



NET-ZERO | 2031 PLAN

Transforming INL to Net-Zero Emissions • 2023

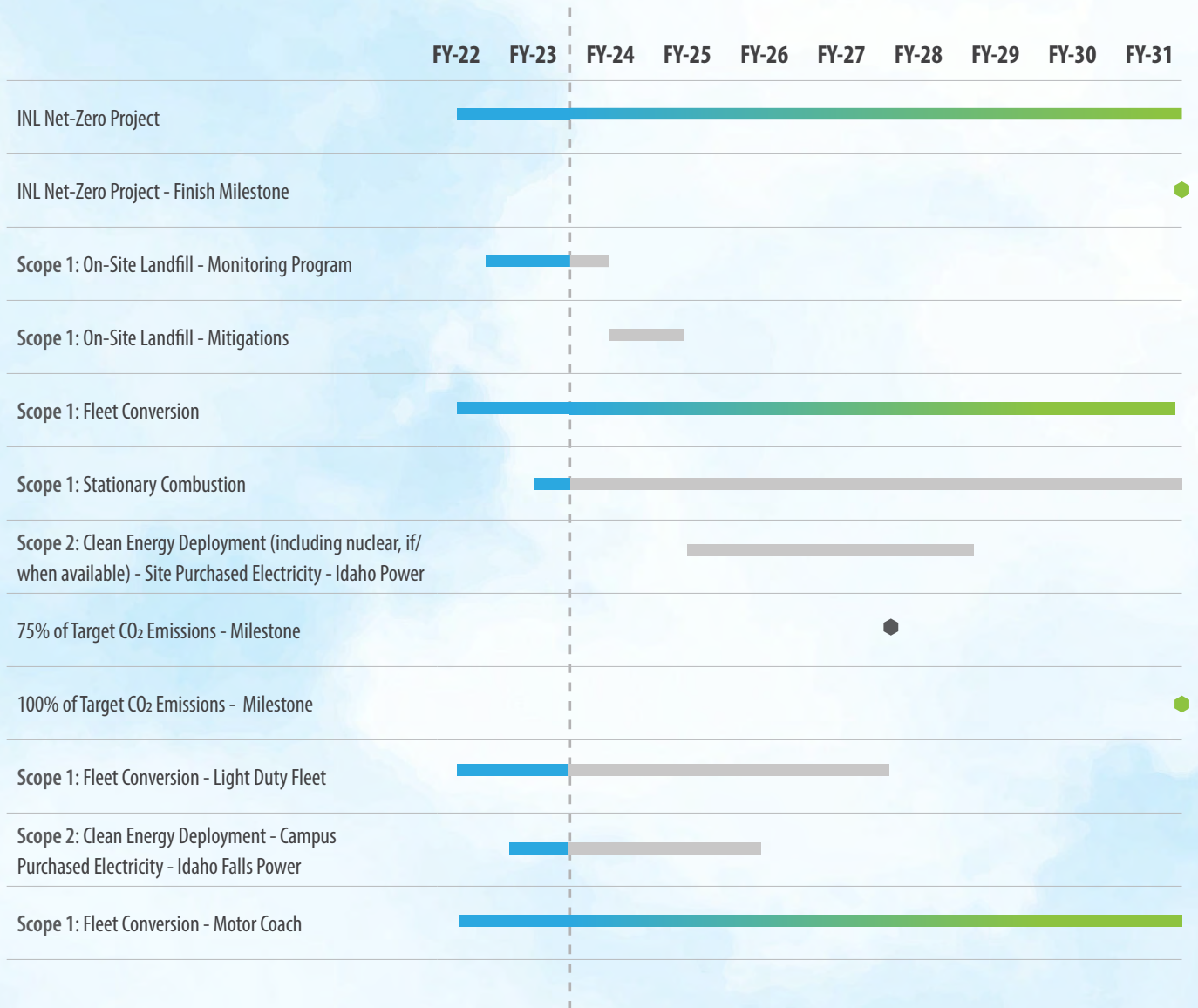
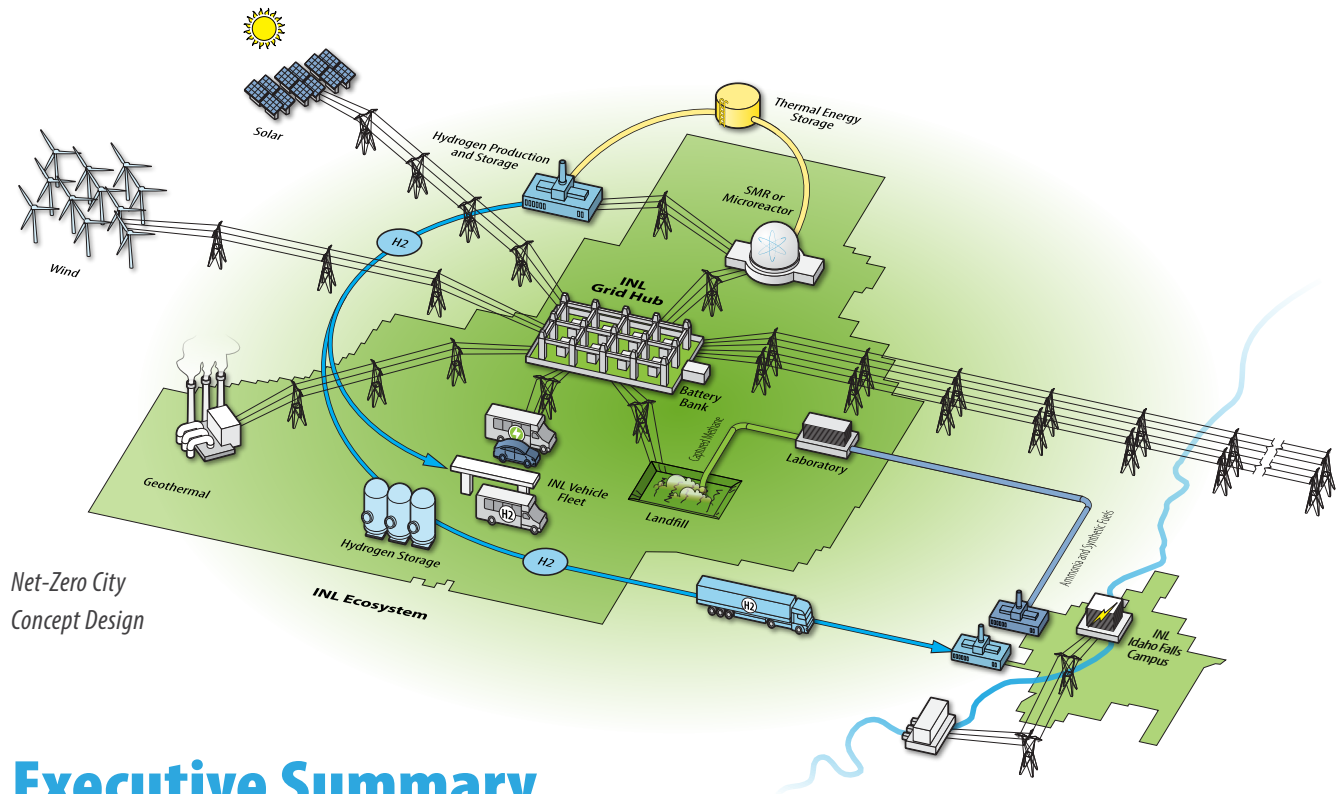


Table of Contents

1	Executive Summary	2
2	INL Mission Overview	6
	2.1 History of Sustainability at INL	7
3	Current Emissions Profile	8
4	Net-Zero Strategy & Action Plan	10
	4.1 Scope 1: Mobile Combustion	11
	4.2 Scope 1: On-site Landfill	13
	4.3 Scope 1: Stationary Combustion	14
	4.3.1 Research and Education Campus (REC)	15
	4.3.2 Site	16
	4.4 Scope2: Purchased Electricity	17
	4.4.1 Energy Efficiency	17
	4.4.2 REC	17
	4.4.3 Site	17
	4.4.4 Roadmap to Net-Zero Through Nuclear	18
	4.5 Scope 3: Employee Commuting & Business Travel	19
5	Regional Engagement	20
6	Community Impacts & Environmental Justice	21
7	Responding to Challenges & Identifying Opportunities on the Path to Net-Zero	22
8	Net-Zero Projects, Indirect Funds, and Appropriations	25
	8.1 Indirect Funding	25
	8.2 Appropriations	25
	8.3 CRADAs/SPPs	25
9	Formal Reporting	25

Battelle Energy Alliance manages INL for the U.S. Department of Energy.



Executive Summary

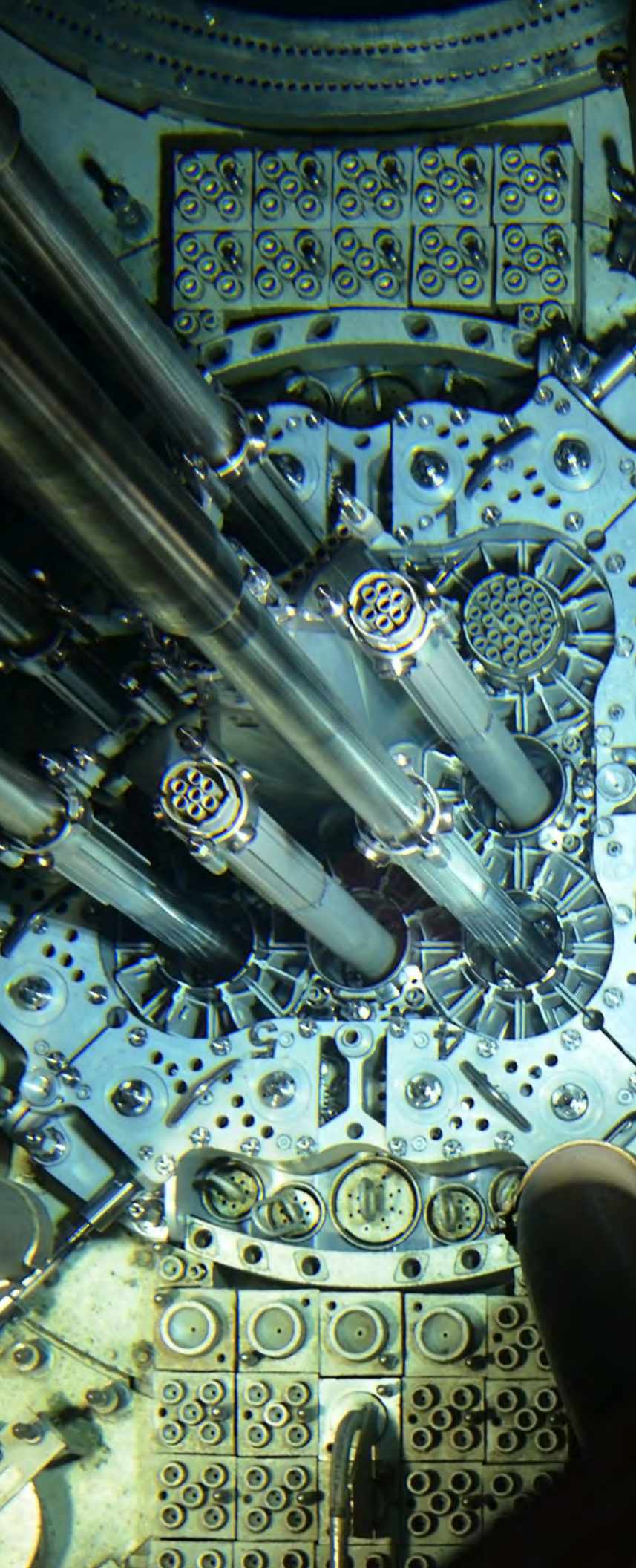
Idaho National Laboratory is changing the world's energy future and securing our nation's critical infrastructure through innovative nuclear energy solutions and other clean energy options.

The Net-Zero Program is leveraging the innovative, synergistic research conducted at Idaho National Laboratory (INL) to achieve net-zero carbon emissions from site operations by 2031. INL's net-zero goals align with Executive Order (EO) 14008, Tackling the Climate Crisis at Home and Abroad, and EO 14057, Catalyzing America's Clean Energy Industries and Jobs through Federal Sustainability.

In 2021, INL released its first Net-Zero Plan to communicate its commitment to net-zero carbon emissions by 2031 and how it planned to reach the goal. This revision – the Net-Zero 2031 Plan – updates our scope and progress to date. It also helps maintain transparency about our work, shares initial results and lessons learned and serves as a touchstone for those engaging in similar efforts. Like the previous version, this revision includes information about our work to decarbonize

energy use from over 300 buildings distributed across a rural 890-square-mile site as well as the Research Education Campus in urban Idaho Falls. This plan also includes the solutions INL is pursuing to eliminate emissions from its vehicle fleet, including its motor coaches that transport an average of 2,500 employees daily.

The Net-Zero 2031 Plan also includes progress and strategies to minimize emissions from on-site landfills and stationary combustion sources. Finally, the plan proposes solutions to decarbonize purchased electricity, which is more than 50% of our total emissions, with nuclear electricity generation as it becomes available. This plan reflects a high-level overview of the work being conducted. INL also maintains a playbook, which is an internal working document used to track progress, ensure accountability, identify obstacles and pursue new opportunities as they arise.



INL will align mission activities with operations to achieve deep decarbonization. By advancing an accelerated timeline earlier than laid out in EO 14057, INL will identify challenges to innovate and share solutions with the nation and the world.

As a Department of Energy national laboratory, INL is positioned to take on difficult problems, identify research needs and propose solutions. Moreover, given the size, characteristics and complexity of INL, which encompasses almost all emissions sectors, the solutions offered through this plan can help inform city-, county- and state-level plans to decarbonize.

The Net-Zero 2031 Plan revisions shows how we have focused our efforts while also setting the foundation for the work that will continue beyond our goal. Achieving net-zero emissions will be a monumental success; making certain this achievement is sustainable and adaptable to changing energy needs without impacting mission work will be essential to realizing U.S. decarbonization commitments.

Overview

The end of ...

FY-25

- Landfill assessment complete

FY-26

- Microreactor deployment

FY-27

- 75% of Net-Zero target complete
- Finalize light-duty vehicle transition plan

FY-29

- Demonstrate INL campuses to operate with 100% CFE

FY-31

- Complete building electrification to DOE-owned facilities on the Research and Education Campus
- Reach Net-Zero



INL NZ Scope	Emission Source	FY-22 Emissions MtCO ₂ e	Inventory	Actions	2023 Current Status	2023 select estimated CO ₂ e reductions
Scope 1	Mobile Combustion	9,038	702 vehicles 210 to transition	Right-size fleet; develop GSA timeline; transition to electric & hydrogen; install supporting infrastructure	23 LDV EVs, 1 electric motor coach	Electric motor coach = est. 36.8 MtCO ₂ e reduction/year LDV replacements = est. 79.5 MtCO ₂ e/year
	Stationary Combustion	3,303 (DOE-owned only)	327 DOE-owned buildings	Identify equipment; pursue building electrification strategies, energy retrofits and whole building commissioning	REC engineering reports complete; REC setbacks; Site prioritization plan in process	Initial REC building setbacks = ~80+ MtCO ₂ e/year propane and fuel oil reductions = 596 MtCO ₂ e reduction/year
	Landfill	5,729	~200 acres	Monitor and determine mitigation strategies	2 quarters of monitoring completed	>50% waste reduction with recycling
Scope 2	Purchased Electricity	42,871		Work with Idaho Power, Idaho Falls Power, and DOE to secure Power Purchase Agreements	Pursuing a PPA for 100% CFE, with nuclear when/if available; increasing building efficiencies	Implemented automated efficiency programs in 16 buildings
Scope 3	Employee commuting, business travel, wastewater	12,611		Expand walking/biking infrastructure, community events, carpool tools, online trail apps	Established Bike Commuter Resource Center; established and released iMap tool	

The above table provides an overview of current inventory, status, actions, and CO₂e savings

INL Mission Overview

As the U.S. leader for advanced nuclear energy research, development and demonstration (RD&D), INL leverages an unmatched combination of nuclear energy research facilities and test beds to execute its mission to discover, demonstrate and secure innovative nuclear energy solutions, other low-carbon energy options and critical infrastructure. INL combines basic research, applied science and engineering, and a problem-solving approach.

INL's vision for the low-carbon integrated energy systems of the future incorporates baseload power from nuclear, geothermal and variable renewables while repurposing heat and electricity from existing reactors for direct use and to support industrial processes, such as hydrogen generation. To achieve this vision, INL will lead RD&D for the advanced reactor technologies and improved fuel cycle elements needed to sustain the existing fleet and expand deployment of nuclear energy.

INL leads RD&D to develop next-generation reactor technologies and advanced, integrated fuel cycles.

INL's innovative approaches to advanced nuclear fuel, fuel cycle technologies, nuclear reactor systems and safety and risk assessments are vital to sustaining and expanding nuclear energy. To further innovative nuclear energy solutions, INL leads the National Reactor Innovation Center (NRIC), a national program authorized in 2018 by the Nuclear Energy Innovation Capabilities Act. NRIC provides resources to test, demonstrate and assess performance of new nuclear technologies, critical steps that must be completed before many are available commercially.

INL advances integrated low-carbon energy options by exploring solutions to challenges in energy technologies and improving the water and energy efficiency of industrial manufacturing processes. INL addresses materials challenges unique to nuclear and other energy systems, as well as aerospace, transportation and

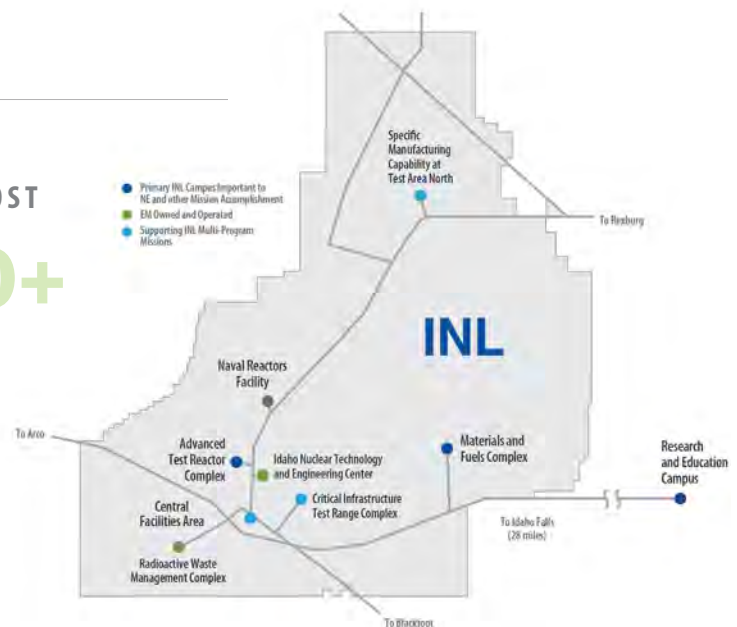
defense systems, through work in advanced materials and manufacturing for extreme environments. To secure the critical cyber-physical infrastructure essential to energy and defense systems now and in the future, INL supports the Department of Energy's National Nuclear Security Administration, the Department of Defense, the Department of Homeland Security and the intelligence community by confronting significant national security challenges in critical infrastructure protection, cybersecurity and nuclear nonproliferation. INL pursues its missions through collaborative partnerships with other federal entities, national laboratories, international organizations, universities and private industry. INL's robust partnerships are essential to accelerating to market those research breakthroughs that will support American competitiveness.

\$1.630M FY22 TOTAL OPERATING COST

EMPLOYEES **5,900+**

569,178 ACRES

SQUARE MILES **890**



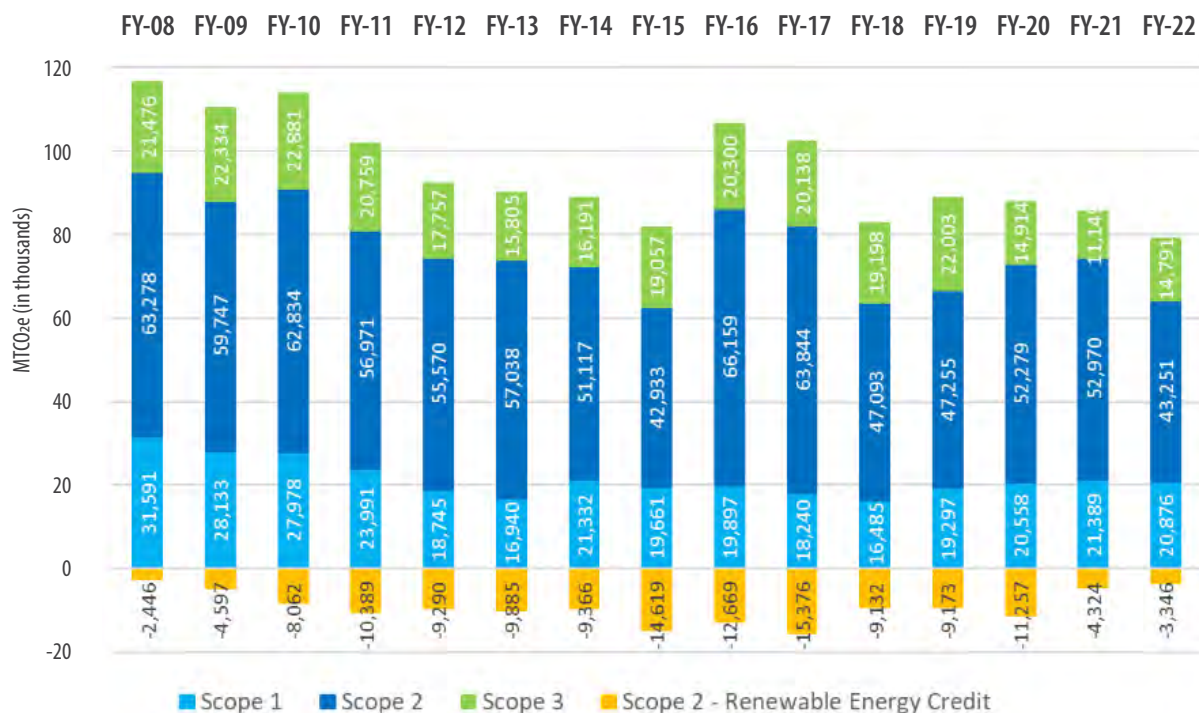
4 Operating reactors
22 Hazard Category II & III non-reactor facilities/activities
49 Radiological facilities/activities
17.5 Miles railroad for shipping nuclear fuel
44 Miles primary roads (125 miles total)
9 Substations with interfaces to two power providers
128 Miles high-voltage transmission & distribution lines
3 Fire stations

2.1 HISTORY OF SUSTAINABILITY AT INL

The Sustainability Program was established in 2007 to measure, report and reduce energy and water use intensity related to all INL operations, enabling the laboratory to uphold federal sustainability standards. The INL Site Sustainability Plan contains strategies and activities that lead to continual energy, water, recycling and transportation-fuels efficiency improvements.

The greenhouse gas (GHG) inventory calculations follow the current methodology available as prescribed in the "Federal Greenhouse Gas Accounting and Reporting Guidance, Council on Environmental Quality, Jan. 17, 2016" (referred to herein as the guidance). In addition to standardizing the methodology, the guidance attempts to use the data federal facilities are already required to report, such as fuel (for energy and fleet) and electricity usage.

While the Net-Zero 2031 Plan uses GHG reporting data from the Sustainability Program, the Sustainability Program reports on additional metrics such as electronics recycling, sustainable acquisitions, water consumption and natural gas consumption in leased facilities. Conversely, some of the data for the Net-Zero Plan is gathered outside the scope of sustainability, including the Roadmap to Net-Zero through Nuclear and carbon capture.



Current Emissions Profile

*INL's Net-Zero Program is dedicated to **reducing emissions in all three scope areas**, as defined by the Environmental Protection Agency.*

The 2022 Net-Zero Plan used FY-19 emissions numbers as the baseline because they reflect emissions prior to the COVID-19 pandemic, which significantly changed operations in FY-20 and FY-21. The updated Net-Zero 2031 Plan uses new calculations based on guidance from EO 14057 that consider availability of technologies, including zero-emission vehicles and HVAC systems that meet mission needs and safety requirements, as well as limitations on electrification of leased facilities.

The Net-Zero Plan also accounts for the laboratory's projected growth – in employees, facilities and energy consumption. As these changes occur, INL will ensure that its carbon footprint does not increase. These measures include negotiating agreements with local utilities to plan for increased carbon pollution-

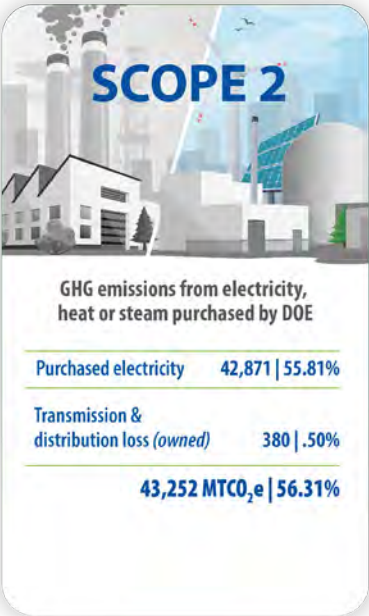
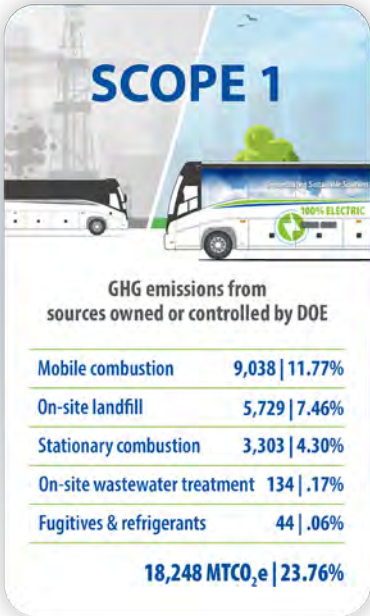
free electricity needs and adhering to engineering standards that require energy efficient net-zero/net-zero ready facilities to be added to the portfolio.

NOTE: The Net-Zero 2031 Plan is inclusive of BEA-operated facilities and does not include emissions related to the Idaho Cleanup Project or Naval Reactors Facility, which report their own data.

SCOPE 1

Direct or INL-owned emissions produced on-site, such as stationary combustion (from fuel combustion), mobile combustion (from fleet vehicles) and fugitive emissions (from refrigerants, landfills and wastewater treatment) are categorized as Scope 1 emissions. These include emissions that may benefit another entity or contractor, but INL controls or owns the associated process.

FISCAL YEAR 2022



SCOPE 2

Scope 2 emissions are indirect or shared and include emissions produced by electricity, heat and steam purchases. Since INL does not purchase heat or steam, these emissions are largely concentrated in purchased electricity as well as associated transmission and distribution losses.

NOTE: As INL's vehicle fleet and building portfolio are electrified, Scope 2 emissions are expected to temporarily increase until 100% carbon pollution-free electricity (CFE) is obtained from local utilities.

SCOPE 3

Scope 3 encompasses emissions that are not produced by INL and are not the result of activities from assets owned or controlled by INL. They occur outside INL's organizational boundaries but are a consequence of INL's activities, including transmission and distribution losses, employee commuting, employee travel, contracted waste disposal and contracted wastewater treatment.

Scope 3 emissions are outside of the scope of the Net-Zero 2031 goals for INL. However, INL is addressing these emissions through a variety of activities as detailed below in the Scope 3 emissions section.

The lessons INL learns from reducing emissions in each of these scopes can provide a robust and inclusive model for

cities, towns and municipalities working to reach net-zero emissions. The desert Site's size, rural location, extreme climate, energy infrastructure, public transit system and overall complexity, which is connected to the more urban Research and Education Campus facilities, make INL ideal to demonstrate what getting to net-zero looks like for diverse urban and rural communities.

NOTE: Greenhouse gas emissions include CO₂ (carbon dioxide), CH₄ (methane), N₂O (nitrous oxide), HFCs (hydrofluorocarbons), SF₆ (sulfur hexafluoride**), PFCs (Perfluorocarbons) and NF₃ (nitrogen trifluoride).

***SF₆-sulfur hexafluoride is used in limited applications such as recharging old breakers and often does not appear in INL's reporting.*

Potential Greenhouse Gas Sources

	CO ₂	CH ₄	N ₂ O	SF ₆	HFCs	PFCs	NF ₃
Fugitive On-Site Wastewater		1					
Fugitive On-Site Landfill		1					
Fugitive Refrigerants	1	1	1	1	1	1	1
Mobile Combustion	1	1	1				
Stationary Combustion	1	1	1				
Purchased Electricity	2	2	2				
T&D Owned Losses	2	2	2				
T&D Losses Shared	3	3	3				
Employee Commuting	3	3	3				
Business Air Travel	3	3	3				
Travel: Rental Vehicles	3	3	3				
Travel: Personal Vehicles	3	3	3				
Contracted MSW Disposal		3					
Contracted Wastewater Disposal		3	3				

NOTE: the colored blocks represent possible sources contributing to each category. Not all fugitive refrigerant sources may be emitted in a given year.



Net-Zero Strategy & Action Plan

The Net-Zero 2031 Plan is focused on eliminating emissions from DOE-owned facilities, non-emergency vehicles and purchased electricity. Procuring 100% carbon pollution-free (CFE) electricity from our utility providers is essential to reducing Scope 1 emissions, especially as buildings and fleet vehicles are electrified. Thus, the Net-Zero Plan's primary focus is working with utilities to procure 100% carbon pollution-free electricity through installing on-site carbon pollution-free electricity, power purchase agreements, renewable energy certificates and energy attribute certificates.

The Net-Zero Program also created a Net-Zero Playbook in concert with operational and asset owners. The playbook is an internal living document that contains individualized action plans updated monthly to ensure accountability, identify challenges and assess progress toward INL's net-zero goals.

Impacts of 100% CFE on Scopes 1, 2 and 3 emissions

Scopes 1, 2 & 3 Emissions	FY-19 Baseline	FY-22
100% CFE for electricity	53% reduction	56% reduction
100% CFE and fleet and stationary combustion are 100% electrified	68% reduction	73% reduction
Only Scopes 1 & 2 Emissions	FY-19 Baseline	FY-22
100% CFE for electricity	71% reduction	70% reduction
100% CFE and fleet and stationary combustion are 100% electrified	90% reduction	90% reduction

Our strategy for Scope 1 has been to first identify and catalogue each building and piece of equipment that falls within the Net-Zero 2031 Plan parameters. After assessing CO₂e outputs and impacts as well as equipment availability and timelines, we prioritized projects on each campus.

The following section offers details of these plans and updates on INL's progress.

NOTE: As mentioned above, achieving net-zero carbon emissions depends on achieving 100% carbon pollution-free electricity. INL anticipates a temporary increase in Scope 2 emissions as fleet vehicles and buildings are electrified due to the associated increased electricity consumption. The table above illustrates the potential impact 100% carbon pollution-free electricity could have on emissions should a full building and fleet electrification be possible.

4.1 SCOPE 1: MOBILE COMBUSTION

INL's fleet is the largest and most complex among DOE's national laboratories. Motor coaches transport approximately 2,500 employees per day to and from the remote site (with some round-trip routes greater than 100 miles) 365 days per year. Annually, they travel more than 2.7 million miles. The site's complexity, topography, extreme weather variations and operation in and between both rural and urban zones make adopting a multifaceted approach to net-zero emissions that includes electric and hydrogen imperative to its success. These factors make INL an ideal test site for new and existing technologies and will offer invaluable data for others seeking to decarbonize their public transportation systems.

To determine the number of fleet vehicles that can be converted to zero-emission vehicles, we first created an inventory of all INL vehicles. We then consulted with emergency services and the General Services Administration to determine which vehicles had suitable replacements. The table on the following page outlines the number of vehicles in the fleet as well as those identified as candidates for transition to zero-emissions replacements.

Our Net-Zero 2031 Plan follows guidance laid out in EO 14057, which prioritizes zero-emission vehicles. The executive order states that each laboratory shall have "100 percent zero-emission vehicle acquisitions by 2035, including 100 percent zero-



emission light-duty vehicle acquisitions by 2027." To that end, INL's fleet services are working to transition eligible vehicles, with a focus on light-duty vehicles.

EO 14057 also acknowledges that certain vehicles cannot be transitioned due to lack of like replacements through GSA, which is highly relevant to INL since it operates an incredibly complex fleet of approximately 700 light-, medium- and heavy-duty vehicles. The latter two currently have no suitable replacements. Until proven technology and fuels are available, INL will continue to operate and maintain the current fleet of medium- and heavy-duty vehicles, including mission critical vehicles such as fire trucks and ambulances. This

omission is in line with EO 14057, which states that any agencies with at least 20 vehicles shall maximize "acquisition and deployment of zero-emission light-, medium- and heavy-duty vehicles where the General Services Administration offers one or more zero-emission vehicle options for that vehicle class." Should zero-emissions vehicles become available for these classes, INL will update its strategy and plan.

ACTIONS

INL will reduce emissions in its light-duty vehicles and motorcoaches by (1) right-sizing its fleet size to meet mission needs with maximum efficiency; (2) determining fleet vehicles in scope (and updating the Net-Zero Plan as new technologies become available); (3) working with GSA to transition 210 of its light-duty vehicles to electric and/or hydrogen; (4) transitioning six motorcoaches to electric and hydrogen fuel cell electric bus as they become available; and (5) implementing the infrastructure necessary for the fleet transition, including EV chargers and hydrogen fueling stations. INL is also investigating carbon capture technologies to help offset any emissions that cannot be eliminated through the aforementioned actions.

ANNUALLY, MOTOR COACHES TRAVEL

2.7M miles TRANSPORTING APPROXIMATELY
2,500 employees PER DAY

Overview of fleet in Scope 1

Vehicle Type	Number To Transition	Number Transitioned To Date
Motor coaches to electric/hydrogen	6	1
Light-duty vehicles	204	23
Infrastructure	Number To Install	Number Installed To Date
Level 2 EV chargers	67 stations	23 stations
Level 3 EV chargers	3 stations	2 stations

Since medium- and heavy-duty alternatives are not available, INL plans to use renewable fuels whenever possible and implement carbon capture options when available.

FY-22 fuel used

Fuel Type	Vehicle Type	Fuel Used (gal)	GHG Emissions (MT CO _{2e})
Diesel	Bus	402,350.41	4,110.34
	Equipment	96,611.90	994.95
	Heavy duty	72,867.66	744.72
	Light-duty car	11.62	0.86
	Light-duty truck	330.94	3.38
E10 ethanol fuel blend	Bus	—	—
	Equipment	9,141.68	73.17
	Heavy duty	88,532.03	708.10
	Light-duty car	126,781.83	1,014.62
	Light-duty truck	168,840.99	1,348.01
E85 ethanol fuel blend	Equipment	0.00	—
	Heavy duty	3,203.53	5.61
	Light-duty car	1,699.43	2.95
	Light-duty truck	6,172.79	9.99
R99 Renewable Diesel	Bus	59,510.99	0.56
	Equipment	1,994.47	20.54
	Heavy duty	1,931.34	0.03
	Light-duty truck	—	—
	Total	1,039,981.62	9,037.83



THE LANDFILL OPENED IN 1944 AND SPANS
~200 acres

4.2 SCOPE 1: ON-SITE LANDFILL

Reaching net-zero includes addressing emissions generated by INL's landfill (which is categorized as a fugitive emission but reported separately). The landfill opened in 1944 and spans approximately 200 acres. It is primarily composed of construction materials and nonreactive, nonhazardous waste that is known to generate emissions.

FY-19 calculations estimated the landfill emitted 6,010 MTCO_{2e}. This number was based on the reported waste sent to the on-site landfill and was calculated using the LandGEM model. In FY-19, INL diverted over 50% of its waste via recycling.

ACTIONS

Monitoring & Mitigation Strategy

Phase 1 (FY-22): INL contracted Tetrtech to monitor the landfill for 12 months to (1) assess the actual amount of emissions being released and compare these to the LandGEM model values used to estimate emissions; and (2) gather data regarding the emissions profile. Tetrtech installed probes in FY-22 to monitor and measure emissions.

Phase 2 (FY-24): Compile emissions report and develop mitigation recommendations using the data collected from the first quarter of FY-23 through the first quarter of FY-24.

Phase 3 (FY-24): Share the report with stakeholders to inform future landfill emissions modeling.

Other Actions: In FY-22, 53.8% of waste was diverted from INL's landfill. The Net-Zero Program is exploring the potential of composting and other waste diversion tactics to further minimize additions to the landfill.

4.3 SCOPE 1: STATIONARY COMBUSTION

DOE Order 436.1A, Attachment 1, Section 5 provides high-level guidance on how to achieve net-zero emissions buildings, campuses and installations through facility electrification to remove reliance on natural gas.

This order and the Federal Sustainability Plan require adherence to the Federal Building Performance Standards, which prioritize the following actions:

1. Pursue building electrification strategies along with carbon free energy use.
2. Energy retrofits.
3. Whole building commissioning.
4. Facility consolidation and improved space utilization.

INL's stationary combustion team identified 327 DOE-owned buildings and is evaluating the equipment in each to create an inventory. Engineering teams are using this information to create conceptual designs to convert boilers, HVAC and water heaters to electric or, potentially, ground-source heat pumps. They are also using this information to retro-commission buildings for energy conservation. These evaluations will then be used to prioritize projects based on CO₂e savings, timelines and equipment availability.

All diesel generators located at INL are for emergency and intermittent back-up use only, and thus are not required to be replaced per "The Federal Building Performance Standard" (2022). The Net-Zero Program is examining options to offset any related emissions with carbon capture. INL is tracking its progress using a system of sensors that report real-time data on electricity and fossil fuel use.



INL operates 36 leased facilities (15 of which use natural gas) where electrification will not be pursued nor funded by BEA. An increased sensitivity to sustainable operations will be used to minimize associated emissions. The

Federal Sustainability Plan prevents INL from entering into new leases (of at least 25,000 sq feet) of a nonelectrified facility after Sept. 30, 2030. Our strategy is to communicate this with the building owners and advise them on changes.

FY-22 fuel used for stationary combustion

Energy Type	Fuel Used		GHG Emissions (MT CO ₂ e)
	Amount	Units	
Fuel Oil No. 2 (used to heat buildings)	171,809.90	Gallons	1,759.59
Liquefied Natural Gas (LNG)	42,407.00	Gallons	313.16
Liquefied Propane Gas (LPG)	49,929.10	Gallons	289.96
Natural Gas (Pipeline)	674,982.90	Therms	3,567.77
	Total		5,930.50

Overview of DOE owned buildings in Scope 1

Area	Number of DOE-owned Facilities	Square Footage	FY-22 Scope 1 Emissions (MT CO ₂ e)
CFA	46	504,134	875.9
CITRIC	14	52,119	0.6
EBR-1	2	27,552	0
Idaho Falls	17	265,095	940.4
MFC	98	629,837	82.3
TAN/SMC	31	374,122	1,231.3
ATR Complex	77	453,071	99.3
Other	37	53,156	0
Total	327	2,377,210	3,229.8

4.3.1 Research and Education Campus (REC)

Natural Gas Utility

Operations across the Research and Education Campus accounted for approximately 28% of the Scope 1 stationary emissions for all DOE-owned facilities in FY-22. The major contributor is the natural gas utility used within the facilities for HVAC, water heaters, etc.

INL is taking the following actions at REC in accordance with EO 14057 and the Federal Sustainability Plan:

1. Develop building electrification strategies alongside carbon-free electricity use

There are 23 REC facilities that use natural gas. Of those facilities, 15 are leased assets and the remaining eight are DOE-owned. This mix represents approximately 74% and 26% of the emissions contribution from pipeline gas, respectively, in FY-22.

Facility and Site Services performed engineering evaluations on the east (owned) and west (leased) REC campuses that provide the conceptual designs for conversion of boilers, HVAC and water heaters from natural gas to electric power supply. These evaluations have set the basis for prioritizing and strategy of achieving electrification and include the following:

- Replace fossil fuel equipment, like for like where applicable in DOE-owned buildings, to avoid substantially increased costs associated with a system redesign.
- Electrification projects are expected to increase the buildings' yearly utility costs by approximately 80%.
- REC Facilities and Operations was awarded indirect funding to electrify select buildings.

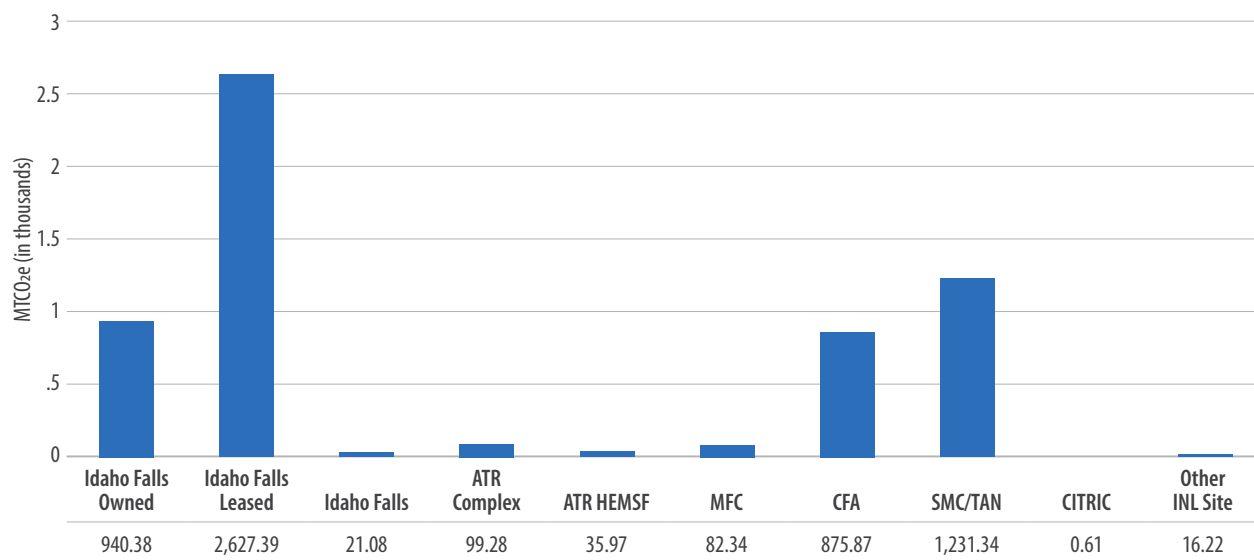
- Funding was awarded to electrify and modernize select HVAC systems. One project alone is expected to reduce Scope 1 emissions by 85 MtCO₂e.

The "REC Retro commissioning/ Electrification Investigation Report" and "Evaluation of Natural Gas Conversion to Electric" offer details about facility electrification and retrofit projects.

2. Whole building commissioning

- REC Facility Management Control Systems is performing facility "set-back" testing and programming across the campus. This essentially moves the HVAC equipment into a reduced operating condition, which reduces power consumption and related emissions and enhances efficiency when buildings are unoccupied. Currently, 16 facilities are operating in this mode.

Scope 1: Stationary



NOTE: HEMSF = high-energy mission specific facility



- We estimate an overall reduction of approximately 15% to 20% upon completion of setbacks and commissioning activities. Savings estimates represent the potential combined total of savings in Scope 1 by reduced fossil fuel heating and also Scope 2 by reduced fan and chiller use. Commissioning will also be important as we aim to limit Scope 2 impacts from this electrification activity.
- Leased buildings: Commissioning will be an important tool to reduce energy consumption of leased buildings where INL is unable to electrify HVAC systems.

3. *Space reduction and consolidation*

- Facilities and Site Services' Campus Development Office is evaluating facilities for space optimization. While the laboratory will continue to expand to meet mission needs, optimization efforts ensure that the growth meets mission needs while maintaining maximum efficiencies.

4.3.2 Site

Scope 1 stationary emissions at the desert Site are largely generated by fuel oil boilers and liquified natural gas and propane-fired HVAC.

INL is taking the following actions at the site in accordance with EO 14057 and the Federal Sustainability Plan:

Pursue building electrification strategies

No DOE-owned facilities at the desert Site use pipeline natural gas utility. These facilities depend on various fossil fuel-powered equipment for operations, and the lab is working to electrify and/or find suitable alternatives. Facilities and Site Services developed an inventory of stationary combustion equipment, developed a site plan and procured engineering assessments, which were submitted to obtain costs for facility upgrades. We are working to obtain funding for upgrades.

4.4 SCOPE 2: PURCHASED ELECTRICITY

The plan focuses on collaborating with the utilities to provide 100% carbon pollution-free electricity to INL, reducing Scope 2 emissions by 100%. More than half of INL's carbon emissions are generated via purchased electricity, which powers buildings, fleet vehicles and research and development activities central to the lab's mission. As of FY-22, 65.1% of the power provided by the utilities at INL is carbon free. Emission calculations for GHG reporting are calculated using EPA regional eGRID factors.

The plan focuses on improving building energy efficiency and collaborating with our two major utilities – Idaho Power and Idaho Falls Power – to provide 100% carbon pollution-free electricity to INL, reducing emissions by 100%.

DOE signed a memorandum of understanding in 2019 with Idaho Power to explore power supply options that support DOE-ID's goal to purchase clean, reliable, resilient and locally generated carbon pollution-free electricity from advanced or small modular reactors.

DOE is working to secure 100% carbon pollution-free electricity via a PPA or other similar agreement, with preference given to CFE from nuclear sources. In 2022, the Net-Zero team began working with local utilities to understand their electricity portfolio and CFE goals. In an effort to help increase understanding of advanced nuclear technologies among utility providers, INL hosted a series of discussions and workshops that brought together DOE, INL leadership, utilities and energy providers.

4.4.1 Energy Efficiency

1. INL will reduce Scope 2 building electricity consumption using principles outlined for reducing Scope 1 stationary combustion in buildings.
2. Whole building commissioning.
3. Space reduction and consolidation.

4.4.2 REC

INL will reduce Scope 2 building electricity consumption using principles outlined for reducing Scope 1 stationary combustion in buildings.

1. Energy retrofits

Planned projects: Lighting retrofits at select buildings. Plans to investigate energy savings performance contracts for lighting.

2. Whole building commissioning

Engineering analyses indicated that the report's retro commissioning measures be pursued as soon as possible to begin their transition to net-zero.

3. Space reduction and consolidation

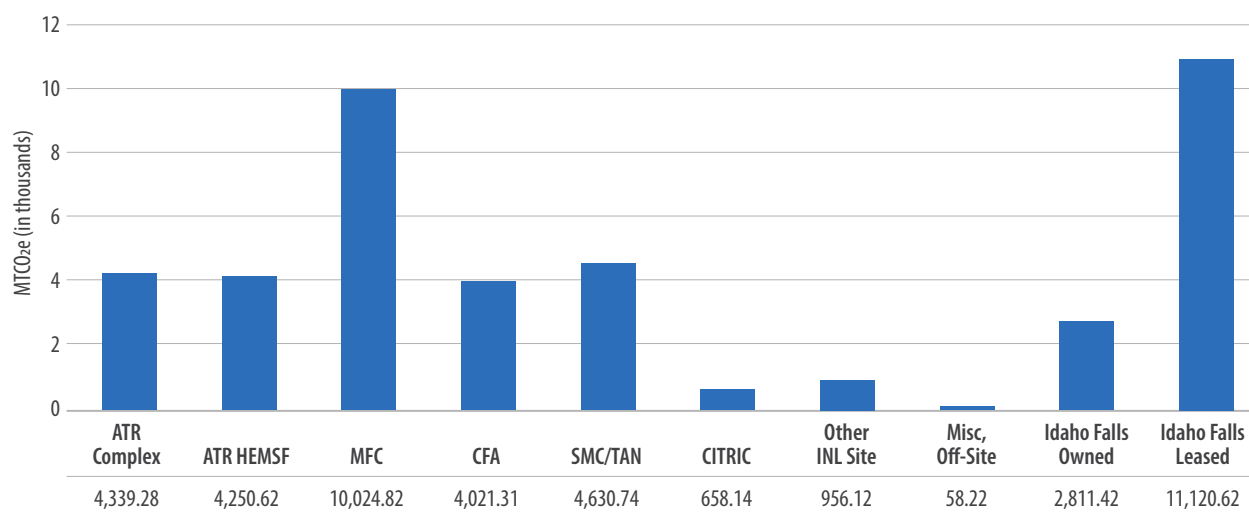
See Section 4.3.1.

4.4.3 Site

1. Energy retrofits

- Facilities and Site Services has sealed and replaced window and doors, and added insulation for four CFA buildings. Future assessments will determine actions for additional facilities.
- Plans to investigate energy savings performance contracts for lighting.

Scope 2: Emissions from Purchased Electricity

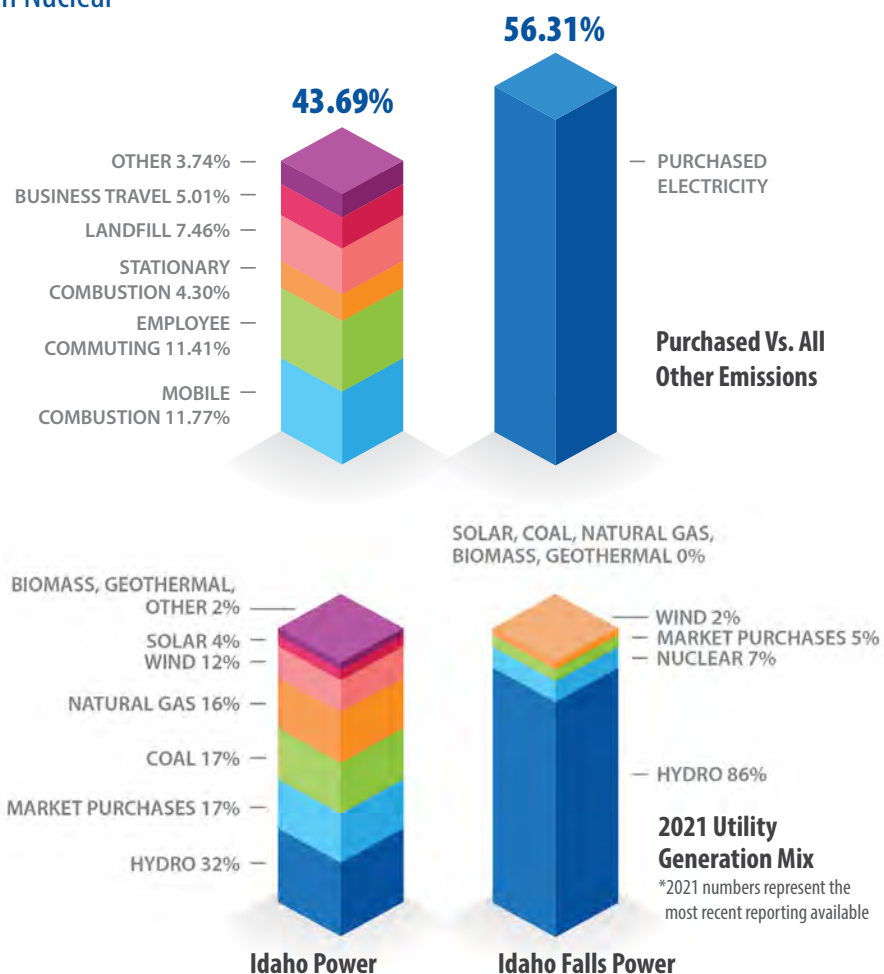


NOTE: HEMSF = high-energy mission specific facility

4.4.4 Roadmap to Net-Zero Through Nuclear

INL's Roadmap to Net-Zero Through Nuclear is a developing document that focuses on the use of microreactors to generate carbon pollution-free electricity. This roadmap includes plans to potentially demonstrate INL's MARVEL microreactor on a microgrid to assess possible net-zero applications (i.e. powering an EV charger with nuclear-generated carbon pollution-free electricity). The Net-Zero Program also plans to use other test reactors to demonstrate their potential to contribute to decarbonization efforts. INL will share the lessons learned from these demonstrations with industry, utilities and other stakeholders to inform the potential integration of new nuclear technologies in their energy portfolios.

The roadmap focuses on the following areas: infrastructure, licensing and regulation, time to market; financial and contracting; and public engagement and education. The Net-Zero Program has collaborated with experts from each focus area to develop this plan, which is truly a labwide effort.



INL's FY-22 electricity purchases by location and provider

Location	Owner of T&D System	Electricity Provider	FY-22 Electricity Purchase (MWh)
INL Site	INL	Idaho Power (includes owned T&D losses)	105,454.43
Subtotal (Site)			105,454.43
Assorted Locations (excludes INL Site)	Electricity Provider	Idaho Power	68.18
Town Facilities	Electricity Provider	Idaho Falls Power	50,870.60
Assorted Locations Outside INL Site and Idaho Falls City Limits	Electricity Provider	Lost River Electric Company	23.75
Assorted Locations Outside INL Site and Idaho Falls City Limits	Electricity Provider	Rocky Mountain Power	120.652
Subtotal (non-site)			51,083.18
Total INL Purchases			156,537.61

4.5 SCOPE 3: EMPLOYEE COMMUTING & BUSINESS TRAVEL

The Net-Zero 2031 Plan includes continued monitoring of emissions related to employee commuting and business travel. The Net-Zero Program will collaborate with the Sustainability Program and Community Outreach to further develop the resources, community and infrastructure needed to support low- and no-carbon commuting options, including expanded INL employee transit options and bike lockers and stands.

Since completely eliminating emissions related to employee commuting and business travel is not feasible, INL is exploring ways to capture carbon via technology and by using trees, sagebrush and other natural interventions.

Notable projects to date



BIKE COMMUTER RESOURCE CENTER

This employee resource was established in FY-23 to provide employees the community, support and resources needed to adopt bike commuting, including cycling safety events, bike lockers, repair stands and a resource webpage.



IMAP NET-ZERO TOOL

This interactive tool launched in FY-22 to provide access to trail maps, bike rack locations, EV charging station locations, carpool forums, shuttle schedules and other low-carbon commuting options across INL.



HOURLY SHUTTLE SYSTEM

INL's fleet services expanded its shuttle system to run hourly between its Research and Education Campus and the desert Site in FY-22.



COMMUNICATIONS

INL developed two internal news stories series titled "How I Net-Zero" and "Net-Zero Champions." The former allows employees to share innovative ways they are reducing emissions outside of work. The latter celebrates individuals and teams who have helped spearhead projects to reduce INL's emissions.



Regional Engagement

*The Net-Zero 2031 Plan continues to **build relationships** with local utilities, local government, industry, tribes and universities to engage in decarbonization efforts.*

UTILITIES

INL has two main utility providers – Idaho Power and Idaho Falls Power. Idaho Power has committed to 100% carbon pollution-free electricity by 2045 via its “Clean Today. Cleaner Tomorrow” program. Idaho Falls Power was 95% carbon pollution-free electricity in 2021.

INL is collaborating with utilities and DOE to purchase clean energy through power purchase agreements or other similar agreements.

INL is working with utilities to meet its Net-Zero by 2031 goals. INL is also working with Idaho Power and Idaho Falls Power to ensure that sufficient power is available at all INL locations to support the necessary EV charging station infrastructure and building electrification projects.

INDUSTRY

INL is engaging industry partners, including advanced nuclear developers, to demonstrate new technologies on-site. We are also hosting DOE’s Cleanup to Clean Energy Information Day, which aims to site new carbon pollution-free electricity projects on federal lands to help the nation achieve its decarbonization commitments.

LOCAL GOVERNMENT

INL will continue to collaborate with the city of Idaho Falls to ensure electric charging availability to support Idaho Falls campus fleet operations.

TRIBES

INL and DOE-ID have established a working relationship with the Shoshone-Bannock Tribes and will continue to work with them to assess their carbon pollution-free electricity needs and discuss how INL can help facilitate greater access to clean energy.

UNIVERSITIES

INL is engaging with local community colleges and universities to explore possible internship programs and other capstone courses that will help prepare students for the changing job market that is accompanying U.S. decarbonization efforts (e.g. EV infrastructure, advanced nuclear operations, etc.).

Community Impacts & Environmental Justice

Underserved communities are particularly vulnerable to climate change, which impacts food availability, housing prices and energy costs. INL is surrounded by a number of underserved, rural and tribal communities that could benefit from the lessons learned through INL's work to achieve net-zero emissions.

First, INL's work to attain 100% carbon pollution-free electricity could expand access to clean energy for nearby communities. Second, the lessons learned from transitioning INL's motor coaches – which transport approximately 2,500 employees per day – to net-zero will provide a model for rural-to-rural and rural-to-urban transit systems that transport people in rural communities to and from their jobs. Third, INL's work to increase efficiencies across its campus, which includes many older buildings, will provide data on the impact of efficiency projects that can be shared with communities with similar profiles.



NEARBY COMMUNITIES WOULD BENEFIT FROM INL'S
WORK TO ATTAIN **100% CFE**





Responding to Challenges & Identifying Opportunities on the Path to Net-Zero

Decarbonizing a site as diverse as INL is challenging, which is why the laboratory is working to develop new technologies to address these challenges and working with DOE to identify legislative/policy challenges. For example, DOE is restricted to 10-year power purchase agreements with utility providers. Longer-term agreements for carbon pollution-free electricity offer utilities greater ability to invest in new projects, including nuclear. This is why we are working with the appropriate representatives to explore options to extend agreement terms.

Additionally, deploying FOAK nuclear technologies will require education and outreach. INL is invested in communicating

the ways advanced nuclear can move the nation closer to a carbon-free energy future by working with students, hosting events for the general public and inviting officials from across the nation and the world to learn about INL's work.

Finally, we recognize that eliminating all emissions to zero is not feasible, which is why we are exploring technological and natural carbon capture options. We are also conducting research to determine the amount of CO₂ captured on the 890-square-mile site, which is home to sagebrush and other native plant life that naturally capture carbon, to offset remaining emissions.

COLLABORATIONS WITH MISSION & MISSION-ENABLING ORGANIZATIONS

INL is home to a unique array of scientific expertise, equipment and vision to help shape extraordinary new technologies into practical, everyday uses. Though our research is diverse, our missions call for us to make a safer, cleaner world with a higher standard of living for everyone.

The Net-Zero Program depends on the innovative research occurring across the laboratory. Here are areas and projects that are critical to realizing our net-zero goal.

Energy and Environment, Science and Technology

- Hydrogen hub (potential support for hydrogen vehicles; research will advance national goals)
- Integrated energy systems (supports microgrid development for testing of advanced nuclear generated carbon pollution-free electricity)
- Carbon capture, utilization, and sequestration

Environment, Safety, Health and Quality

- Landfill monitoring and safety
- Environmental safety

External Engagement and Communications

- Public Engagement and Education

Facilities and Site Services

- Implement the transition of stationary combustion to electric and non-carbon emitting alternatives
- Implement transition of fleet to zero-emission vehicles
- Grid modernization

National and Homeland Security

- Cyber and physical infrastructure
- Securing the path to net zero

Nuclear Science and Technology

- Advanced nuclear technologies
- Licensing and regulatory
- Fuel cycle research

Availability of 100% Carbon pollution-free Electricity

INL's ability to procure carbon pollution-free electricity depends on its availability, which is why the Net-Zero Program is creating a Roadmap to Net-Zero Through Nuclear that explains the processes, procedures and challenges related to deploying advanced nuclear in the form of microreactors to increase the supply. This plan includes sections on infrastructure, licensing and regulation; time to market; fuel cycle; financial and contracting; and public engagement and education.

AFFECT Grants

Securing funding for innovative net-zero projects will be critical to the Net-Zero Program's success, which is why the program is working with researchers across the lab to develop solutions. Below is a list of the seven AFFECT grant proposals INL submitted for consideration.



Projects under Topic 1: Feasibility Study (pending funding decision)

Description	INL Location	Potential Project Benefits
1. Increase Building Efficiencies With Novel Heat Sources		
Assess the impacts and costs associated with installing a ground source heating and cooling system to replace the antiquated heating, ventilation and cooling system at INL's Central Facilities Area (CFA). CFA is comprised of eight buildings (approximately 300,000 ft ²).	CFA	This project could help demonstrate the importance of diversifying energy sources, especially in rural areas that experience extreme weather conditions.
2. Net-Zero Buildings for Net-Zero Fleets		
Assess the feasibility of using rooftop solar at the Materials and Fuels Complex (MFC) to provide carbon-free electricity to the growing fleet of electric vehicles, using net-zero buildings to transition to a net-zero fleet.	MFC	This project aims to realize CO ₂ e savings by utilizing buildings to power INL's extensive vehicle fleet, which it is currently transitioning to electric.
3. Replace Fossil Fuel Heat with Hydrogen in Buildings		
Examine the feasibility of adding clean hydrogen produced on-site at the Research and Education Campus to the natural gas supply pipeline to offset carbon emissions related to building heat; develop metering system.	REC	Diverse technologies will be needed to make the transition to net-zero buildings. Replacing fossil fuels with hydrogen as a drop-in could help communities reach net-zero without investing in new infrastructure.
4. Decarbonize Municipal Solid Waste		
Determine potential emissions reductions achieved by using an AI-powered automated waste sorting system to divert municipal solid waste into building materials, including insulation and paneling.	CFA/EIL	This technology could create a new sector of manufacturing that can expand the U.S. workforce and generate American-made products.
5. Microreactor Application For Net-Zero Infrastructure		
Identify options and opportunities for the novel use of DOE's Microreactor Applications Research Validation and Evaluation (MARVEL) project to produce carbon-free energy in the form of electricity to perform small-scale demonstration of a nuclear-enabled microgrid that could power buildings, electric vehicle charging and clean hydrogen production.	MFC	This study could help establish the U.S. as a leader in advanced nuclear, an essential carbon-free energy source for the transition to net-zero.
6. Power Net-Zero Rural Research Units with Hydrogen		
Determine the feasibility of using hydrogen power modules alongside wind, solar and batteries in mobile research units deployed to rural and remote areas.	CFA	The lessons learned could benefit underserved communities, including tribal nations.
7. CO₂ Capture for HVAC Emissions		
Determine the feasibility of integrating carbon capture technologies into building operations to reduce HVAC-related emissions.	Multiple	This technology could help communities unable to afford to replace carbon-emitting HVAC and vehicles with a more accessible, affordable and mobile alternative that can be used for near-term benefit.

Net-Zero Projects, Indirect Funds and Appropriations

8.1 INDIRECT FUNDING

NL plans to use indirect funding to accomplish certain net-zero projects, including those funded prior to the release of this revision. The lab will also use advanced planning funds to scope and plan the projects up front, providing cost estimates and schedule information.

8.2 APPROPRIATIONS

Projects that cannot be funded through indirect means will require a direct funding source from DOE. The lab will pursue AFFECT grants and other direct funding opportunities as they become available.

8.3 CRADAS/SPPS

These may be used to work with industry partners to collaborate and receive funding for net-zero projects. Both require partners who may provide funds-in or other resources for INL to perform work that benefits all parties involved.

Formal Reporting

SITE SUSTAINABILITY PLAN AND THE VULNERABILITY ASSESSMENT AND RESILIENCE PLAN

NL reports its site emissions annually through the DOE Sustainability Dashboard, which expands beyond the scope of the Net-Zero 2031 Plan to include electronics recycling, Scope 3 emissions, leased facilities and other related emissions.

INL also produces a Vulnerability Assessment and Resilience Plan, updated every five years, that identifies relevant climate hazards and proposes appropriate resilient solutions.

NET-ZERO PLAN UPDATES

The Net-Zero Plan will be regularly updated. Each update will incorporate actions to address any updates to existing policies and executive orders

and/or address new policies and orders. Subsequent revisions will also consider new technologies and other innovations that could alter the scope of the plan.



Battelle Energy Alliance manages INL for the
U.S. Department of Energy's Office of Nuclear Energy.

GA23-50647