IES
Integrated Energy Systems

The Role of Nuclear Energy Innovation in Achieving a Clean Energy Economy

2021 ROBERTSON LECTURE: Small Nuclear

Johnson Shoyama Graduate School

University of Regina and University of Saskatchewan

Shannon Bragg-Sitton

National Technical Director, DOE-NE Integrated Energy Systems

Lead, Integrated Energy Systems

Nuclear Science & Technology, Idaho National Laboratory

shannon.bragg-sitton@inl.gov

17 February 2021

Idaho National Laboratory

DESIGNING FUTURE ENERGY SYSTEMS

What goals are we trying to achieve?

How will energy be used?

What role(s) can each energy source fill?

IES
Integrated Energy Systems

Global Reality

28% by 2040

Projected increase in world energy use by U.S. Energy Information Administration.*

2.7 degrees by 2040

Projected increase in atmospheric temperatures if global greenhouse gas emission continue at current rate by Intergovernmental Panel on Climate Change

MIT Future of Nuclear Energy Study (2018)

Key finding: Without contribution from nuclear, the cost of achieving deep decarbonization targets increases significantly.

International Energy Agency, Nuclear Power in a Clean Energy System (May 2019)

Despite significant renewable energy growth over the last 20 years, the overall contribution of clean energy supply to electric generation has not changed… In many parts of the world, low-cost natural gas is displacing nuclear generation as a complement to variable wind, solar.

Clean Energy Targets are Trending. *updated Dec 2020*

Clean energy commitments are rapidly gaining popularity. ThirdWay research for the U.S. identified a total of 153 portfolio standards and other commitments to clean energy since 1983; 67% were adopted since 2016.

Climate leaders want more technology options to choose from. Prior to 2016, 90% of commitments in the U.S. were exclusive to renewable energy. That trend has almost completely reversed, with 73% of states, utilities, and major cities now embracing “technology-inclusive” commitments like **clean energy standards** that take advantage of nuclear power, carbon capture, and other carbon-free options.

IES Integrated Energy Systems

The limitations of today's grid and traditional energy planning

Today

Electricity-only focus

Characteristics of today's grid (generalized)

- Individual generators contribute to meeting grid demand, managed by an independent grid operator
- Individual thermal energy resources support industrial demand
- Transportation mostly relies on fossil fuels (with growing, yet limited, electrification)

We must assess both the *benefits* and the *shortcomings* of all energy generation options as we look to future solutions to sustainably support growing energy demands.

IES
Integrated Energy Systems

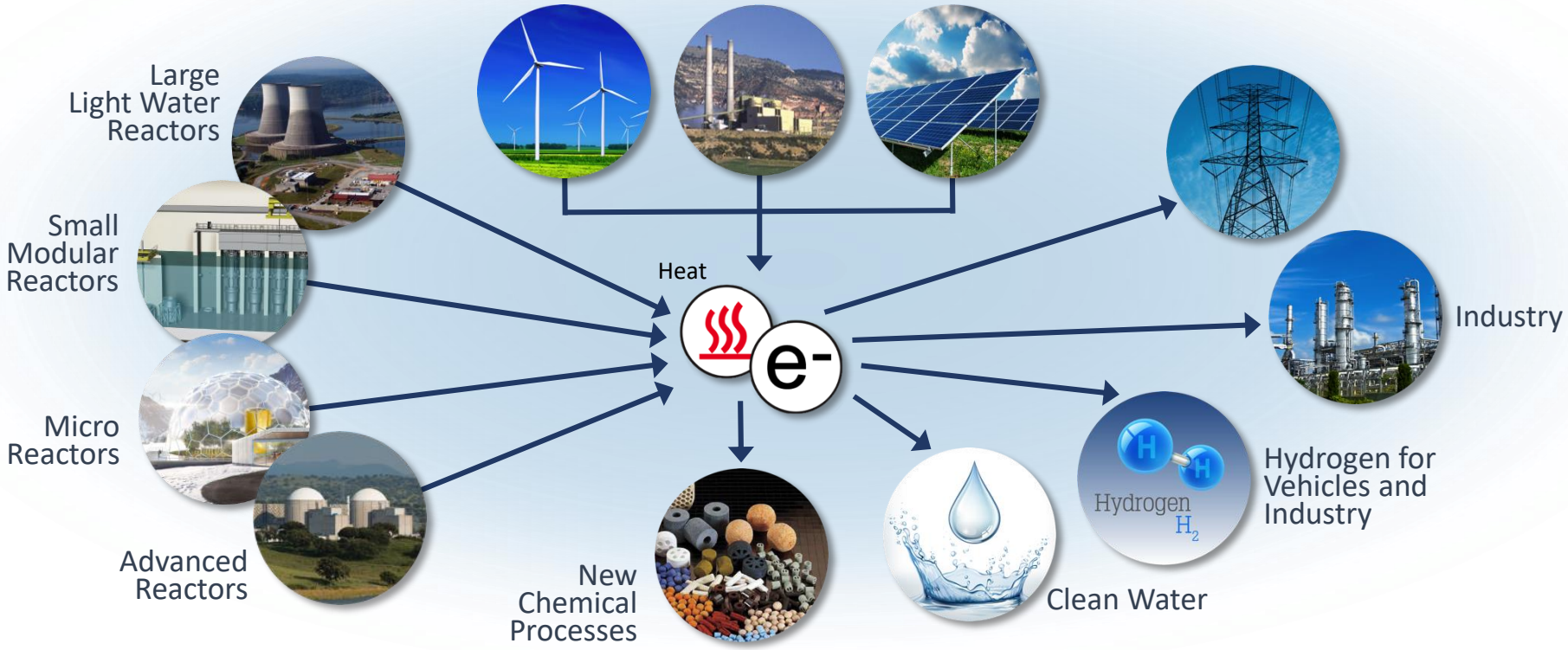
Maximizing energy utilization, generator profitability, and grid reliability and resilience through systems integration—while maintaining affordability

Today

Electricity-only focus

Potential Future Energy System

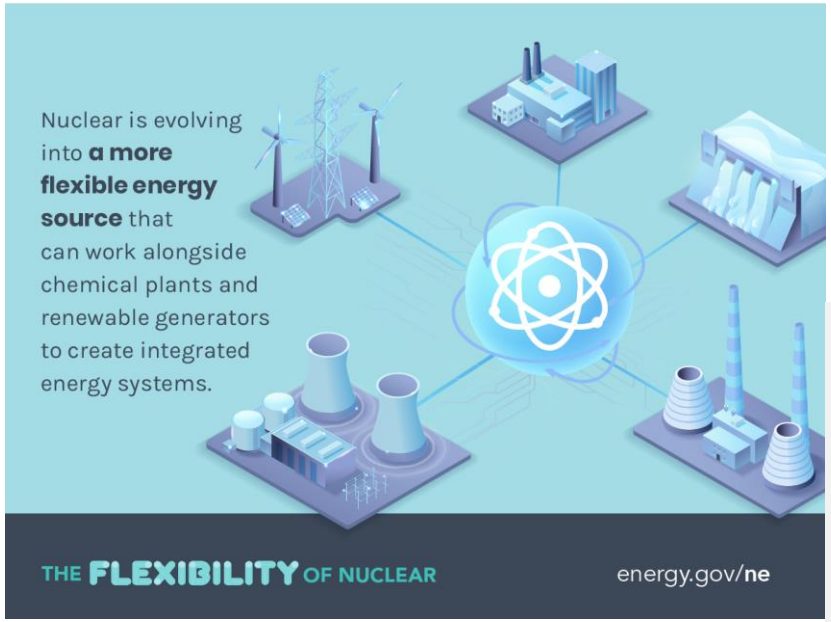
Enhanced energy system leverages contributions from low emission energy generation for electricity, industry, and transportation



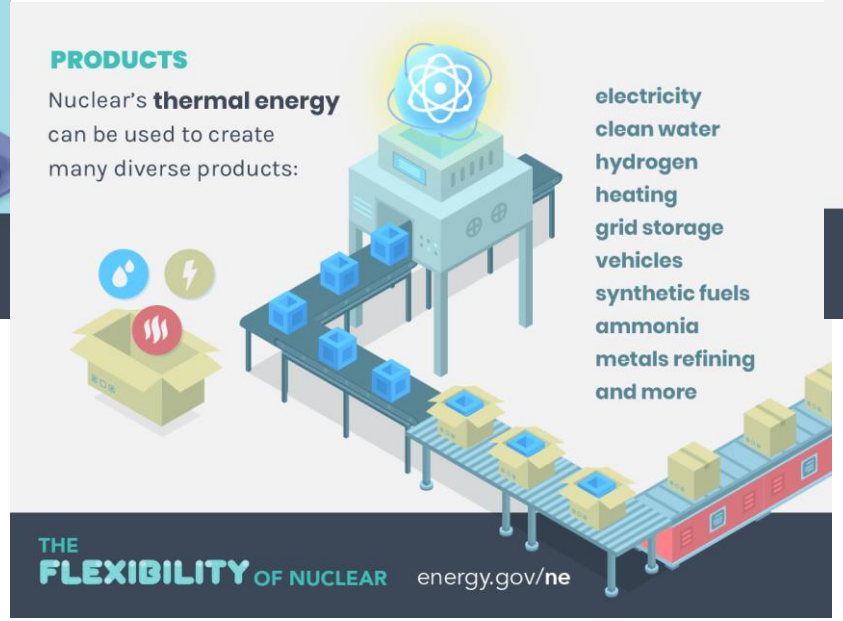
Flexible Generators ❖ Advanced Processes ❖ Revolutionary Design

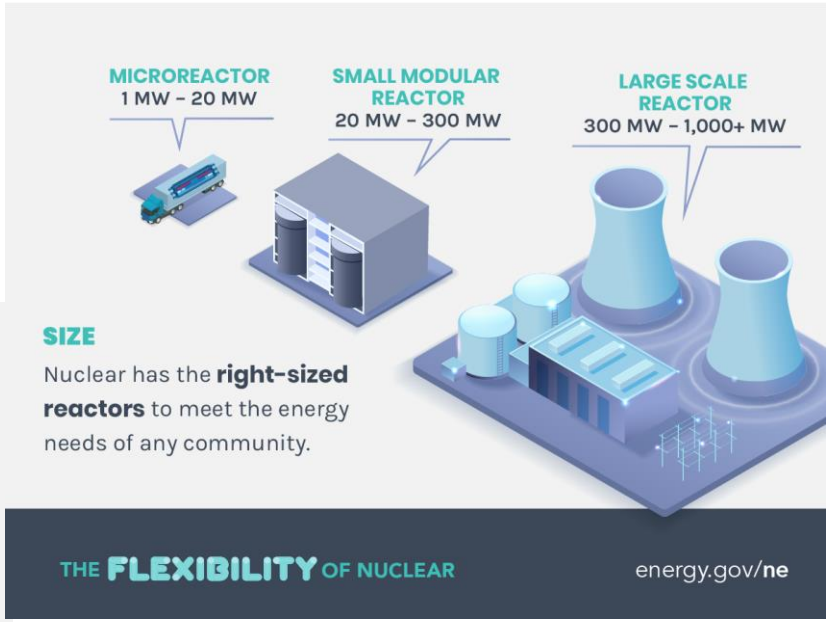
IES
Integrated Energy Systems

Integrated Energy Systems—A key opportunity for flexibility



Nuclear flexibility can be key in enabling other clean energy generators.





- ***Operational* flexibility**
  - ***Product* flexibility**
    - ***Deployment* flexibility**

U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Flexible Nuclear Energy for Clean Energy Systems, September 2020
https://www.nice-future.org/flexible-nuclear-energy-clean-energy-systems

IES Integrated Energy Systems

International Efforts—Nuclear Innovation: Clean Energy Future (NICE Future), an initiative of the Clean Energy Ministerial

NICE Future
Nuclear Innovation: Clean Energy Future

The NICE Future initiative explores the potential for nuclear energy uses, innovations, and greater systems integration to accelerate progress toward clean energy goals. The initiative recognizes there is no one-size-fits-all solution to energy and fosters collaboration among clean energy supporters in exploring diverse solutions.

Lead Countries


Canada


Japan


USA

Participant Countries


Argentina


Poland


Romania


Kenya


Russia


UAE


UK


Jordan

Focus Areas

Exploring innovative applications for advanced nuclear systems both electric and non-electric.

—

Pooling experience on economics, including valuation, market structures, and ability to finance.

—

Engaging policy makers and stakeholders regarding energy choices for the future.

—

Communicating nuclear energy's role in clean integrated energy systems and developing the nuclear workforce of the future.

External Partners

International Energy Agency
OECD Nuclear Energy Agency
International Atomic Energy Agency
International Framework for Nuclear Energy Cooperation
Generation IV International Forum
ClearPath
Third Way
Energy for Humanity
Energy Options Network
Women in Nuclear Global
International Youth Nuclear Congress
Nuclear Industry Council
Nuclear Energy Institute
World Nuclear Association
American Nuclear Society
Electricité de France

For more information, visit nice-future.org.

Multiple generation options
~
Multiple opportunities for energy security and decarbonization

Images courtesy of GAIN and Third Way, inspired by the *Nuclear Energy Reimagined* concept led by INL. Learn more about these and other energy park concepts at thirdway.org/blog/nuclear-reimagined