GAIN Overview

June 6, 2022

Andy Worrall, Deputy Director
Christine King, Director
Chris Lohse, Technology and Innovation Manager

GAIN
Gateway for Accelerated Innovation in Nuclear

The GAIN Team


Director – Christine King
Deputy Director – Andrew Worrall

Senior Advisor – Hussein Khalil

Program Manager
Lori Braase

- **Administrator** – Teresa Krynicki
- **Media Liaison** – Donna Kemp Spangler
- **Business Manager** – Alison Conner
- **Project Coordinator** – Holly Powell

Innovation & Technology Manager
Chris Lohse

- **Voucher Principal Investigators**
- **National Lab Technical POCs**
- **Process Modernization** – Rachel Taow
- **Regulatory Interface** – Jim Kinsey

November 5, 2021

GAIN Gateway for Accelerated Innovation in Nuclear

GAIN Goals for FY 2020-2025:

Goal #1. Provide nuclear industry entities access to financial support opportunities and national laboratory capabilities (facilities, expertise, and tools) to accelerate commercialization of innovations through research, development, demonstration, and deployment.

Goal #2. Work with industry to identify gaps, gather needs, and develop viable paths forward to inform DOE research programs and remove barriers for industry.

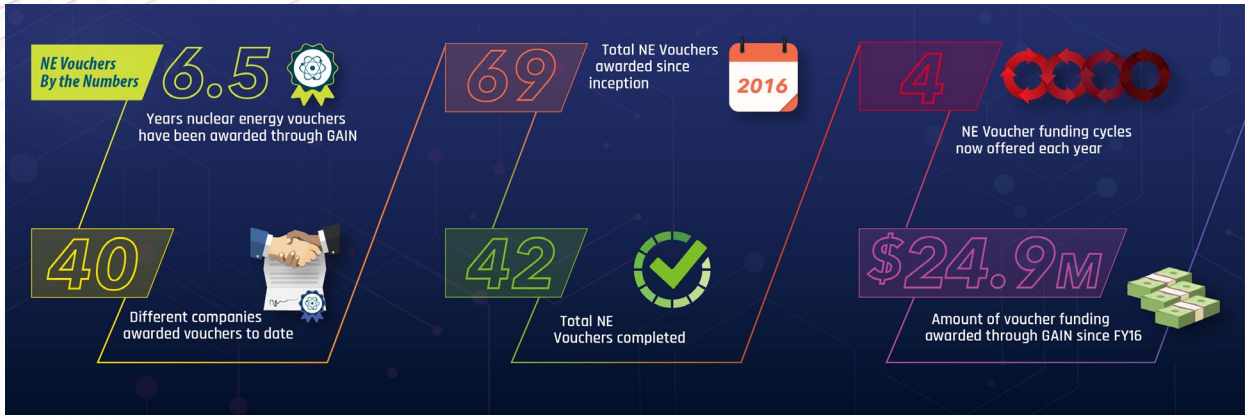
Goal #3. Work with industry stakeholders and NRC as means of communicating and resolving common (industry-wide) issues through regulatory interactions.

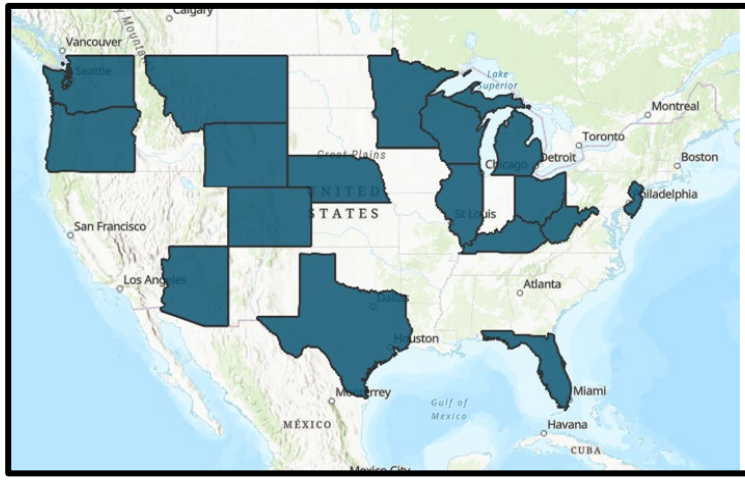
Goal #4. Facilitate the advanced nuclear industry's access to information to support their technology commercialization efforts.

Goal #5. Contribute tailored, factual information to key stakeholders to motivate the integration of clean nuclear energy for long-term success.

2022 Activities

GAIN Gateway for Accelerated Innovation in Nuclear





State Level Outreach

- Policymakers, NGOs, Utilities, Regulators, Industrials, Commissioners
- Introduce Advanced Nuclear through direct conversation or testimony
- Help connect states to financial or technical resources across DOE complex
- Looking at state level regs

Coal to Nuclear Transitions

- Leading Industry Research Group
- Specific Case Studies: WY, AZ, MD, KY
- Coordinated with Interagency WG

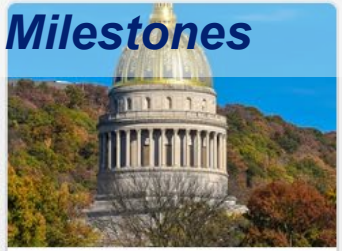
Advanced Nuclear Industry Milestones

Purdue University and Duk...
DATE
4/27/2022

VA Legislature Passes Bill ...
DATE
4/11/2022

Indiana Passes SMR Bill
DATE
3/18/2022

NuScale Power and KGHM ...
DATE
2/14/2022



West Virginia Repeals New...
DATE
2/8/2022

Oklo Partners with Argonn...
DATE
2/8/2022

USNC Partners with Coppe...
DATE
2/2/2022

State Energy Policy Drivers

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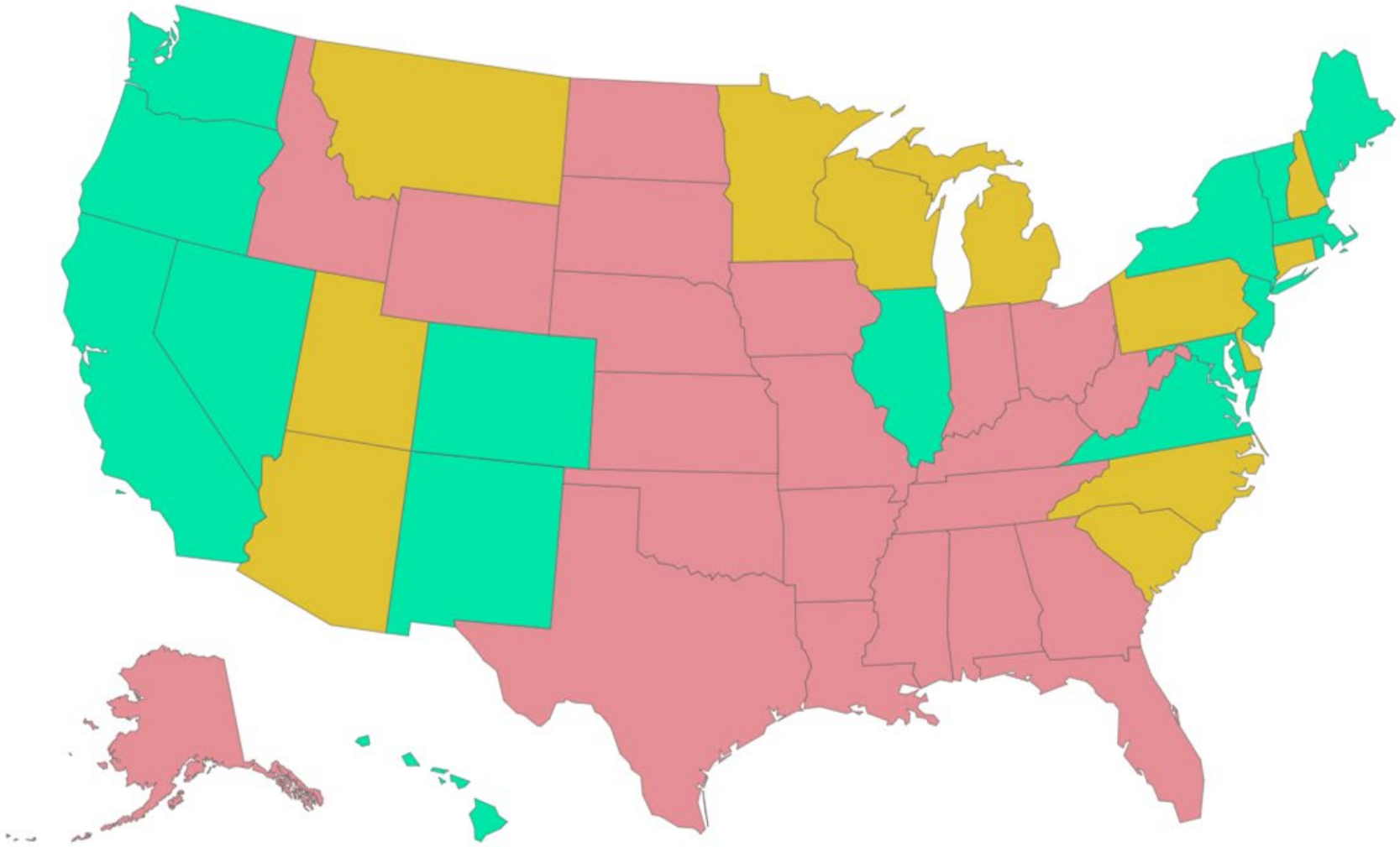
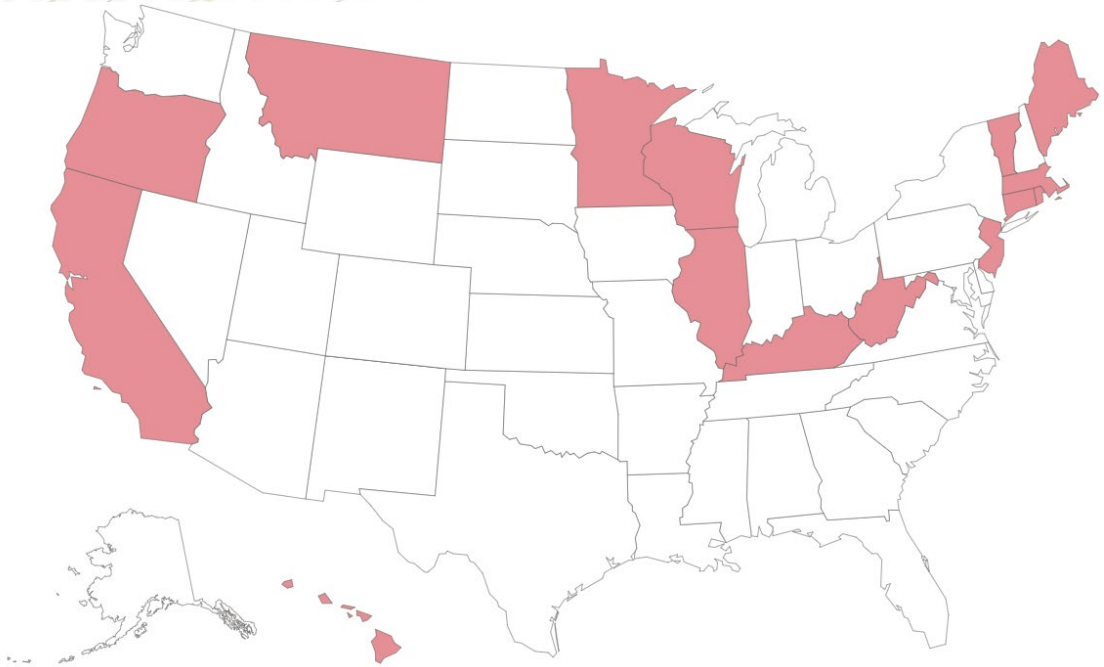
Rapidly Decarbonizing:
State has passed aggressive, binding carbon/GHG reduction targets for the electric sector

Tipping Point:
State has a sunsetting RPS/CES or is considering broad energy policy with no clear consensus

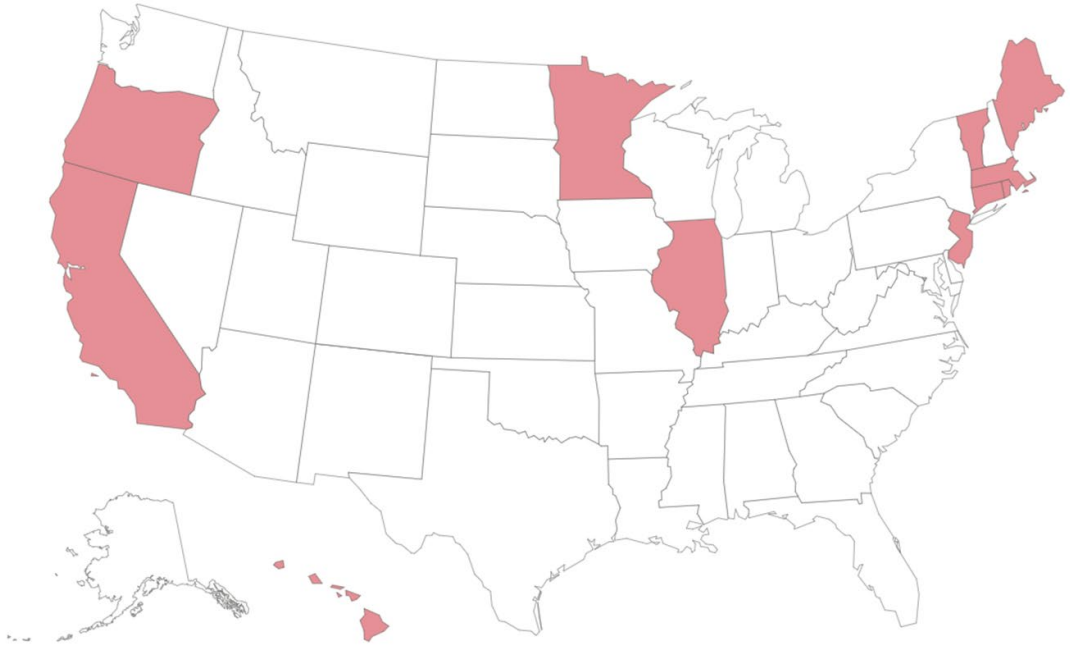
Carbon Dependent:
State has no aggressive, binding carbon/GHG reduction targets for the electric sector and is not considering them



Nuclear Restrictions and Moratoria



as of 2016



Current

SMR/AR Legislation Enacted 2020

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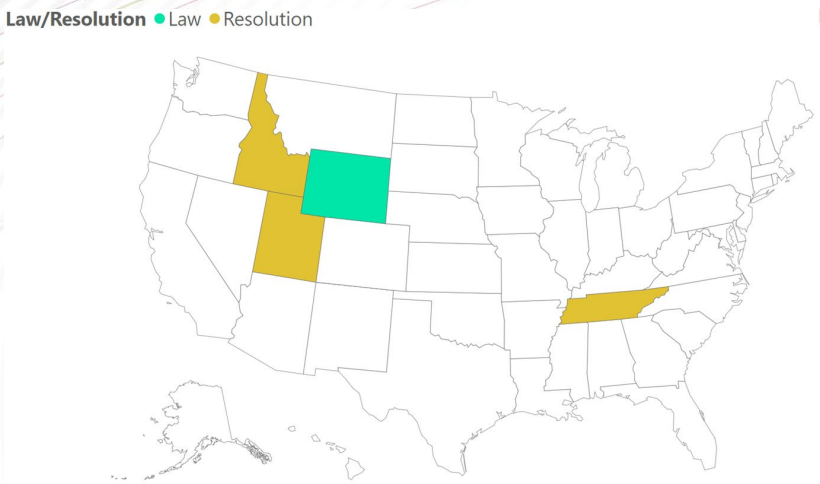
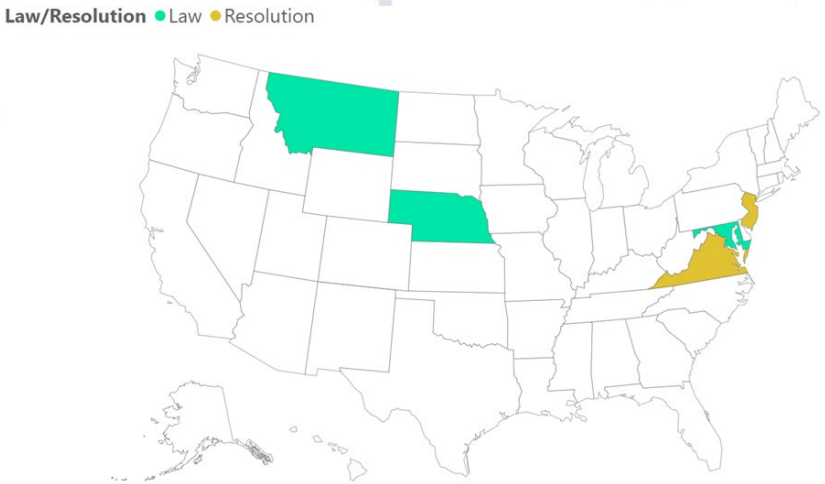
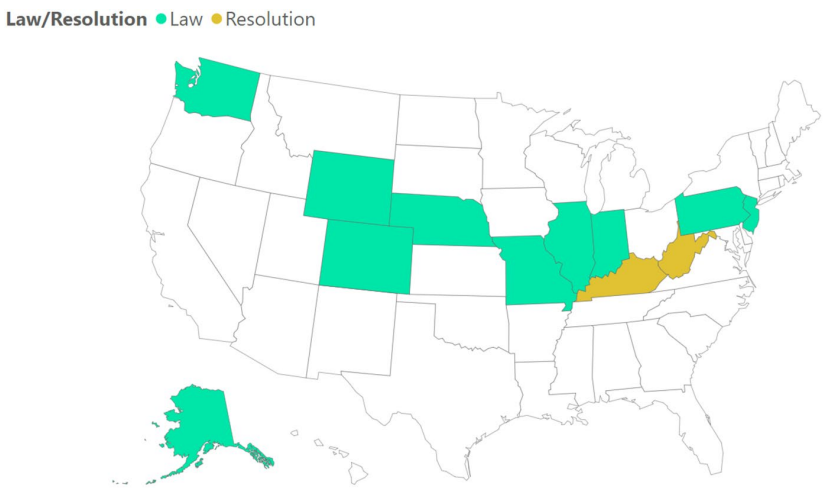


SMR/AR Legislation Enacted 2020



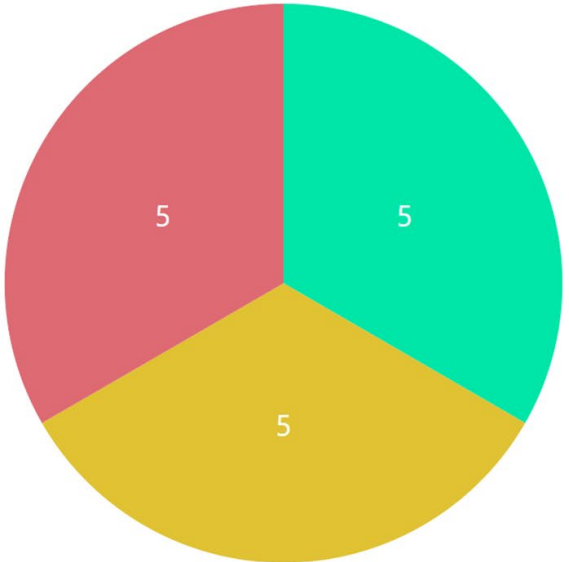
Recently Enacted or Adopted SMR/AR Initiatives

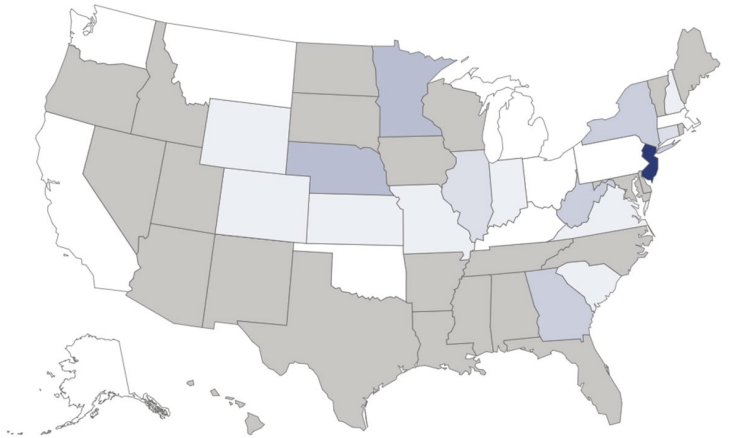


Recently Introduced SMR/AR Legislation

Legend
- Market Incentives / Financial Mechanisms
- Siting and Licensing Pathways
- Study / Review of AR Applicability to State Energy Goals

State	Relevant Legislation
Alaska	SB 177 / HB 299
Colorado	SB22-073
Indiana	SB 271
Kentucky	SCR 171
Missouri	HB 1684
Nebraska	LB 1100
Nebraska	LR 136
New Jersey	A3074 / S2307
Ohio	HB 434
Oklahoma	SB 1794
Pennsylvania	SB979
Virginia	HB 894
Washington	WA S 5244
West Virginia	HR 5
Wyoming	HB 131 / SF 104





All recent Nuclear Legislations
Pass/Fail/Pending

Coal to Nuclear Transition Project
Major Elements, Partners, Unique Features

1. Wyoming Summary: TerraPower, WY Energy Authority, PacifiCorp, Kemmerer

- Document the decisions that led to siting the Natrium project at the Kemmerer site.
- GAIN will help share the WY experience and perspective to a broader audience by preparing a report/roadmap and likely filming some short videos.
- This will help other communities and/or utilities begin their journey to consider advanced nuclear as part of a new energy future

2. Case Study Pilot (in partnership with DOE-FECM)

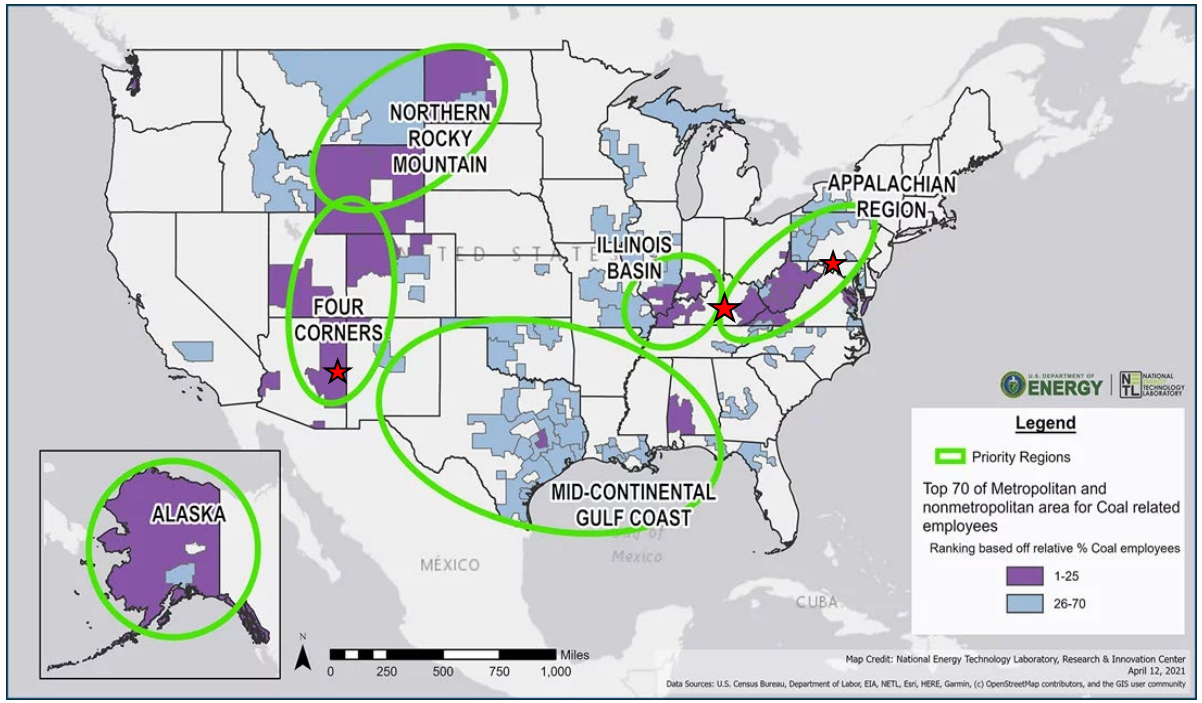
GAIN is in the process of scoping several case studies of specific coal sites/plants to understand the parameters that will have the most influence on moving forward with transitioning a coal site to nuclear. Scope several this year – complete 1 or 2 in the calendar year and initiate others in the future.

a. Coronado Generating Station, St Johns, Arizona
b. Warrior Run Generating Station, Cumberland, Maryland
c. EW Brown Generating Station, Harrodsburg, Kentucky

3. Coal to Nuclear Research Group

Each group is leading important projects associated with potential repurposing coal sites with nuclear technology. Use group discussions to align our individual efforts to make the most of this opportunity for the broader industry. In addition, get constructive feedback on GAIN case study pilot project.

a. GAIN, MPR (Contractor)
b. DOE-NE & -FECM
c. NRIC
d. SODI (Orano, Southern)
e. TerraPraxis
f. NEI
g. CATF
h. EPRI
i. DOE SA&I Campaign



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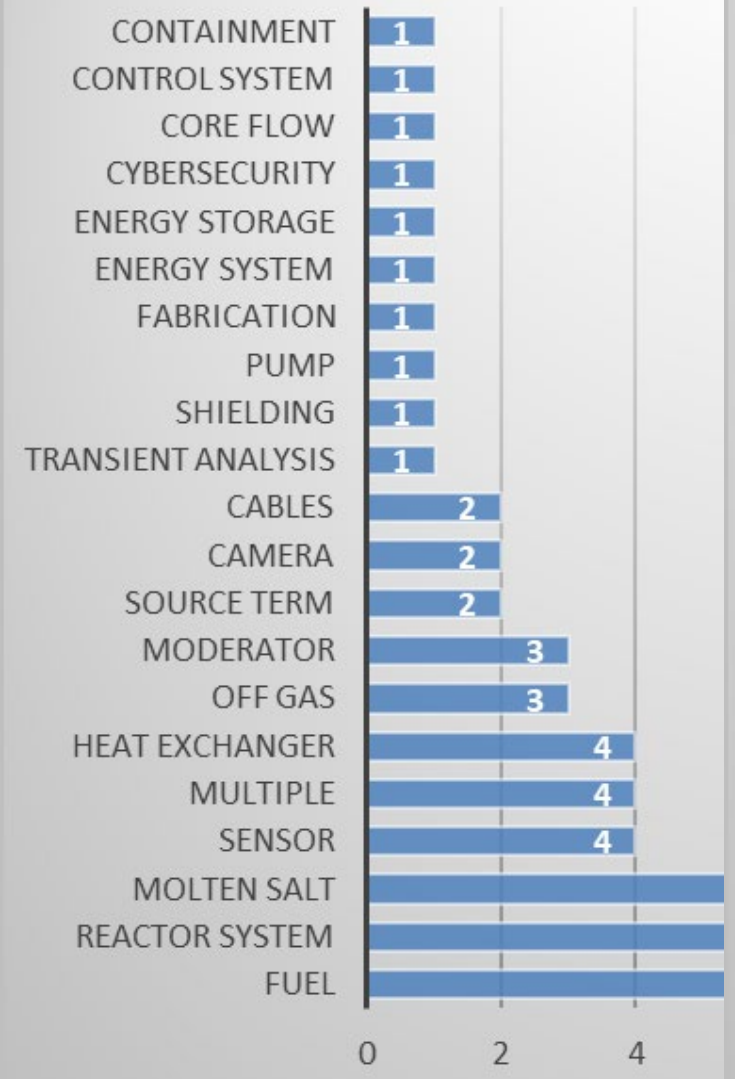
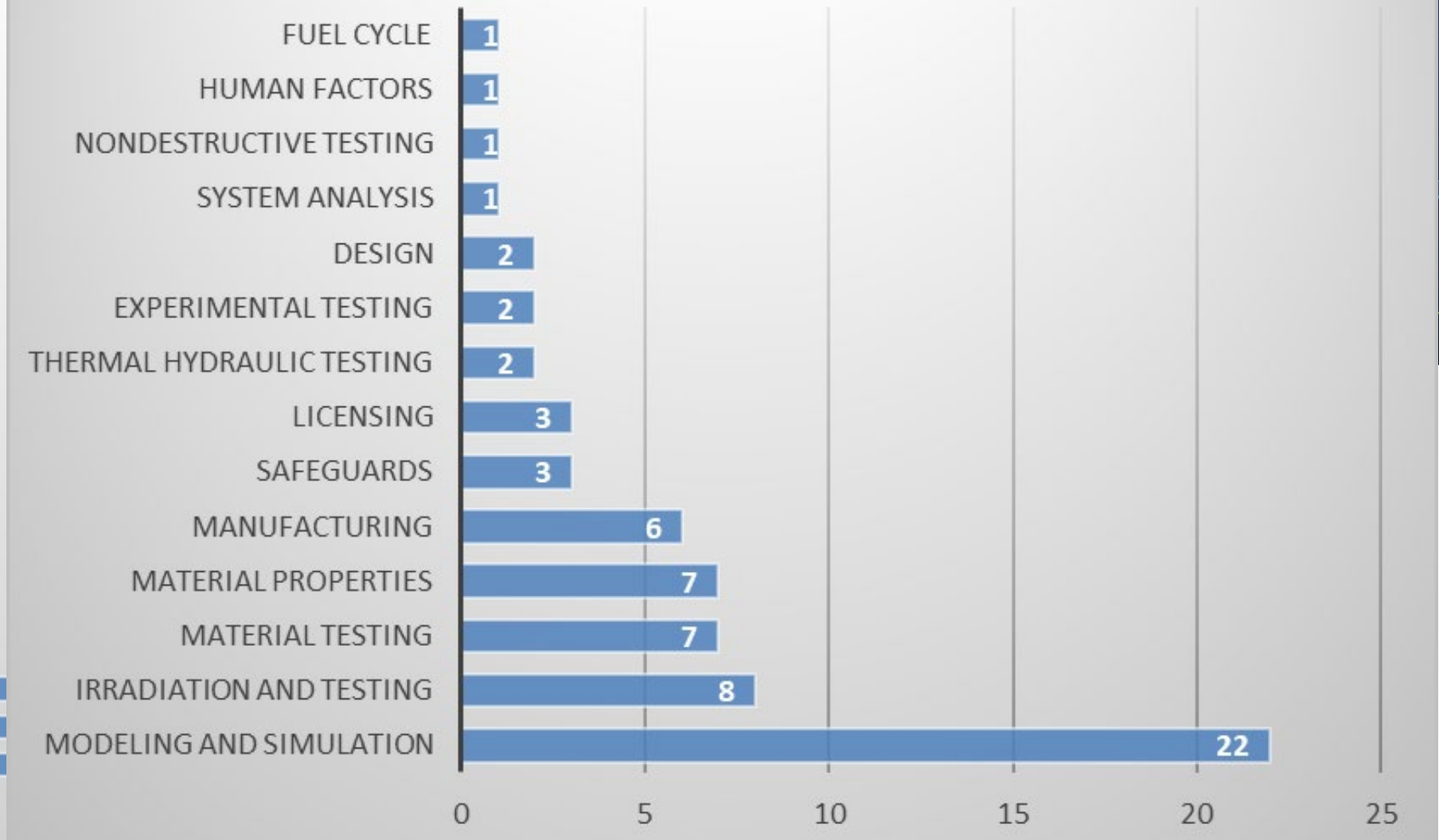
Voucher Awa



Voucher Awards by Work Type



AVAILABLE NOW: Completed Voucher Summaries

Year ↓	Recipient	Proposal
2019	Analysis & Measurement Services Corp.	Testing of I&C Sensors and Cables for Small Modular Reactors
2018	Exelon Corporation	Plasma Separation Process Feasibility Study for the Commercial Enrichment of Gadolinium-157
2018	Vega Wave Systems	Radiation Testing for Nuclear Inspection Systems
2018	Oklo Inc.	Accelerate Development of Industry-Relevant Features in Modern Simulation Tools
2017	Micro Nuclear LLC	Development of the Microscale Nuclear Battery
2017	Kairos Power	Nuclear Energy Advanced Modeling and Simulation Program Thermal-Fluids Test Stand

GAIN Voucher

https://gain.inl.gov/SitePages/Nuclear%20Energy%20Vouchers.aspx

Kairos Power
partnered with
Argonne National Laboratory and Idaho National Laboratory

RFA-17-14580, Nuclear Energy Advanced Modeling and Simulation Program Thermal-Fluids Test Stand

YEAR AWARDED: 2017

TOTAL PROJECT VALUE: $500K ($400K DOE funds awarded, $100K awardee cost share)

STATUS: Completed

PRINCIPAL LAB INVESTIGATORS: Elia Merzari (emerzari@anl.gov); Rich Martineau (INL retired)

DESCRIPTION: Argonne National Laboratory (ANL), Idaho National Laboratory (INL), and Kairos Power, LLC partnered to implement a multiscale thermal-fluids hierarchy analysis methodology for Kairos' fluoride high-temperature reactor (FHR). The project demonstrated Kairos Power's design optimization process for the heat exchanger, a vital component of the reactor's design. ANL performed high-fidelity simulations of Kairos' heat exchanger design at different spatial scales. Simulations using Nek5000, an open-source computational fluid dynamic code developed under the Nuclear Energy Advanced Modeling and Simulation program analyzed the heat and fluid flow in twisted tube heat exchangers. Software design improvements were implemented in the System Analysis Module (SAM) with the ultimate goal of providing a reliable thermal-fluid system simulator for FHRs. INL implemented additional efforts to improve the software compatibility between SAM and RELAP-7 and to bring SAM in line with the Multiphysics Object-Oriented Simulation Environment (MOOSE) Software Quality Assurance Plan. A prototype-coupled simulation was performed for a simplified tank loop. Based on the MOOSE multi-app framework, this prototype-coupled code will constitute the basis of future work in this area.

BENEFIT: Plant-scale physics (SAM) informed by the lower-length scale (Nek5000) can significantly improve solution accuracy and reduce uncertainty when using the software in a predictive sense where little to no empirical data is available.

IMPACT: This collaborative process between INL, ANL, and Kairos resulted in multiscale, multiphysics advances for FHR concepts and other advanced reactor concepts. Forming a team that worked cooperatively using the same simulation tools resulted in a shared ownership of the tools.

LESSONS LEARNED: Improved cooperation among DOE laboratories enhanced industry partners' confidence in relying on DOE for developing advanced modeling and simulation tools.

NEXT STEPS: Incorporating the Griffin application environment's use into reactor physics and radiation transport should be straightforward, as both INL and ANL are developing Griffin. Including Griffin will allow the state-of-the-art calculations to be performed on most advanced reactors incorporating single-phase coolants. Finally, the BISON nuclear fuel performance code can be coupled to the system to evaluate long-term fuel phenomena, such as irradiation damage and creep.

GAIN Vouchers – RFA Update

- Three main changes to vouchers
  - Removed the limitation of 2 active vouchers. Now is a limit on active DOE funding of $975,000.
  - Added a section for discussion of other DOE awards (ARDP and iFOA)
  - Added a cost estimate template

Voucher Project Schedule and Cost Estimate

Project Milestones	Weeks or Months Duration (After Start of Project)	DOE Lab Cost by Task	High-Level Task Breakdown			Company Cost Share by Task	Total Project Cost by Task
			Labor	Materials	Travel/Other		
Project Task A (Please list each task)	0-20	$5,000	$0	$0	$5,000	$10,000	$15,000
Project Task B	21-35	$5,000	$0	$5,000	$0	$25,000	$30,000
Project Task C	36-45	$250,000	$250,000	$0	$0	$35,000	$285,000
Project Task D	45-52	$90,000	$90,000	$0	$0	$17,500	$107,500
			$0	$0	$0		$0
			$0	$0	$0		$0
			$0	$0	$0		$0
			$0	$0	$0		$0
			$0	$0	$0		$0
TOTALS		$350,000	$340,000	$5,000	$5,000	$87,500	$437,500
			78%	1%	1%		

Column A. Enter project task list; this is a high-level task breakdown
Column B. Enter task duration; this can be in weeks or months (these are estimates)
Column C. Enter DOE cost estimates by task
Columns D-F. Assign DOE cost estimates to the specific task type
Column G. Enter Company cost share estimate by task
Column H. This column contains a formula and it will total for you.
Note. Company cost share amounts are not included in the High Level Task Breakdown.

Helpful Links

How to do business through GAIN
- How to do Business through GAIN

Proposal Submission System
- Submit a Proposal

Nuclear Energy Voucher Documents
- NE Voucher Process Flowchart
- NE Voucher Request 2.24.2022
- NE Voucher Cost Estimate Template 2.24.2022
- Voucher RFA Summary of Changes 2.24.2022
- Ten Tips for Writing a Successful NE Voucher Request
- NE Voucher FAQ's 2.24.2022
- GAIN Small Business Voucher CRADA 11.1.18
- DOE Standard CRADA 11.1.18

Legacy Documents / Industry Access

July 13, 2021
Fast Reactor (FR) Technology List provides access to 4,250 openly published FR documents available on OSTI (December 2018).
Molten Salt Reactor (MSR) Technology List provides access to 210 cataloged MSR documents available on OSTI (February 2017).
OSTI Spreadsheet of 12,000 Applied Technology (AT) Documents with abstracts provided to GAIN. List reviewed/released with abstracts and provided to TWG Chairs in March 2019. ~100 reviewed; public-released documents provided to industry.
Clinch River Breeder Reactor (CRBR) Project Documents (235 boxes + 75 reels of microfilm). Contract with Iron Mountain was initiated in February 2020. Scanning is currently on hold (COVID-19). Iron Mountain will proceed as soon as facilities open.
LOFT and other LWR Experiments. Fauske and Associates developed a pilot knowledge preservation activity in March 2019. Phase II was completed in 2021 resulting in the development of an electronic database of data related to key LWR experiments. Phase III is underway to capture additional key experimental program data and to organize it by reactor coolant type.
New Production Reactor (NPR) Documents at INL Storage (125 boxes-Idaho Falls). Red Inc. Communications has scanned 33 boxes and organized the files for Export/Classification Reviews. Two boxes of documents are in Export Review.
Loft Experiment Data for code validation. (Box of data—INL—to be scanned and reviewed.) **PBF Documents** (3 boxes at INL) will be scanned and reviewed.

Databases of Experimental Information

Database	Lab	Status (19July21)
TREXR TREAT Experiment Relational Database	ANL	https://www.trexr.anl.gov/ Access available by application
NaSCoRD Sodium System & Component Reliability Database	SNL	https://www.sandia.gov/nascord/ Phase II completed in FY20
ETTD EBR-II Transient Testing Database	ANL	https://ettd.ne.anl.gov/ Access available by application
FIPD EBR-II Metallic Fuel Irradiation Database *Includes data for U-Zr fuel employed in commercial designs; being qualified in accordance with NRC approved QAPP*	ANL	https://fipd.ne.anl.gov/ Access available by application
FFTF Passive Safety Testing & Metal Fuel Irradiation Database	PNNL	Available FY21; external access plan complete
OPTD Out of Pile Transient Testing Database	ANL	https://optd.ne.anl.gov/ Access available by application
IMIS (IFR Material Information System) EBR-II and FFTF Metal Fuel Experiment PIE Data	INL/ANL	Supplements the FIPD and FFTF Databases; complete in 2021
MSRE Molten Salt Reactor Component Reliability Database	ORNL/ EPRI	Available FY-21; currently being populated with operations, maintenance, and experimental data

All databases will have links available at gain.inl.gov

Agreement Types for Industry Partnerships

DOE

- *Cooperative Agreement*
  - Allows Industry to generate protected information and subject inventions using government funding and cost share

Labs

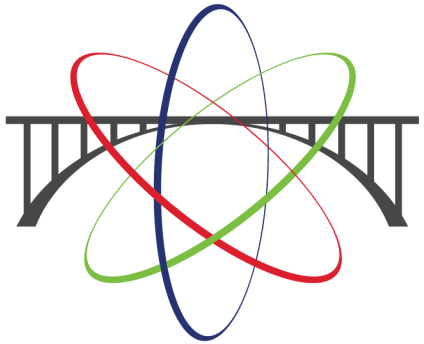
- *Cooperative Research and Development Agreement (CRADA)*
  - Allows labs to generate protected information for Industry using government resources and in-kind contributions; negotiable terms and conditions
- *Strategic Partnership Project (SPP) Agreement*
  - Allows labs to generate proprietary information and subject inventions for Industry through full cost recovery; negotiable terms and conditions

Contract Modernization

- GAIN Access CRADA fully executed Aug. 2021.
- Longer periods of protection for information generated under CRADAs.
  - Infrastructure Investment and Jobs Act extends period of protection from five to thirty years.
- GAIN is working with DOE and labs to adopt efficiencies in review process associated with DOE Policy 485.1A Foreign Engagements with National Laboratories.

Multi-Lab Access Agreement

- *INL signed March 31, 2021*
- *Kairos Power signed April 1, 2021*
- *ANL signed June 8, 2021*
- *LANL signed Aug 20, 2021*



GAIN

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