



Innovation & Research Portfolio Current Investments & Future Direction

John Lochner, Vice President Innovation | August 16, 2023



NYSERDA

New York State Acronyms

- ▶ **CEF:** Department of Public Service Clean Energy Fund
- ▶ **CLCPA:** 2019 Climate Leadership & Community Protection Act
- ▶ **DPS:** Department of Public Service
- ▶ **I&R:** NYSERDA Innovation & Research
- ▶ **NYSERDA:** New York State Energy Research and Development Authority
- ▶ **PSC:** Public Service Commission

Agenda

- ▶ Overview of Innovation
- ▶ NYSERDA Innovation Investment Portfolio
- ▶ 2023 Strategic Planning Process



NYSERDA

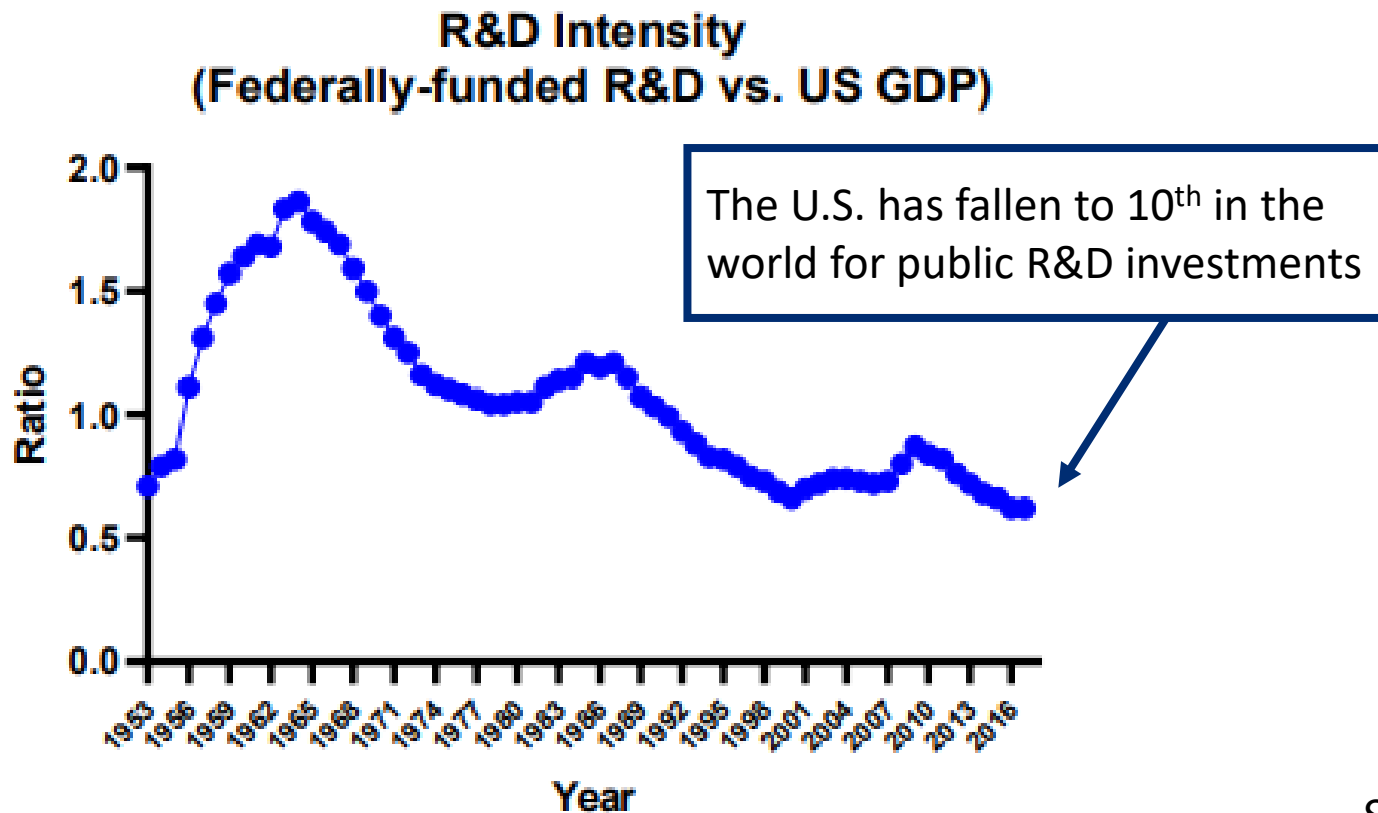
Overview of Innovation

The government has achieved monumental outcomes through investment in R&D

1. **Google**, Stanford University
2. HIV anti-viral therapies, Emory University
3. Radiotracer FDG medical imaging, Brookhaven National Laboratory
4. **Insulin**, University of Toronto
5. Vitamin D fortification, University of Wisconsin
6. Electron Microscope, University of Toronto
7. Lead-free solder, Ames Laboratory, Iowa State University
8. Blood preservation, Columbia University
9. Radiofrequency heat for food safety, Princeton Plasma Physics Laboratory
10. Ultrasound, University of Vienna
11. Streptomycin, Rutgers University
12. Heart-lung machine, University of Minnesota
13. Holographic millimeter wave detector, Pacific Northwest National Laboratory
14. Pacemaker, University of Minnesota
15. Warfarin, University of Wisconsin Alumni Foundation (WARF)
16. CdTe, CIGS & perovskite photovoltaics, National Renewable Energy Laboratory
17. Hepatitis B vaccine, University of Pennsylvania
18. Molecular Breast Imaging, Thomas Jefferson National Accelerator Facility
19. **MRI**, State University of New York
20. Recombinant DNA Technology, Stanford University
21. T7 Gene expression, Brookhaven National Laboratory
22. Synthetic Taxol, Florida State University
23. Laser cataract surgery, University of California, Los Angeles
24. Quantum cryptography, Los Alamos National Laboratory
25. **COVID-10 vaccine**, Washing University in St. Louis, Colorado State University, Baylor College of Medicine
26. **Solid state lighting** (LED), Sandia National Laboratories
27. RotaTeq (rotavirus vaccine), The Children's Hospital of Philadelphia
28. Nickel Manganese Cobalt Batteries, Argonne National Laboratory
29. The Bradford Assay, University of Georgia Research Foundation
30. Cystic fibrosis gene diagnostic, The Hospital for Sick Children, Toronto
31. Argus II retinal prosthesis, National Eye Institute
32. The @ sign for use in email addresses, Rensselaer Polytechnic Institute
33. Quantum dots for electronic displays, Lawrence Berkeley National Laboratory
34. **Cochlear implant**, University of California, San Francisco
35. BeadArray, Tufts University
36. Metal Hydride Thermal Energy Storage, Savannah River National Laboratory
37. Restriction Endonuclease Digestion: Cutting to the Chase for Molecular Biology, The John Hopkins University
38. Nanocrystalline Steel Technology, Idaho National Laboratory
39. B73 line of hybrid corn, Iowa State University
40. HPV vaccine, (German Cancer Research Center, DKFZ), Georgetown University

Source: MSN Business Economy, 50 inventions you might not know were funded by the US government

Lack of government investment is leading to negative economic consequences



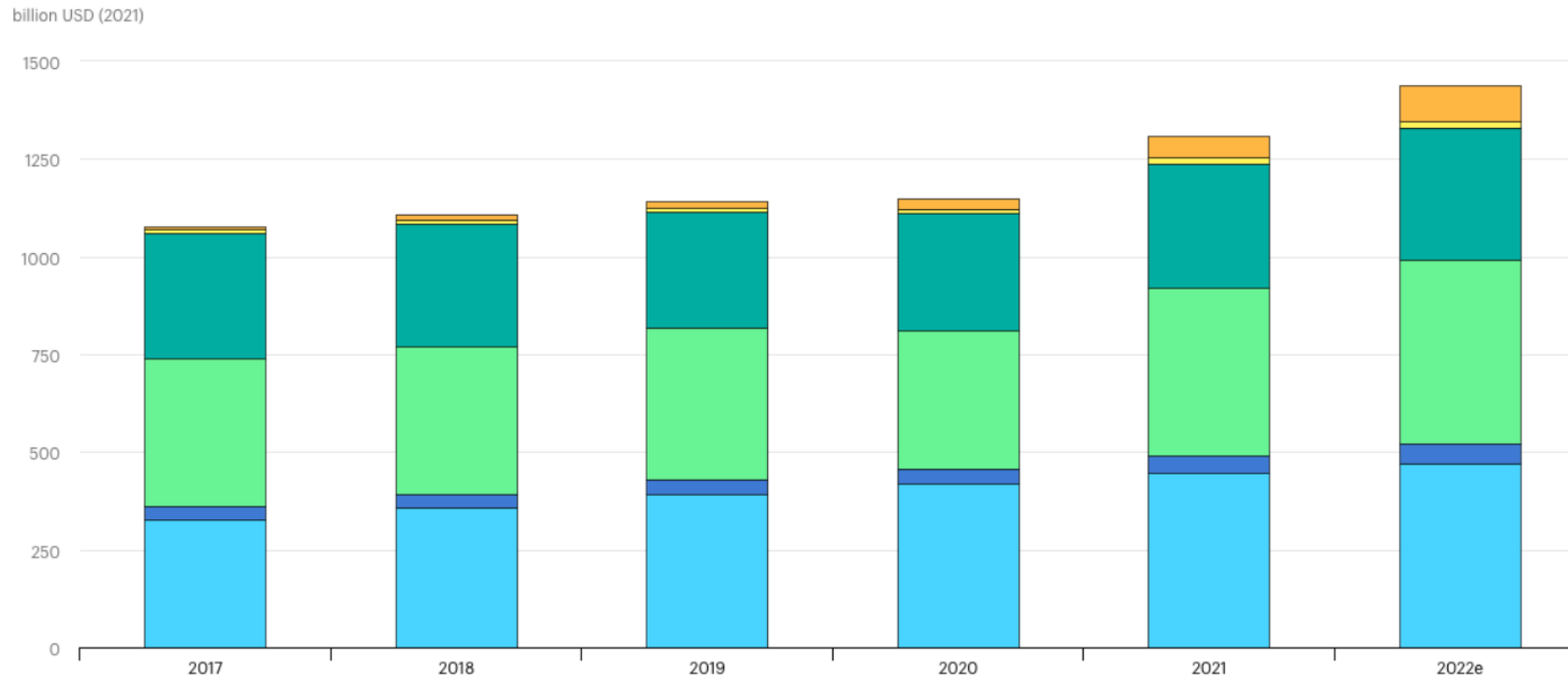
Source: MIT policy review, August 20, 2020 vol. 1



Source: White House - Innovation, Investment, and Inclusion: Accelerating the Clean Energy Transition and Creating Good Jobs, April 23, 2021

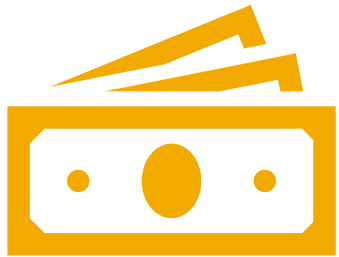
Yet the scale and scope of U.S. investments are insufficient (public and private)

Annual clean energy investment, 2017-2022



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Innovation R&D supports the economy and communities



\$46B

Economic Benefit



58%

Social Return

A 20+ year study of DOE RD&D programs in energy efficiency found the total net realized economic benefits were \$46 billion (4x the investment)

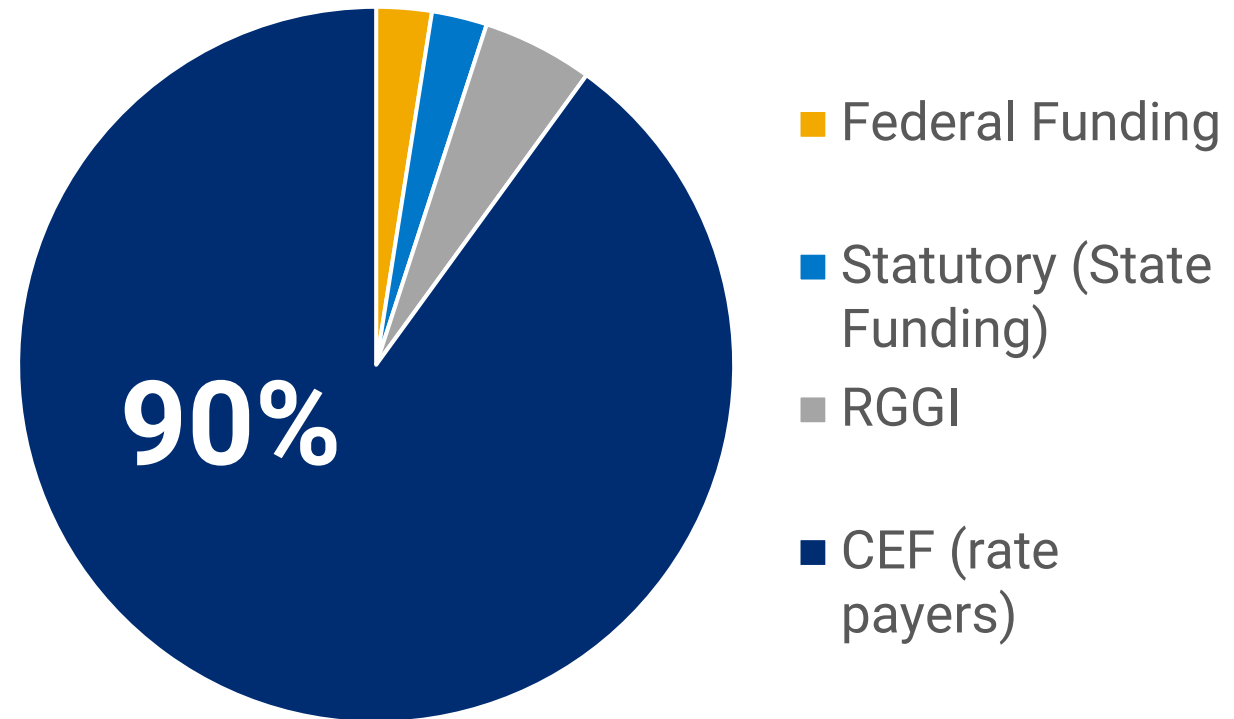
The social return to R&D is 58% percent

NYSERDA Innovation Investment Portfolio

NYSERDA Innovation Overview

- Approximately **90% of portfolio funding** comes from ratepayers via IOUs & the PSC in the Clean Energy Fund (CEF), a 10-year investment fund
- **Remaining funding provided** via:
 - ✓ State budget (statutory funding)
 - ✓ Regional Greenhouse Gas Initiative (RGGI)
 - ✓ Other PSC Orders
 - ✓ Federal funding and other grants

Example I&R Budget



Purpose of CEF

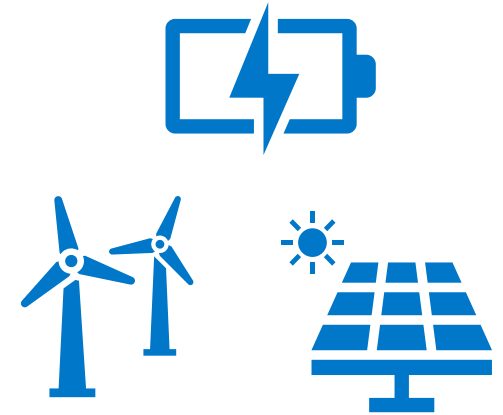
“To tap [NYS potential for clean energy programs] ... we focus on ways in which the State’s clean energy program can be made more efficient and its resources can be deployed or redeployed to stimulate innovation and increase clean energy investment.” – May 8, 2016 initiating order



Fund research
and technology
development



Drive clean-tech
business growth
and jobs



Provide more energy
choices to residential and
commercial customers

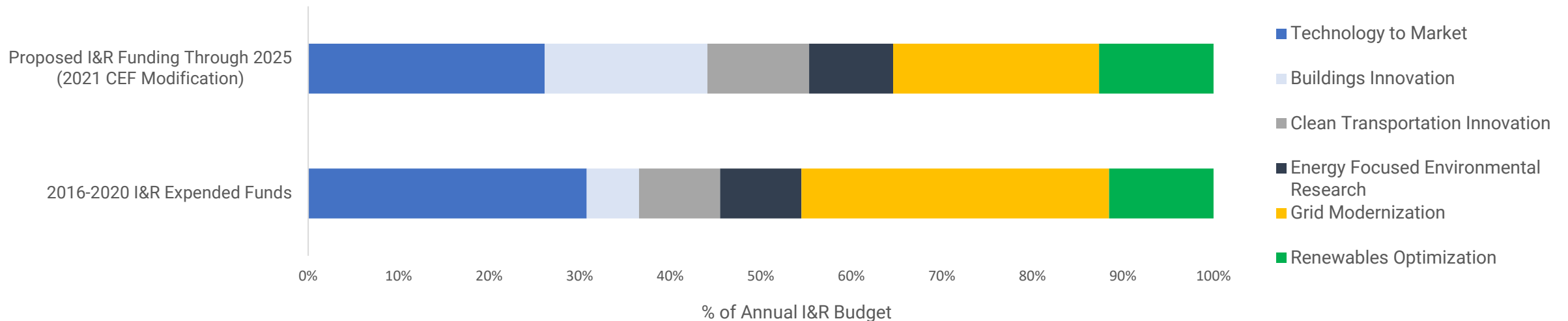
Flexible portfolio evolving alongside policy and DPS priorities

▶ **The 10-year CEF 1.0 fund (2015-2025) required flexibility to build investment theses over time and adjust regularly**

- Initial budgets refined through filing of investment plans with DPS throughout the life of the CEF
- Investment activities within investment plans adjusted due to learnings and changes in the market
- Substantial continuity of focus industries and technology areas

▶ **The 2019 Clean Energy and Community Leadership Protection Act (CLCPA)**

- The CEF investment plan was first approved by the Public Service Commission (PSC) in January 2016
- After the CLCPA was passed, the plan was modified in 2021, recognizing a shift in speed and ambition



I&R provides value through diverse technology development and deployment mechanisms



Support Mechanism

Product Development

Pilot and Demonstration Projects

Technology Analysis and Roadmap Development

Project Examples

Compact GSHP Drilling Technology (Dandelion Energy)

Meter Collar Adapter (ConnectDER)

Nine Mile Point Nuclear Site Demonstration (Zero Carbon H2)

NYCHA Window Mounted Heat Pump Demonstration (Gradient)

NREL H2 Technoeconomic Analysis

NYS LDES Roadmap

I&R provides value through diverse technology development and deployment mechanisms

Product Development

▶ **Compact Ground Source Heat Pump (GSHP) Drilling Technology**

- Dandelion Energy received funding to develop new drilling technology reduces the cost of GSHPs for homeowners by 20%
- Compact drilling equipment offers opportunities for GSHP installations not serviceable by larger drilling equipment

▶ **Dynamic Line Rating (DLR) to Increase Transmission Capacity**

- LineVision and WindSim will validate a new Dynamic Line Rating (DLR) monitoring system on transmission lines
- New technology will increase transmission capacity by 35% on average improving reliability and reducing ratepayer costs

▶ **Streamlining Distributed Energy Resource Deployment**

- I&R funded ConnectDER to deploy 2,400 meter collar adapters throughout the Con Ed system to gather production data from solar systems at 15-minute intervals
- The ConnectDER meter collar adapter reduces rooftop solar installation costs by \$400-\$1500 per building



LINEVISION

windsim
POWER



I&R provides value through diverse technology development and deployment mechanisms

Pilot and Demonstration Project Funding

▶ **Nine Mile Point Nuclear Site Demonstration**

- First-of-its-kind facility in the United States opened in 2022; generating emissions-free hydrogen in a Proton Exchange Membrane (PEM) electrolyzer using nuclear power
- I&R funded demonstration of long-duration hydrogen energy storage paired with peak power generation from nuclear



▶ **New York City Housing Authority (NYCHA) Window Mounted Heat Pump Demonstration**

- Gradient and Friderich are developing a cost-effective window unit heat pump that offers multifamily buildings a path to electrification of heating/cooling and tenant control for energy savings
- Gradient was selected for a procurement of 30,000 window unit heat pumps in NYCHA buildings



I&R provides value through diverse technology development and deployment mechanisms

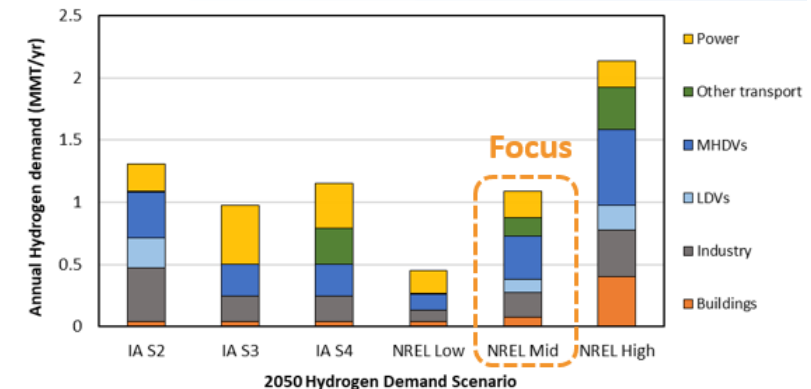
Technology Analysis and Roadmap Development

▶ National Renewable Energy Laboratory (NREL) H2 Technoeconomic Analysis

- Estimated the overall hydrogen demand in NYS until 2050 and identified hard to electrify applications; NREL built an analytic model to estimate cost for a hydrogen ecosystem under numerous scenarios

▶ Long Duration Energy Storage (LDES) Road-Mapping

- In support of the NYS 6 GW battery storage roadmap, developed LDES technology commercialization recommendations including pilot and demos project examples



New York's 6 GW Energy Storage Roadmap:
Policy Options for Continued Growth in Energy Storage

I&R participates in strategic stakeholder engagement to catalyze commercialization outcomes



Support Mechanism

Ecosystem growth to catalyze private sector investment and reduce required public support

Industry coordination and collaboration with investors, customers, and partners

Prize competitions to catalyze market focus / drive towards specific outcomes

External program design, set up, and support

Project Examples

EIR Program

Accelerators & Incubators

Deep Decarbonization Workshop

Investor Advisory Board

\$10 M Empire Technology Prize

NY Clean Transportation Prizes

New Energy Nexus NY Outpost

M Corps start-up support

I&R participates in strategic stakeholder engagement to catalyze commercialization outcomes

Industry coordination and collaboration with customers, investors, and partners

▶ Hydrogen Strategy Meeting

- The workshop, held at Columbia University reviewed the federal and state roadmap for H2 deployment, R&D opportunities, and market barriers

▶ Deep Decarbonization Workshop

- A workshop held to engage stakeholders in sharing knowledge and resources on green hydrogen and carbon capture to reach CLCPA goals



I&R participates in strategic stakeholder engagement to catalyze commercialization outcomes

Prizes to catalyze market focus / drive towards specific outcomes

▶ Empire Technology Prize

- I&R funding The Clean Fight to administer an ambitious corporate challenge that aims to create a blueprint for decarbonizing cold-climate buildings around the world

▶ NY Clean Transportation Prizes

- I&R funding that focuses on assisting underserved communities in electrifying transportation, reducing air pollution, and enhancing clean mobility



NEW YORK
Clean Transportation Prizes

I&R participates in strategic stakeholder engagement to catalyze commercialization outcomes

External program design, set up, and support

▶ **M-Corps Initiative**

- Aims to provide capital investment in manufacturing build-out and scale-up activities of clean tech



▶ **New Energy Nexus- NY and The Clean Fight**

- Focuses on assisting underserved communities in electrifying transportation, reducing air pollution, and enhancing clean mobility



Measuring impact and investment return for CEF 1.0 funding

Annual Metrics Reporting and Data Collection

- NYSERDA I&R collects reporting metrics from all projects on an annual basis
- Reporting data is logged in NYSERDA's CRM from which it can be pulled and analyzed

Evaluation Studies

- Alongside portfolio-wide reporting, impact studies assess and communicate I&R's value to ratepayers by quantifying the benefits of representative projects across the portfolio
- Example case study metrics include:
 - *Avoided CO2 emissions*
 - *GWh energy savings*
 - *Monetized ratepayer benefits*

Reporting Metrics Overview

Commercialization Outcome Metrics

- ▶ Products Commercialized
- ▶ Product Revenue Generated
- ▶ Product Unit Replications
- ▶ Demonstration Projects Funded
- ▶ Company Revenue Generated

Intellectual Property Metrics

- ▶ Patents Granted
- ▶ Publications

Follow-On Funding Metrics

- ▶ Private Sector Funding
- ▶ Cost Share Provided
- ▶ External Grant Funding
- ▶ Leverage Ratio

Through the current portfolio, I&R is accelerating commercialization of energy innovations

I&R used CEF funding to deliver critical commercialization outcomes and advance DPS priorities

Commercialization Outcomes

- ▶ **301** Products Commercialized
- ▶ **\$54 Million** Product Revenue Generated
- ▶ **1,329** Product Unit Replications
- ▶ **84** Demonstration Projects Funded
- ▶ **\$1.25 Billion** Company Revenue Generated

Follow On Funding

- ▶ **\$4.2 Billion** Follow-on Funding
 - *\$3.9 Billion* Private Sector Funding
 - *\$289 Million* Cost Share Provided
 - *\$173 Million* External Grant Funding
- ▶ **12.5x** Leverage Ratio (\$12.5 raised in follow-on funds for every \$1 from I&R)

▶ **Outcomes continue to grow as our portfolio continues to hit milestones**

2023 Strategic Planning Process

PSC Investment Prioritization Process

- ▶ **By July 1, 2024, NYSERDA is directed to file an Innovation & Research portfolio petition with the PSC including...**
 - A quantitative and qualitative summary of performance of the Innovation & Research portfolio to date, including data trends, lessons-learned, findings from relevant evaluations, and an identification of any necessary portfolio modifications
 - A funding request for post-2025 Innovation & Research initiatives
- ▶ **PSC and NYSERDA are working together to assess historical performance, lessons learned, best practices, and new goals and priorities to focus the development of a new investment portfolio**

New technology innovations remain critical to achieve aggressive energy and climate targets

- Despite press that suggests we have all the technologies we need to reach decarbonization and clean power goals, it is not accurate that technologies are always:
 - ✓ *Affordable to ratepayers*
 - ✓ *Available at a price and functionality that is proven to be acceptable to consumers*
 - ✓ *Deployable on the timelines required by the CLCPA*
- Innovation continues to be critical to ensure affordability and reliability

Initial Technology Assessment Framework

Research

To inform highest areas of impact that I&R could invest in to support clean energy early-stage deployments that achieve DPS' goals and provide ratepayer value, extensive background research was conducted:

- CLCPA
- Scoping Plan
- Literature Review
- Studies
- Roadmaps

←→
Gap
Analysis

Focus Areas

The background research and a gap analysis leads to identifying key focus areas that align with I&R's mission space and New York State goals and provide the greatest potential benefits. Examples from current CEF include:

- Decarbonized Buildings
- Electric Grid optimization
- Long duration storage
- Hydrogen

←→
Tech
Explor-
ation

Technology Evaluation

Within the focus areas, technologies will be identified where I&R could have the most beneficial impact on ratepayers and a framework developed to quantify:

- Technology potential
- Benefits
- Risks
- & an overall Investment Opportunity measurement

Methods for defining and assessing risk against achieving investment goals

Technologies

- Stage (TRL/CRL/ARL)
- Expected impacts
- Market Adoption Potential
- Timeline to scale

Programs

- What startup capital is needed?
- What size of investment(s)?
- What other resources are required?
- Is policy aligned? What will enable / drive scale?

Risk Severity Matrix

Likelihood		Consequence				
		1	2	3	4	5
Almost Certain	5	Moderate	High	Extreme	Extreme	Extreme
Likely	4	Moderate	Moderate	High	Extreme	Extreme
Possible	3	Low	Moderate	Moderate	High	Extreme
Unlikely	2	Low	Low	Moderate	High	High
Rare	1	Low	Low	Low	Moderate	Moderate

Review of Current & Potential New Metrics



Leverage



Products
Commercialized



Patents &
Publications



Replications



Follow-on Funds



Demonstrations



Revenue

Approaches to Measure Portfolio Impacts

- Core metrics of success aligned with goals vs. ancillary benefits
- Cost / ability to collect data
- Accuracy of measurements
- Long-term vs. short-term



Employees/
Jobs



M&A
IPO



Partners



Diversity/
DACs



Applicants vs
Awarded



Economic
Development

Thank you

John Lochner
Vice President, Innovation

