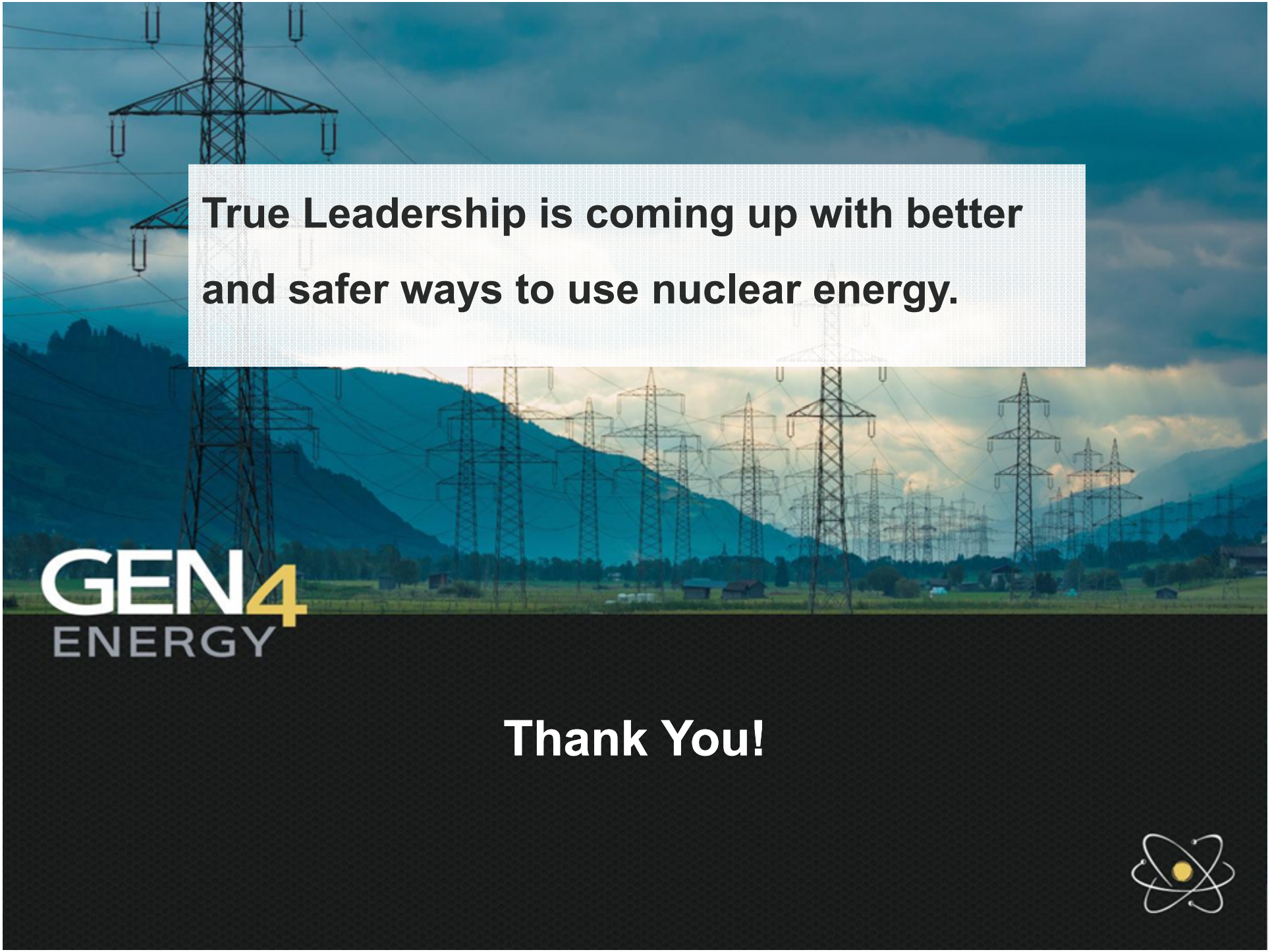
- Right now the nuclear commercialization time line is very long—20 plus years.
  - Time to commercialization matters to potential investors.
  - Things that shorten the time are good.

- Advanced reactors like Gen4 are important to the future.
  - Added safety margin over today's fleet; prepares for replacements
  - Sustains our leadership in all things nuclear
  - Sustains the baseload, carbon free power with a small energy density footprint

- The most recent FOA for advanced reactors is great, but it is not enough. A long term program is needed that fosters new ideas and shows the financial community the future.

As an industry

Do it safely… do it fast… make the future occur

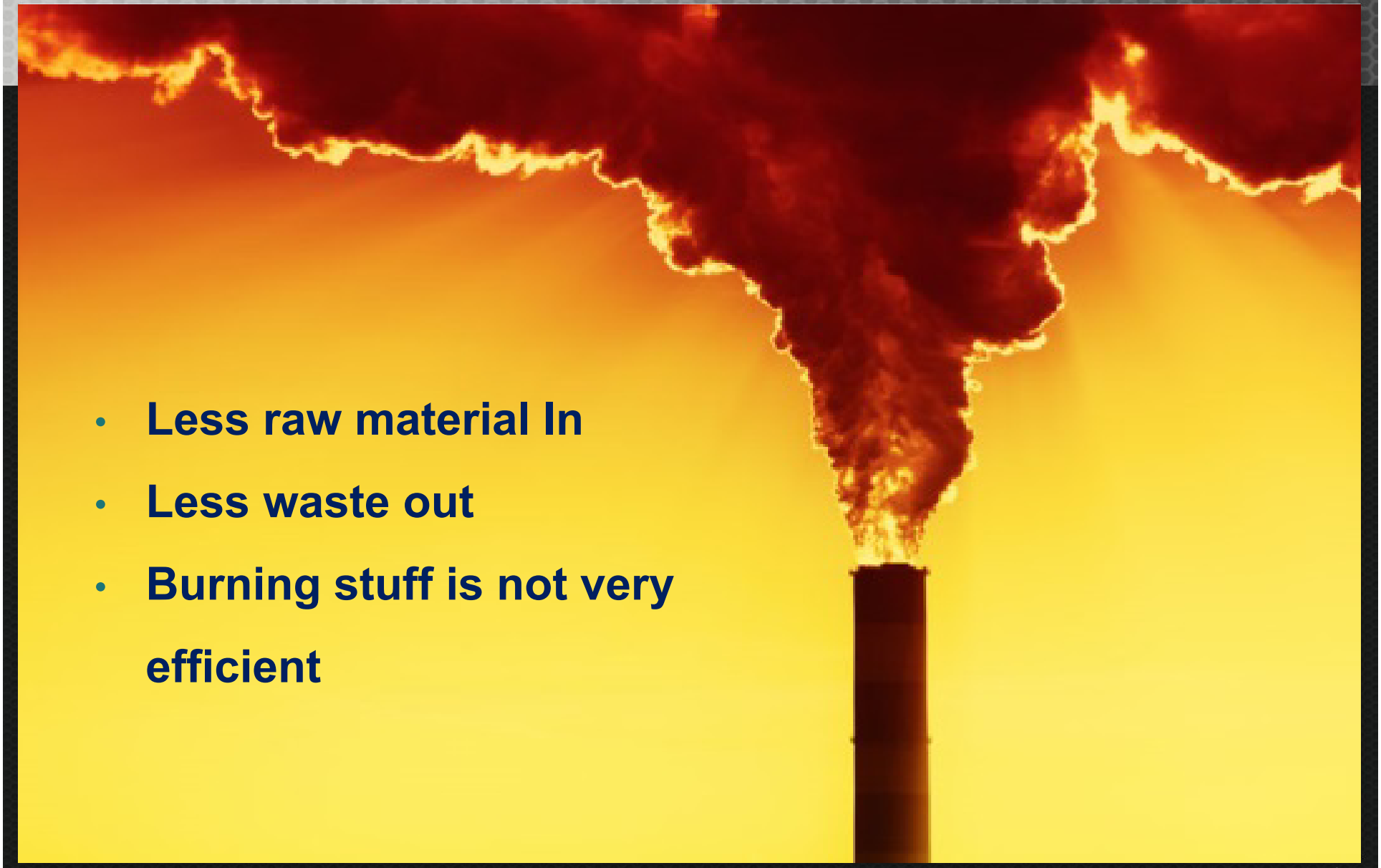

True Leadership is coming up with better and safer ways to use nuclear energy.
GEN4 ENERGY
Thank You!

Backup Slides

In Summary – What is needed?

1. Verbal support and encouragement of all viable designs.
2. Reduced cost or free technical advice (in lieu of the TRP process?)
3. Move toward a future 50/50 cost share licensing exercise, similar to NP 2010 or the current SMR Licensing Technical Support contract.
4. Work towards a new U.S. advanced test reactor (like VATR) that can support advanced reactor design and testing needs.

Energy Density Does Matter:

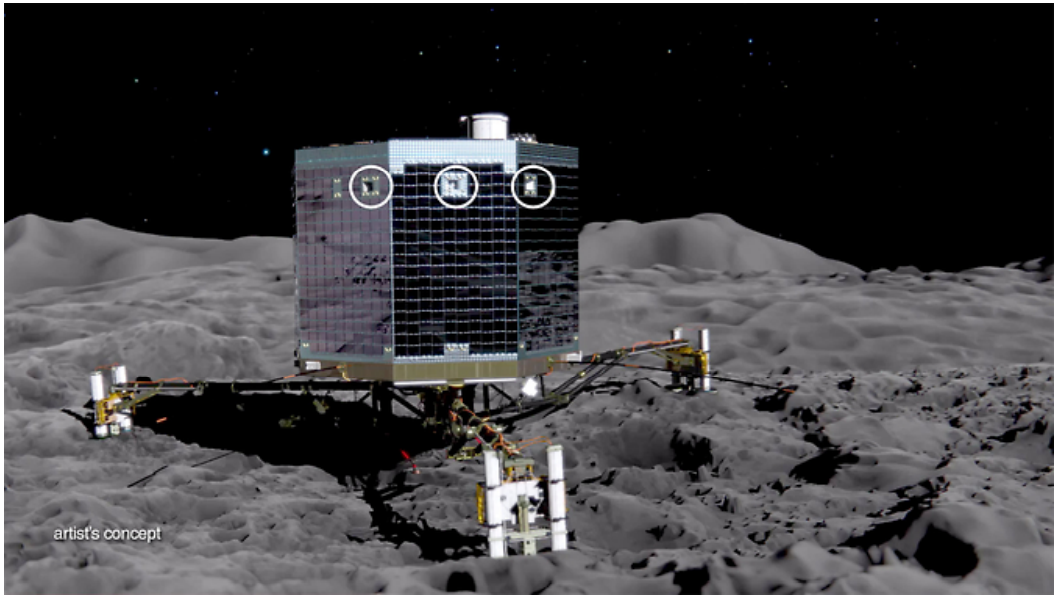


- Less raw material In
- Less waste out
- Burning stuff is not very efficient

Fit-For-Purpose ?

An example:

- The European Space Agency chose solar panels to power the lander on their Rosetta asteroid mission.
- The Philae lander ended up in the shade after it bounced.
- Since the solar panels did not have a good view of the sun, the batteries died after 2 days.



Nuclear energy (Pu-238) was fit-for-purpose, but solar panels were used.

