

SRS Energy Park

The Bridge to Sustainable National Energy Security
Vision and Implementing Concepts

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Acronyms

DOD-Department of Defense

DOE-Department of Energy

EM-Office of Environmental
Management

GHG-Greenhouse Gas

HEU-Highly Enriched Uranium

HTGR-High Temperature Gas Reactor

LWR-Light Water Reactor

MOU-Memorandum of
Understanding

MOX-Mixed Oxide Fuel Fabrication

MWe-Megawatts Electric

NNSA-National Nuclear Security
Agency

NRC-Nuclear Regulatory Commission
Pu-Plutonium

SMR-Small Modular Reactor

SRNL-Savannah River National
Laboratory

SRNS-Savannah River Nuclear
Solutions, LLC

SRS-Savannah River Site

SWOT-Strength-Weakness-
Opportunity-Threat

TRSWA-Three Rivers Solid Waste
Authority



What is an Energy Park?

- Redeploys under-utilized DOE assets to produce diverse, green, domestic energy sources
 - Solar, wind, biomass, geothermal, nuclear, clean coal, hydrogen
 - Smart grid, storage, efficiency manufacturing
- Cuts greenhouse gas emissions
- Reduces dependence on foreign oil; improves energy security
- Restores American leadership of energy/climate technology
- Provides sustaining missions for DOE Sites
- Joint effort of DOE, local and regional communities, private sector, unions, and other interested parties



What is the role of SRNS?

- Inventory SRS assets and competencies
- Identify national energy security needs
- Assist DOE with the development of an SRS Energy Park vision
 - Align SRS assets and competencies with national energy security needs
- Generate concepts for consideration by DOE and stakeholders



What has SRNS done?

- 2 Strength-Weakness-Opportunity-Threat (SWOT) workshops
 - Inventoried SRS assets and competencies
 - Targeted 3 pressing national needs
- Assisted with 2 DOE public workshops
- Strategic View Interviews
 - >100 long-term employees
 - 115 representatives of DOE/NNSA, community, industry, academia, and gov't
- Formulated vision and implementing projects
 - Long-term vision--National Fusion Energy Park
 - Implementing Projects—BioEnergy Integration Center, Modular Reactor Demonstration Complex, Modular Reactor Power Park, U.S. Energy Freedom Center™
- Energy Park Executive Roundtable
 - Focus group on vision and projects
 - 35 representatives of industry, community, and SRS
- Launched Modular Reactor Demonstration Complex
 - Hyperion memorandum of understanding (MOU)



What has SRNS learned?

- Focus should be on energy security, climate change, and **ECONOMIC SECURITY**
- Energy park must transcend Site boundaries
- Public-private partnerships are essential
- Authorizing legislation and appropriated “seed” funding needed
- SRS has many relevant capabilities and assets
 - nuclear materials processing, biomass, and other renewables
 - BUT, SRS is primarily a nuclear site
- The backbone the SRS energy park must be **nuclear**



Targeted National Needs

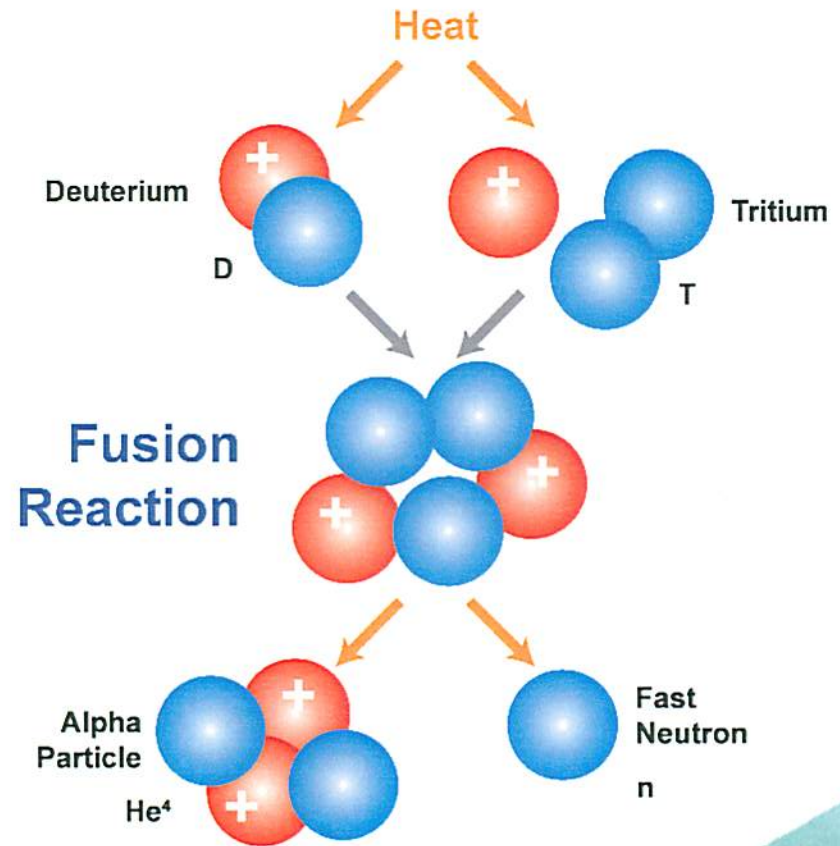
- Energy Security
 - Achieve independence from foreign oil
 - Improve electricity generation, storage, and efficiency
 - Solar and Wind—advanced collection and conversion
 - Clean Coal—gasification and carbon capture
 - Nuclear—greater utilization of uranium, recycle used fuel
 - Transmission/Distribution—advanced batteries, superconductors, smart grid
 - Develop and deploy fusion energy
- Climate Change
 - Reduce greenhouse gas (GHG) emissions
 - Close carbon fuel cycle
- Nuclear Nonproliferation
 - Secure and disposition surplus weapons materials
 - Recycle used nuclear fuel without separating Pu



Vision for SRS

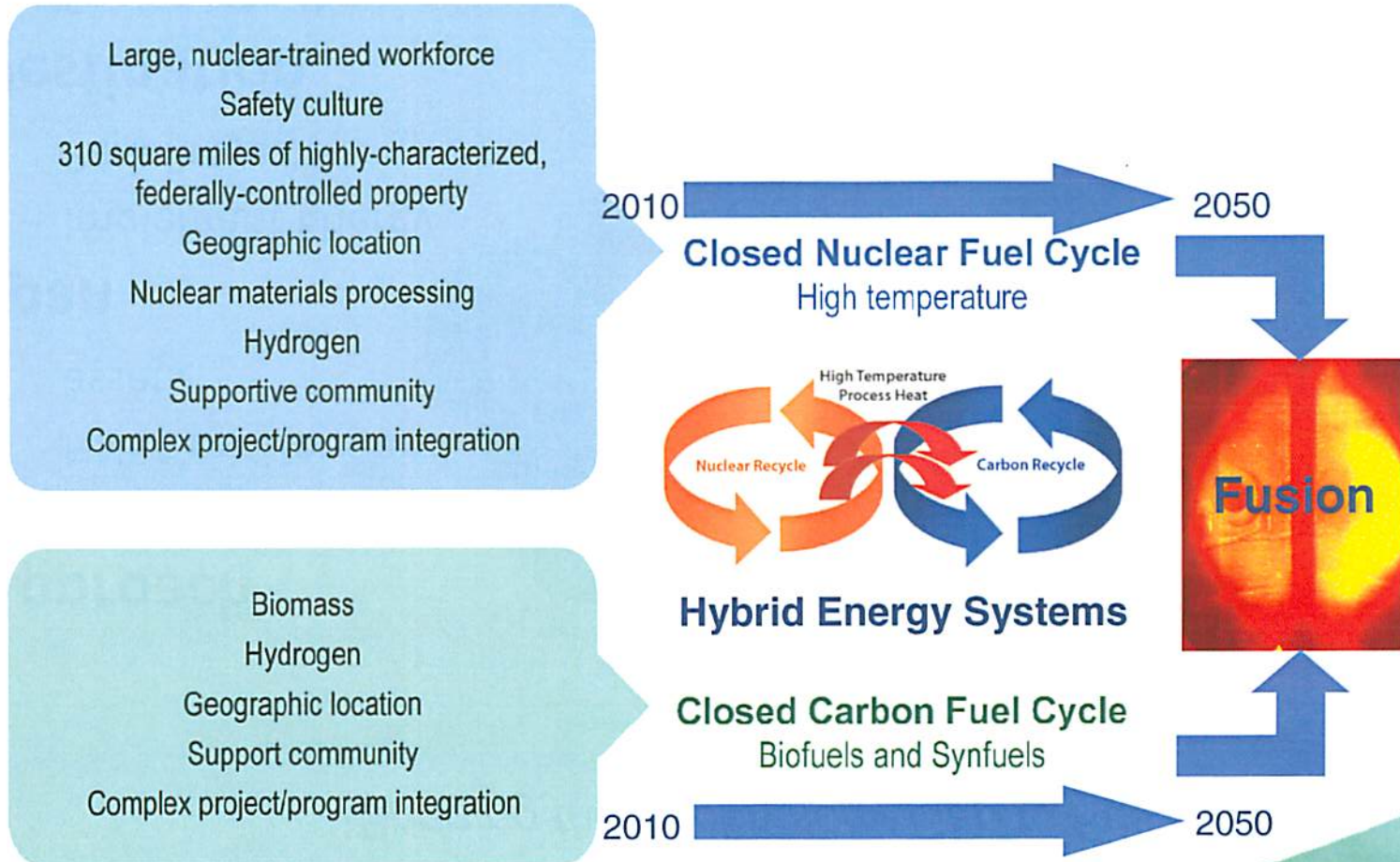
Putting SRS to Work for America on the Path to Fusion

- 2010-2050
 - Renewable fuels
 - Nuclear stepping stones to fusion
 - Small modular reactors
 - Light isotopes and hydrogen
 - Advanced fuel cycles
 - Recycle used nuclear fuel
- Beyond 2050
 - National Fusion Energy Park
 - Host site for 1st generation of fusion and fission-fusion hybrid technologies



Convert Vision to Reality

Intersecting SRS capabilities with pressing national needs while maintaining long-term focus on fusion



Build the Energy Park

Bridging the Technology Gap to Fusion

- **Approach**

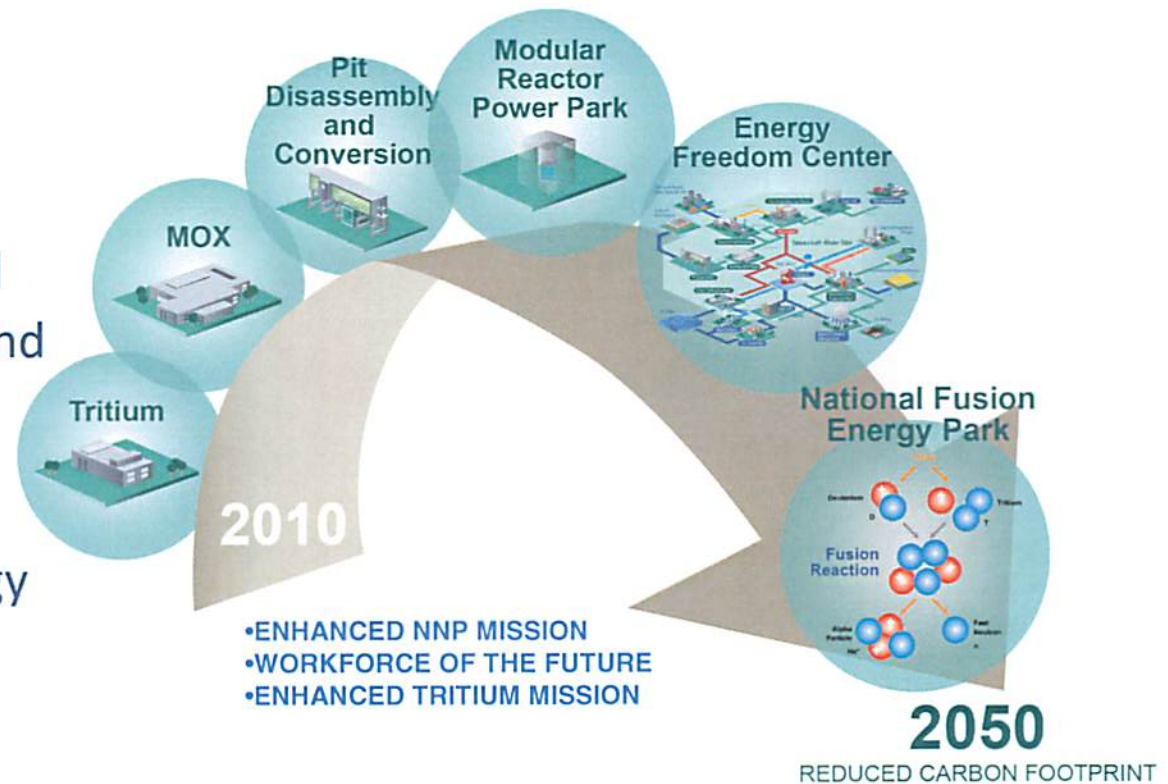
- Leverage EM and NNSA missions and assets

- **Span**

- Implement Energy Park Projects

- **Destination**

- Evolve into the Fusion Energy Park



SRS Energy Park Concepts

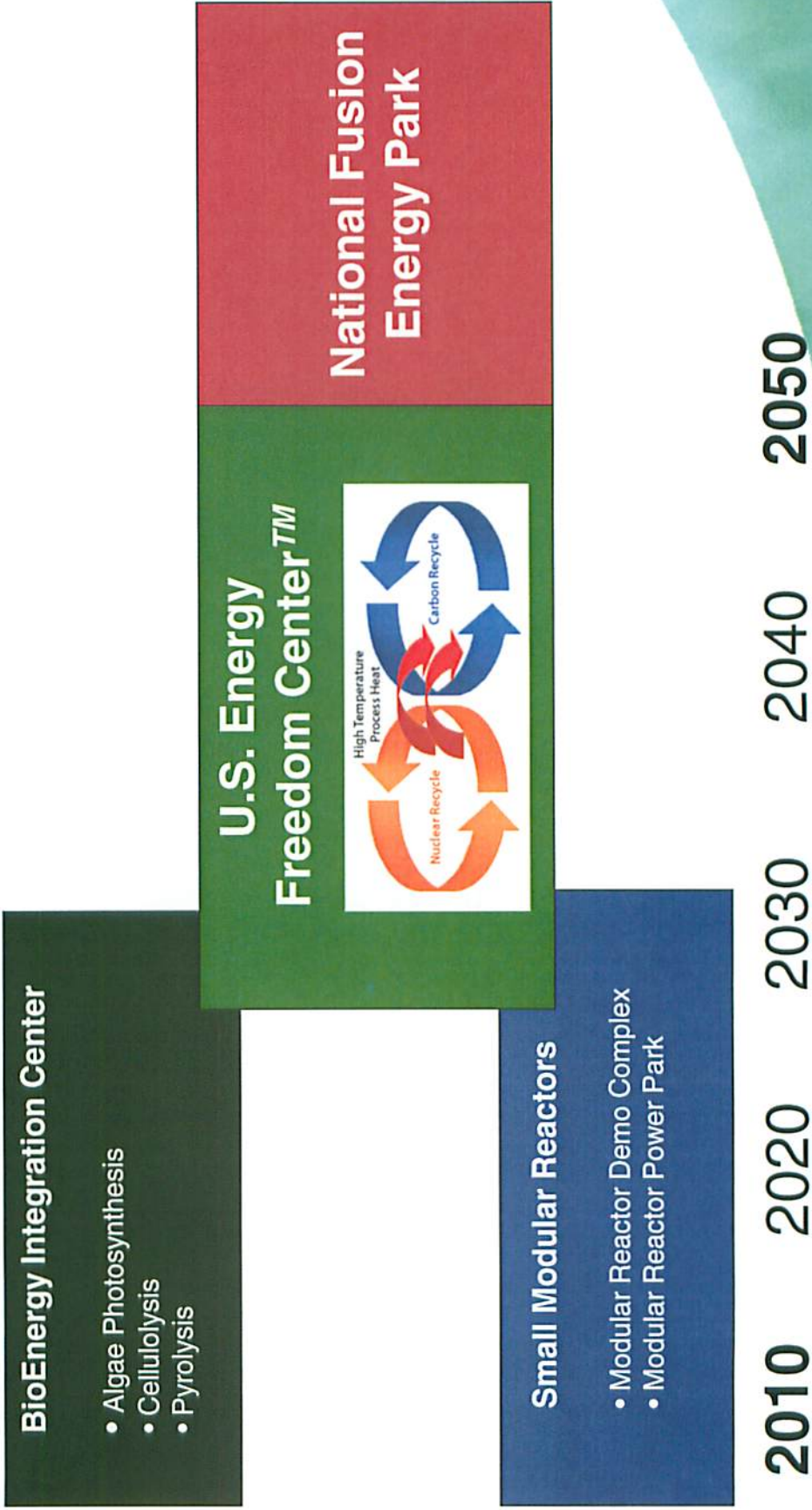
Progressively complex fusion energy building blocks

- **Near-Term, 2010 to 2025**
 - BioEnergy Integration Center—transportation fuels from algae and biomass
 - Modular Reactor Demonstration Complex
 - Modular Reactor Power Park
- **Mid-Term, 2026-2050**
 - U.S. Energy Freedom CenterTM
 - Hybrid energy systems
 - Closed and integrated nuclear and carbon fuel cycles
- **Long-Term, Beyond 2050**
 - National Fusion Energy Park
 - Fusion and fission-fusion hybrid reactors



SRS Energy Park Master Plan

Staying on the path to fusion energy



BioEnergy Integration Center

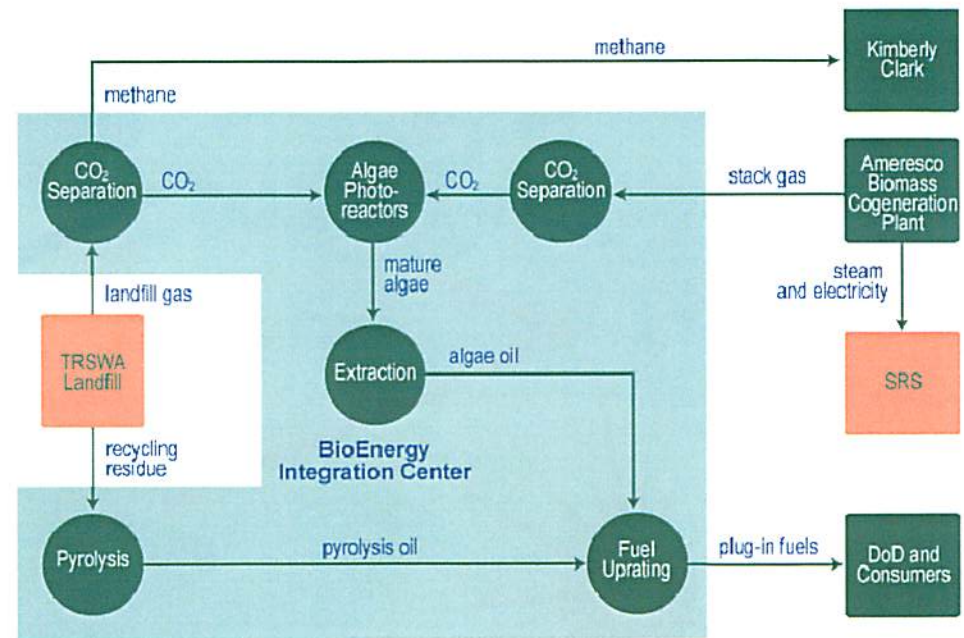
Greening the renewal of SRS

Features

- Flexible feedstock biorefinery
 - Algae, biomass, solid waste recycling residue
- Located near landfill and cogeneration plant
- ~\$200 million in new construction

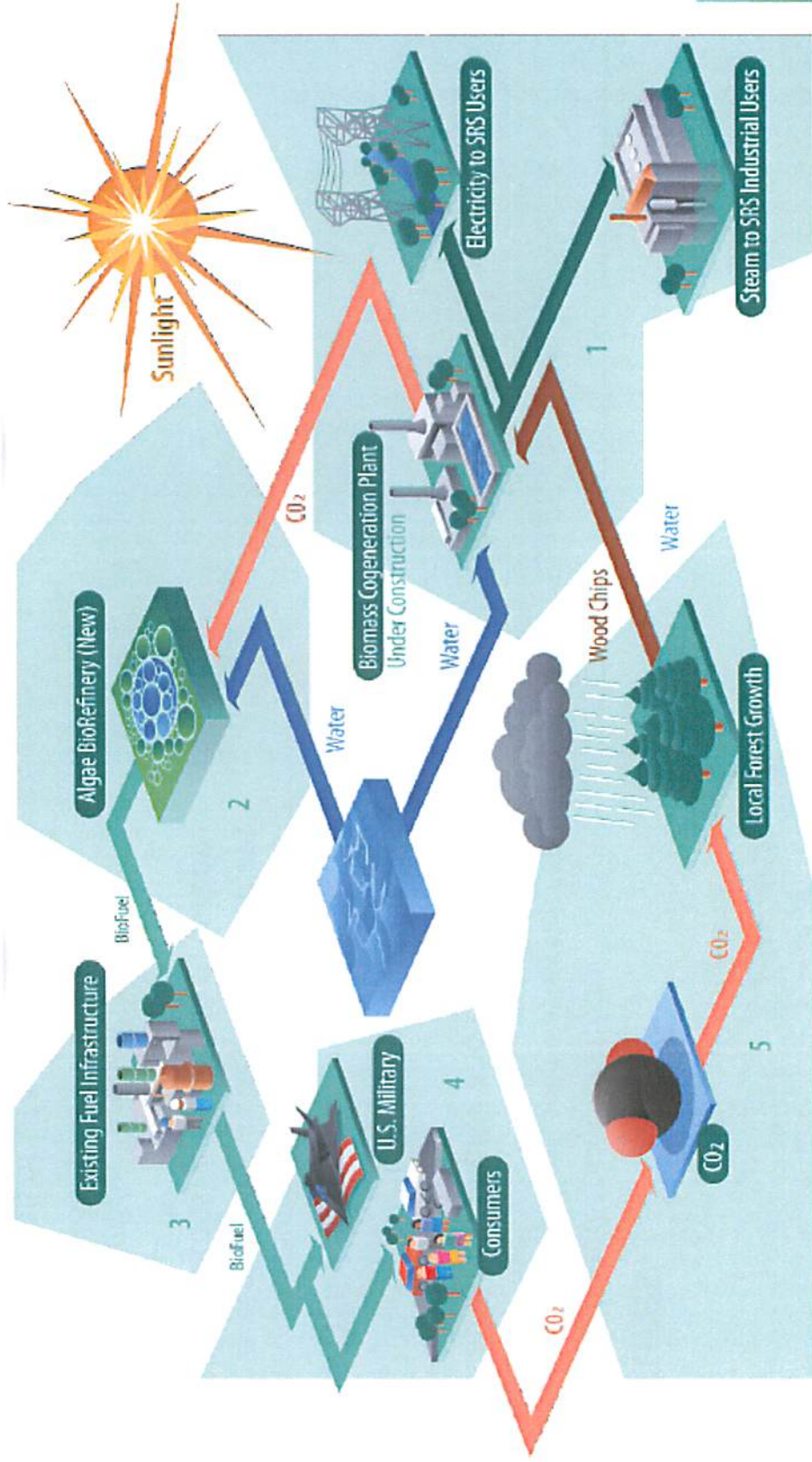
Benefits

- Integrates with Three Rivers landfill and Ameresco biomass cogeneration plant
- ~500,000 tons/yr reduction in carbon footprint
- ~5 million gal/yr “drop-in” *green* transportation fuels
- Diversification of site missions
- Hundreds of high-paying and enduring green economy jobs
- Improves economics of recycling
- Reduces landfilling



Algae Biofuels Production

Taking the first SRS step to carbon-neutral fuels and electricity



Modular Reactor Demo Complex

Ensuring American workers benefit from the global nuclear renaissance

- Features

- Small modular reactor (SMR) test bed
 - One test bed, shared utilities and support systems/services
 - Each <300 MWe
 - Wide range of designs
 - Some burn used light water reactor (LWR) fuel and surplus Pu and highly enriched uranium (HEU)
 - ~\$500 million investment required

- Benefits

- Accelerated NRC licensing
 - Deployed at SRS in parallel with licensing process
 - Cuts 10 years out of development cycle
- Shared overheads, reduced costs
- American leadership of SMR technology
- Green electricity, process heat, and medical isotopes
- **JOBS, JOBS, JOBS**

Small Packages

True to the old saying about small packages, SMRs offer flexibility that traditional LWR operations simply cannot equal.



A number of competing designs could be prototyped at SRS in the SMR Demonstration Complex.

| | | |
|--|--|--|
| PRISM General Electric-Hitachi 300 MWe, liquid metal cooled | mPower Babcock & Wilcox 125 MWe, pressurized water reactor | NuScale NuScale, Inc. 45 MWe, pressurized water reactor |
| Energy Multiplier Module (EM2) General Atomics 240 MWe, helium gas cooled | Hyperion Hyperion Power Generation, Inc. 25 MWe, Pb-Bi cooled | Pebble Bed Modular Reactor Eskom (South Africa) and Toshiba-Westinghouse 80 MWe, helium gas cooled |
| Traveling Wave TerraPower, LLC 300 MWe, liquid-metal cooled | IRIS Toshiba-Westinghouse 350 MWe, pressurized water reactor | 4S Toshiba-Westinghouse 10-50 MWe, liquid metal cooled |



Modular Reactor Power Park

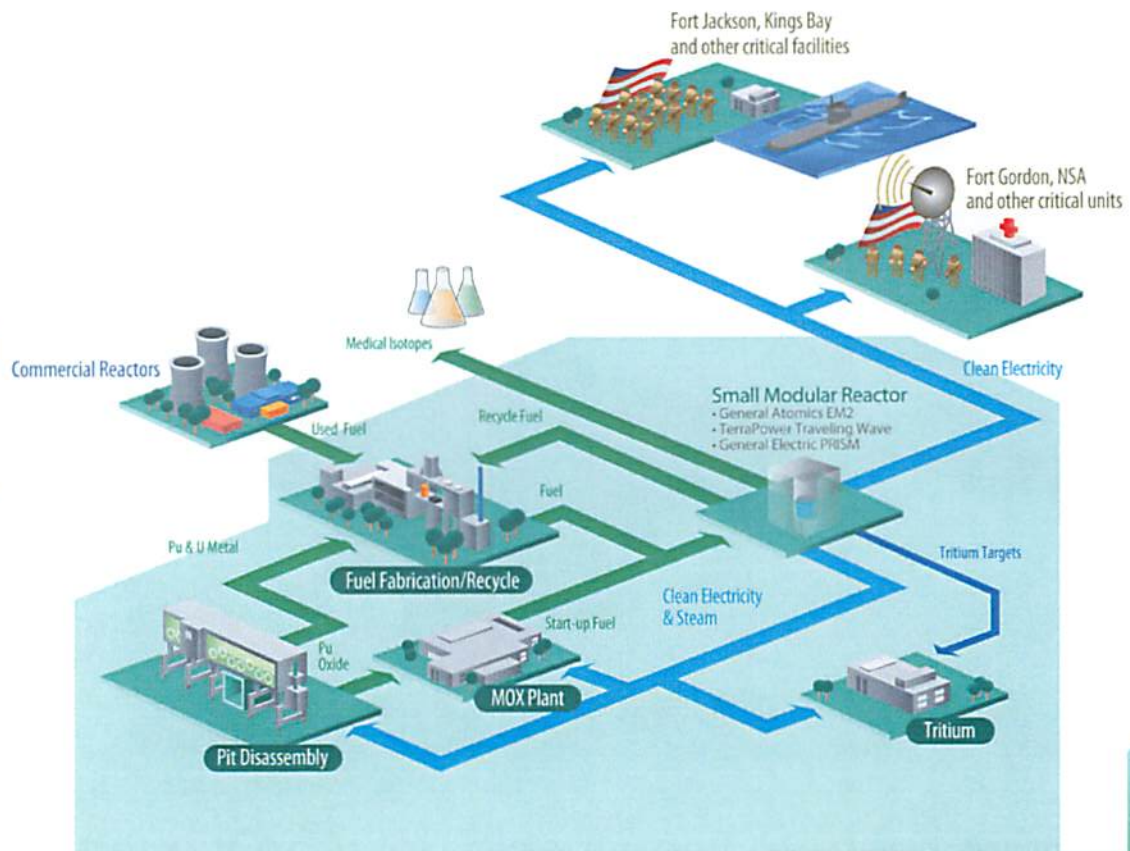
Collaborating with DOD on green security

At SRS

- Pit Disassembly (K-Area, in design)
- MOX Plant (F-Area, under construction)
- Fuel fabrication / recycle center (New)
- Small modular reactor (New)
- Clean electricity and steam to NNSA operations (New)
- Tritium and medical isotopes (New)

Off-Site

- Electricity to smart, secure mini-grids at Fort Gordon, NSA and other nearby military installations (New)
- Disposition path for used commercial fuel in South Carolina (New)



EM Environmental Management
safety → performance → cleanup → closure

U.S. Energy Freedom Center™

Prototyping hybrid clean energy systems at SRS

Closed Nuclear Fuel Cycle

- Advanced Reactor(s) (new)
 - HTGR or modular reactor(s)
- Fuel Recycling Facility (new)
- Pit Disassembly and Conversion (in design)
- MOX Plant (under construction)

Closed Carbon Fuel Cycle

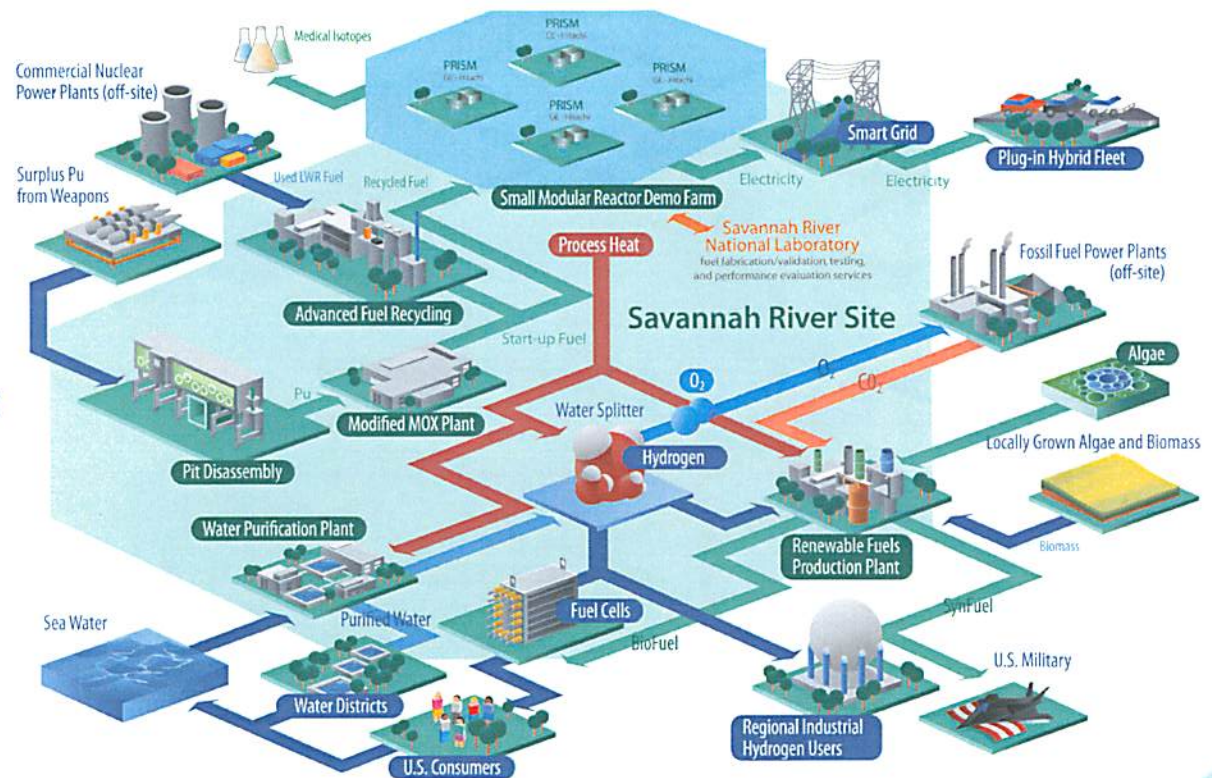
- Carbon-Neutral Fuel Manufacturing (new)
- Algae, biomass, recycled CO₂, coal feedstocks

Water and Hydrogen Facilities

- Desalination Plant (new)
- Water Splitter (new)

Medical Isotopes

- Mo-99 and others (new)



U.S. EnergyFreedomCenter™



EM Environmental Management
safety + performance + cleanup + closure

U.S. Energy Freedom Center™

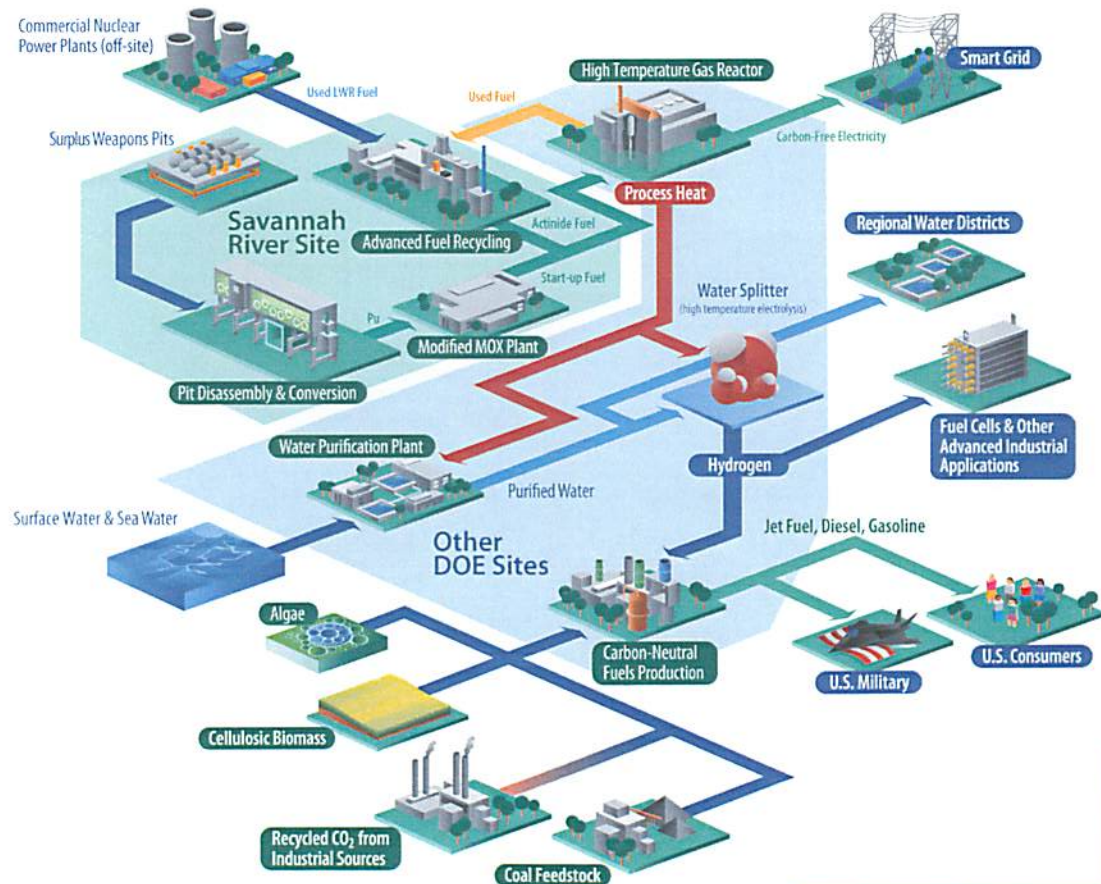
Creating a national model for hybrid energy parks

At SRS

- Nuclear fuel fabrication and recycling facilities
 - Expanded on modular basis to support nationwide network of reactors

At Each DOE Site

- Next Generation Nuclear Plant or SMR Demo Complex
- Water Purification Plant
- Hydrogen Production Plant
- Carbon-Neutral Fuel Production Plant



Benefits to America

Transformational Energy and Climate Technology

- Carbon-neutral electricity, “plug-in” fuels, and hydrogen from surplus weapons and used nuclear fuel
- Pathway to independence from foreign oil
- Revitalization of the American manufacturing sector
- Renaissance of science and mathematics education
- Sustainable clean energy jobs



Benefits to the Region

Leadership. Sustainable Jobs. Hub for Clean Energy.

- Keeps SRS on the path to fusion
- Makes SRNL the clean energy integration laboratory
- Potential for up to 25,000 sustainable, high-paying jobs
- Increases clean water supplies for regional growth
- Expands potential for light element and medical isotope missions at SRS
- Reutilizes EM assets following Recovery Act footprint reduction
- Delivers the new missions and state of the art facilities needed to attract workforce of the future



Implementation Plan

- Forge an industry-DOE-NNSA-DOD-community partnership
- Develop a compelling business case
- Induce an “Apollo-like” Presidential challenge
 - Align with the President’s agenda for nuclear nonproliferation, energy, and climate change
 - Acquire local and regional buy-in
 - Expand to a broad national coalition of support
 - Public, elected officials, industry, labor, environmentalists
- Secure “seed” funding
- Plan and launch with resolve
 - Realize big vision through a series of small implementing projects
 - First Project--Hyperion Power Module



SRNS Expectations

- Continue role as incubator of concepts and facilitator of implementation
- Acquire buy-in from DOE/NNSA and the “community” to a common energy park vision within 6 months
- Transition leadership and ownership of the Energy Park Initiative to the “community” within 12 months
- Put the “shovel in the ground” for the first implementing project(s) within 18 months
 - Modular Reactor Demonstration Complex
 - BioEnergy Integration Center

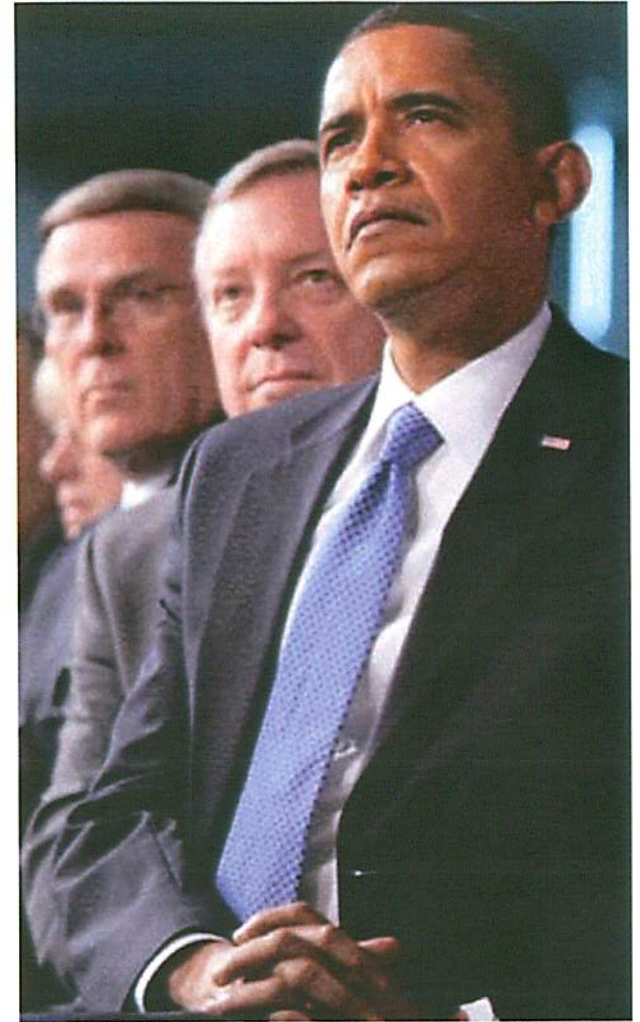


“I am convinced that whoever builds a clean energy economy, whoever is at the forefront of that, is going to own the 21st Century economy.

*I’m convinced **America can win the race.***

Let’s get it done.”

***President Barack Obama**
February 3, 2010*



Perhaps he meant to say...

Let's get it done right...

- *Using DOE/NNSA assets*
- *Starting at SRS*
- *Engaging the Community and Region*

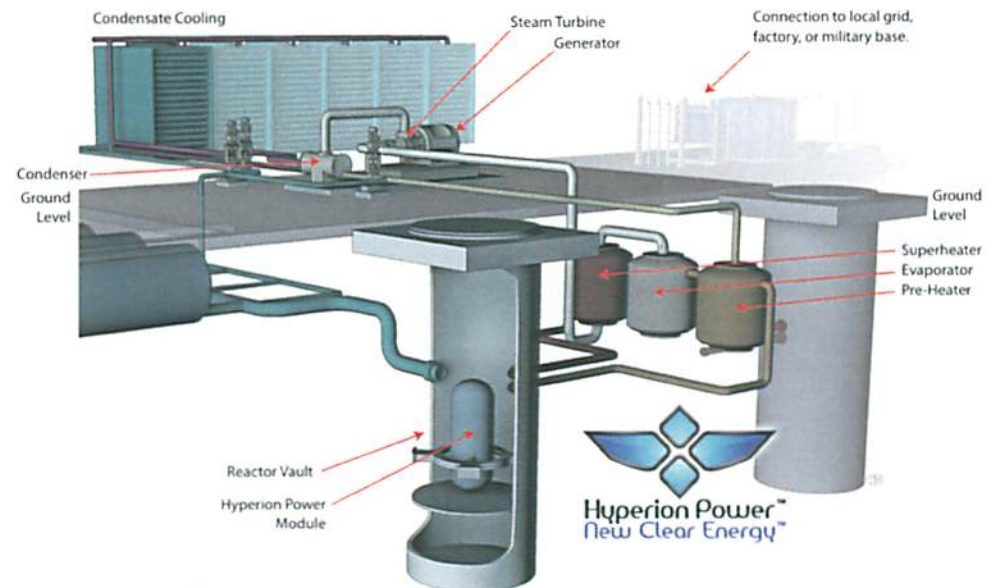


Back-Up Slides



Hyperion Power Module

- 25 MWe, Pb-Bi metal cooled fast reactor
- Factory-built
- Capable of burning downblended HEU from surplus weapons
 - Another great fit for SRS
- Ideal design for military bases and other government complexes
- MOU executed between Hyperion and SRNL earlier this month

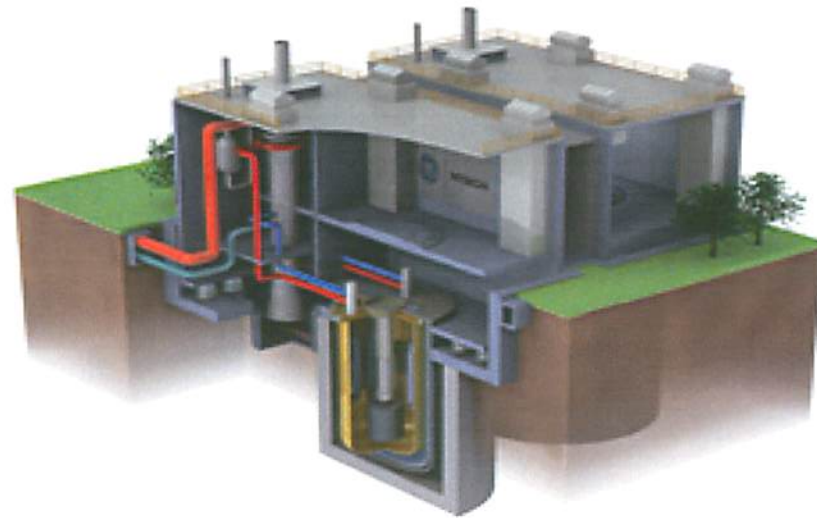


Hyperion Power Module-based 25MWe Electric Power Plant



General Electric PRISM

- 300 MWe sodium cooled fast reactor
- Factory-built reactor vessel
- Burns surplus Pu and recycled LWR fuel
 - Fits SRS core competencies
 - Potential alternative to Yucca Mountain
- Significant prior DOE investment in technology
 - *America's Fast Reactor*
- Included in SRNS' original proposal to DOE in 2007 as alternative for EM Pu disposition
- MOU being developed



General Atomics EM2

- 240 MWe gas-cooled fast reactor
- Factory-built, transportable
- Capable of burning surplus Pu and HEU as start-up fuel
 - Great fit for SRS
- Burns used LWR fuel without conventional reprocessing
 - Potential alternative to Yucca Mountain
- Significant new mission for SRNL and other SRS facilities
- General Atomics and SRNL talking



TerraPower Traveling Wave

- 300 MWe, liquid metal cooled fast reactor
- Capable of burning surplus Pu and HEU as start-up fuel
 - Another great fit for SRS
- Burns used LWR fuel without conventional reprocessing
 - Potential alternative to Yucca Mountain
- Financially supported by Bill Gates
- TerraPower and SRNL talking

