U.S. Department of Energy Office of Nuclear Energy

Voucher Request for Assistance

Section I: Technical Merit

1. Company Introduction: Describe the mission and vision for your company. What differentiates your company from others in this market?

Since 1823, the Consolidated Edison, Inc. (CEI) family of companies have been committed to developing, maintaining, securing, and enhancing the viability and sustainability of our nation's energy infrastructure. With over 15,000 employees, CEI operates the most reliable electric utility and the largest steam distribution system in the world and is the second largest developer/owner/operator of renewable generation in North America. Con Edison Clean Energy Businesses' (Con Edison CEB) mission is to provide resilient, renewable, and sustainable energy resources for communities nationwide. Con Edison CEB currently maintains over 4.4 gigawatts of PV, wind, and battery storage assets across 190 facilities and 21 states. Con Edison CEB, distinguishes itself in the market by the size, scale, and number of assets we hold, commitment to build/own/maintain, knowledge and experience in energy generation and distribution systems and markets, and the understanding of the importance and necessity of building a national energy infrastructure with multiple energy resources and technologies that is safe, reliable, and available to meet the needs of the people, businesses, institutions, communities, and economies for which it is intended to serve.

2. Problem Statement: (a) Describe the challenge your company is facing and how this assistance, if granted, will help you overcome that challenge.

With the scheduled shutdown of the Craig, Colorado coal power plant and associated coal mine beginning in 2025, it is imperative to establish and evaluate the alternatives for replacement energy generation resources that support the current and long-term energy and community needs of the immediate and regional area. Our goal in working with the National Labs is to develop a body of work that forms the foundation for the decisions necessary to move the project forward through corporate assessment and approvals and community acceptance. Components of the analysis will include: technical SMR options, feasibility, and operational requirements and risks; economic viability including financing costs, energy market pricing and dispatch optimization; utilization of existing assets, and community impact and opportunity.

Assessment of the feasibility of Small Modular Reactors (SMRs) on the existing coal site in Craig Colorado will include the integration and utilization of the existing coal and supporting energy infrastructure in terms of power conversion equipment, grid interconnection applicability, integrity, capacity, and utility; rail optionality for hydrogen transport; support of the on-going needs of a SMR facility; and availability of talent/labor pool. Additionally, assessment of the water rights relative to the requirements of a SMR and hydrogen production.

The concept of an Energy Park, providing and allowing for the development of integrated energy resources across the immediate location of the coal facilities and its environs. Incorporation, utilization, and optimization of various renewable technologies such as PV, wind, battery storage, working in conjunction with SMR to maximize the value of the site in the market and to the community.

Exploring hydrogen production as a component of the integrated energy resource plan and dispatch optimization in addition to assessing the market for hydrogen regionally or nationally and identifying the infrastructure necessary to make it a reality including pipelines, tanker trucks, and train transport.

Assessing community acceptance and impact of reutilizing the plant and its workforce. The impact and importance of this work to establish viable alternatives for this community are significant. For Craig Colorado, energy is the backbone of the local economy. To create a scenario that utilizes local, land, infrastructure, and labor resources while providing a significant contribution to the tax revenue for years to come, utilizing advanced and sustainable technologies is a goal the National Labs can support us in accomplishing.

(b) Also describe why the national laboratory capability is necessary to address your challenge.

Our proposed study relates to technologies with little in the way of commercial precedent. The feasibility of replacing coal-fired power plants with nuclear reactors has been well explored in the recent DOE Coal-to-Nuclear report, but decades of cheap petroleum and natural gas have prevented SMR projects from establishing a foothold in the electricity production market. Energy parks built around multiple electricity generation sources (SMR, PV systems, wind, hydrogen load shifting) and process heating for decarbonizing industrial applications (hydrogen production, steel production, district heating) are still mostly in the "paper" phase. Such concepts are promising, though more techno-economic analyses are required before the ability to compare possible capital investments reliably is possible.

With limited examples of nuclear-based energy parks and with the site-specific constraints, we will be reliant on projections from computer models. These technologies and their associated economic constraints are multi-faceted and heavily interdependent. Any projections will have to be tailored to the specific site and the surrounding community of Craig. The repurposing of plant and grid infrastructure will require a detailed survey of the existing Craig plant. Assessing community impact will involve evaluating the role of the facility on the local population in terms of specialized jobs, salaries, and tax base. The National Laboratory System will provide the modelling capabilities to help us understand the performance and potential return of different combinations of technologies and their applications.

3. Work Scope and funding: Describe the national laboratory or partner facility capability you need and the work you would like completed.

Through preliminary discussions with the GAIN team, it is apparent that the expertise at Idaho National Laboratory (INL), Argonne National Laboratory (ANL), and National Renewable Energy Laboratory (NREL) can provide us with the necessary skillsets to determine the viability of adapting the coal facility and retrofitting it with a nuclear reactor. To begin, an audit of the existing facilities capabilities and existing infrastructure conducted by the scientists at Argonne National Labs would determine the value of the existing transmission, water, and grid connections and components such as the cooling and power conversion infrastructure of the coal plant. INL has demonstrated expertise in the techno-economic optimization of an energy park that can account for the alternate designs of the site to adequately replace the electric needs, taxation value, and workforce needs of the city of Craig and determining the applicable federal assistance programs to consider for the development of the retrofitted facility. NREL's expertise on hydrogen network design could be best utilized to determine the viability of establishing a hydrogen hub in NW Colorado alongside assistance from the Integrated

Energy System teams at both NREL and INL can determine the possible approaches and outputs of a combined energy system.

Provide an estimate of the necessary funding for the work to be performed at the national laboratory along with a short basis for this estimate. It is advisable to consult with a point of contact at the laboratory or the GAIN office to assist with this information. Please include the following cost estimate template in your two-page appendix. The link for the template can be found at:

Based on discussions with Dr. Hansen from the Idaho National Laboratory, the proposed budget for the project is $500,000. The budget and tasks are shown in the Appendix.

4. Nuclear Energy Impact: Describe how this project, if successful, will contribute to advancing nuclear energy deployment in one or more of the following areas:

a. Energy generation economics

The concept of an energy park, with a small modular reactor, depends on the relative economics of nuclear generation with that of PV, wind turbines, battery storage, and hydrogen-based load shifting. Our goal in this effort is to determine the optimal electricity mix of a commercially viable energy park at the Craig site.

b. Economic competitiveness (capital cost,operations cost,enhanced performance)

Establishing the economic competitiveness of the energy produced relative to investment required over the life of the assets will be necessary to establish consideration/viability of the investment opportunity.

c. Capability to penetrate non-electricity market

Industrial process heat from a nuclear reactor has potential for use in industrial processes such as district heating, supporting steel production, refining of liquid fuels, hydrogen production, and purification of water. The proposed hydrogen and ammonia production and regional hydrogen hub would represent penetration into a non-electricity market.

Section II: Business & Market Impact

1. Use of Project Results: Describe how the results of the proposed assistance will enable technical advancement of your company's innovation, concept, or technology.

The results of the proposed research will enable Con Edison Clean Energy Businesses to assess the feasibility of converting the Craig coal plant into an energy park centered around an SMR. This includes providing recommendations for utilization of existing plant and grid infrastructure. The results must clarify the interplay of different generation technologies and make recommendations as to the optimal electricity mix in terms of commercial viability and positive impact on the Craig community. Further recommendations must be made regarding the commercial potential of supporting industrial applications, including district heating, hydrogen production, and steel production.

The metrics by which to compare the generation technologies will include electricity generation capacity, capital costs, financial return, and community impact in terms of employment and local and

regional economic viability. The industrial applications will be assessed in terms of technical viability, market potential, and community impact. Understanding the technologies by the above metrics will allow this site to serve as a baseline for assessing future sites. Future projects which may benefit will range from conversion of other coal power plants, energy parks, and industrial parks. The studies related to hydrogen production and its market potential are of particular interest because the results will inform how to navigate this growing market sector.

Models of near-term hydrogen markets will inform whether hydrogen production could be economically competitive. We will need to clarify whether hydrogen should be used onsite for load shifting, or whether it should be transported and sold as a commodity or both. We will also need to know whether hydrogen should be sold within the local region or nationally. Predictions of market potential would inform the amount and type of transportation infrastructure to be developed. The feasibility of establishing a hydrogen hub in the region of NW Colorado is of major interest.

Provide specific information on the degree of impact the project, if successful, will have on your company's products or services.

The success of this project will significantly impact the Con Edison Clean Energy Businesses product mix and market strategy. Currently our product offering is primarily based on renewable resource development; PV and wind, with battery storage providing some level of reliability and dispatch optimization capability. Our target markets include: utilities, municipalities/co-ops, Department of Defense, and large commercial and industrial businesses that desire renewables while requiring reliable and economically competitive energy resources, such that their market competitiveness and reliability and integrity of production of their products and services are maintained. Markets such as these require triple redundancy of energy generation for reliability, on-site generation for security, and renewable generation to satisfy market driven sustainability goals.

2. Market Analysis: Describe the expected impact on the broader market if the project is successful.

Beyond supplanting the energy requirements that would displace the coal power generation previously at the facility, the hydrogen generation at the facility would allow for the introduction of hydrogen generation in Northwest Colorado to optimize the planned installation of PV while utilizing the existing infrastructure that is otherwise slated for decommissioning. Beyond establishing a future pathway for the plant's operation and retaining and possibly expanding the currently available workforce, the potential of establishing hydrogen generation or industrial heating can also introduce green processing in the region of products such as green steel that would require both high temperature processing and hydrogen.

By establishing a path for the utilization of this facility, the current economic contributions of the plant would grow. In addition, wages will increase as new permanent jobs are added to the community directly increasing the direct and indirect local economic activity. Hydrogen used locally or exported as a commodity would introduce the hydrogen markets in a critical location in the region. Also, the value of the carbon offset would establish a new exportable resource for the region.

3. Deployment Approach: When and how will these new or improved products or services be introduced to the market or otherwise benefit your company?

The goal of the analysis will satisfy the question of economic competitiveness, community impact, and technical viability, at a prescribed site affected by coal plant closures and to which Con Edison CEB is developing a large-scale renewable installation on adjacent land. Our goal, if development is viable, would be to incorporate the results into an initiative currently underway by former Senator Rankin and the Associated Governments of Northwest Colorado and to continue to gain public support for an installation of this kind. Ultimately, the viability of a multiple energy resource facility would serve many markets melding reliability with renewables and providing the energy necessary to support economic growth and support the landscape of the local communities.

Section III. Qualifications & Experience

List the key members of your company's leadership and technical team. Briefly describe their qualifications and experience. Respondents may include up to three resumes.

(If including resumes, first remove all phone numbers, addresses, etc.)

This initiative will be sponsored and lead by Con Edison Clean Energy Businesses, leadership team including Mark Noyes, President and Chief Executive Officer, Akshaya Bhargava, Vice President, Assets, and Thomas Sweeney, Managing Director Distributed Energy Resources. In addition, the technical aspects for the project will be supported by Benjamin Ryan Bouricius and Nicolas Perticari Pesci, consultants to the project.

Mark Noyes - President and Chief Executive Officer of the Con Edison Clean Energy Businesses and is responsible for the growth and success of the renewable energy businesses. During his tenure the asset portfolio has grown to 190 facilities, across 21 states, totaling 4400 MW/DC and valued at approximately $7 billion. Prior to becoming President and CEO of the Con Edison CEB's in 2016, Mr. Noyes was Vice President of Con Edison Development, responsible for the development and implementation of the strategy to divest 1,700 MW of fossil fuel generation plants under management, and initiated the strategy to build, own, and operate large scale renewable generation assets. Mr. Noyes, worked for Con Edison Company of New York, the regulated utility for 15 years where he gained his experience in power plant management and operations.

Akshaya Bhargava - Vice President, Assets. Since joining Con Edison Development in 2001, Mr. Bhargava has had increasing responsibilities, with regard to, assessing, and developing, renewable energy market opportunities and identifying and evaluating project opportunities to develop/acquire, build, own, and operate; developing business policies, processes and plans; and financial analysis. Mr. Bhargava has closed on the development and acquisition of projects worth more than $1.4 billion and his responsibilities have included financial evaluation, due diligence, power purchase agreement negotiations, and debt and equity financing.

Thomas Sweeney - Managing Director Distributed Energy Resources. Mr. Sweeney is responsible for defining, identifying, and developing all Distributed Energy Resources opportunities across the U.S. Mr. Sweeney has been a leader in the Community Solar marketplace since 2012 and has developed more than 150 projects across 19 states. Prior to joining Con Edison CEB in 2020, Mr. Sweeney was the President of Clean Energy Collective a leader in the influencing the evolution of the Community Solar markets throughout the U.S.

Benjamin Ryan Bouricius

EDUCATION:

PhD Student in *Nuclear Science and Engineering*: *Colorado School of Mines*, GPA 4.00, (May 2026)

MS in *Advanced Energy Systems*: *Colorado School of Mines*, GPA 3.85, December 2022

BA in *Physics*: *Ithaca College*, Ithaca, New York, GPA 3.3, May 2017

Senior Thesis: *Get a Grip: An Exploration of 3D Printed Mechanical Prosthetic Hands*

WORK EXPERIENCE:

Legislative Research Fellow: *Colorado State Legislature* :: June 2022 - August 2022

- *Colorado Science and Engineering Policy Fellowship*
- Worked under Senator Chris Hansen and Senator Bob Rankin at the Colorado State Capitol
- Conducted preliminary policy research grounded in scientific understanding
- Drafted a policy proposal related to the geological disposal of Colorado's spent nuclear fuel
- Helped to increase the presence of scientists and engineers in public policy

Noyce Grant Project Coordinator: *IC Education Department* :: June 2017 - July 2018

- Managed budget records for $1.2 million NSF grant for Science Teacher Graduate Program
- Coordinated conference visits, grant reporting, and camera equipment for graduate students

Teaching Assistant (TA), Astronomy: *IC Physics Department* :: January 2017 - May 2017

- Assisted with administering assignments, examinations, conducting review sessions, et cetera

Lead Designer / Project Manager / TA: *IC 3D Laboratory* :: January 2016 - May 2018

- Managed daily operation of laboratory equipment: 3D printers, laser scanners, computers
- Designed custom prints for students, faculty, administrators, and community members
- Met with clients to review project proposals and to guide drafting of prototypes
- Managed interns, coordinated project scheduling, held office hours
- Managed inventory, purchase requisitions, operational records
- Conducted routine maintenance and occasional repairs on 3D printers
- Conducted workshops, community outreach, educational demonstrations for the public
- Mentored students in Sketchup CAD software and principles of iterative design

ACADEMIC RESEARCH EXPERIENCE:

Laser Scanner Operator: *Ferrycarrig, Co. Wexford, Ireland* :: June 2018 - July 2018

- Operated a *Leica P40* laser scanner in support of archaeological research conducted by the Irish Archaeology Field School in the Irish National Heritage Park in Co. Wexford, Ireland

Senior Thesis Student: *IC Physics Department* :: January 2016 - May 2017

- Designed and printed an anthropomorphic opposable thumb assembly which greatly improved the overall functionality of the open-source *Raptor* prosthetic hand design provided by *e-NABLE*
- Wrote a ~130-page technical paper about the project for which I earned a department award

Laser Scanner Operator: *Trim Castle, Trim, Co. Meath, Ireland* : Summers 2016 & 2017

- Operated a *Leica C10* 3D laser scanner as part of a collaboration between Ithaca College, SUNY Cortland, the Irish Archaeology Field School, and the Irish Office of Public Works
- Mentored student researchers on international travel, assisted with travel arrangements

PUBLICATIONS:

- Rogers, M., **Bouricius, B**., Shine, D., Mandal, S. (2018) "*Laser-scanning Trim Castle,*" *Archaeology Ireland*, Autumn 2018, Issue No. 125, Volume 32 No. 3, ISSN 0790-892x

- Rogers, M., **Bouricius, B.**, Shine, D., Mandal, S., "*Capturing Carrick: a digital approach to constructing and deconstructing the modern and relict landscape*." In "*Carrick, County Wexford: Ireland's first Anglo-Norman stronghold*," Shine, D. et al, Editors, Four Courts Press, December 6, 2019

PRESENTATIONS GIVEN & WORKSHOPS HOSTED:

July 2017	*3D Laser Scanning Trim Castle*, Trim Library, Trim, Co. Meath, Ireland
April 2017	*3D Printing in Support of Architectural Design Projects*, ARTH 30100: Architectural Studio I, Ithaca College, Ithaca, NY
April 2017	*Get a Grip: Modifications of 3D-Printed Mechanical Prosthetic Hand Design*, J.J. Whalen Academic Symposium, Ithaca College, Ithaca, NY
March 2017	College Showcase: *3D Visualization using 3D Laser Scanners and 3D Printers*, Educational Technology Day, Ithaca College, Ithaca, NY
January 2017	*3D Printed Mechanical Prosthetic Hand Design and Modifications*, Occupational Therapy Faculty Meeting, Ithaca College, Ithaca, NY
November 2016	*Get a Grip: Designing an Opposable Thumb on a 3D Printed Mechanical Prosthetic Hand*, 2016 Quadrennial Physics Congress, Silicon Valley, CA
October 2016	*3D Printing in Support of OT Projects*, OTMS-65500: Technological Interventions in Occupational Therapy, Ithaca College, Ithaca, NY

NOTEWORTHY ACHIEVEMENTS

- Outstanding Senior Thesis Award
- Keith C. Lee Advocacy Award
- First-Year Fellowship (PhD Scholarship)
- John Harcourt Merit Scholarship

Nicolas Perticari Pesci

EDUCATION:

M.S in *Advanced Energy Systems*: *Colorado School of Mines*, GPA 3.92, December 2022

G.C in *Humanitarian Engineering*: *Colorado School of Mines*, GPA 4.0, December 2022

B.S in *Mechanical Engineering*: *San Francisco State University*, GPA 3.7, May 2021

WORK EXPERIENCE:

Policy Research Fellow: *Colorado State Legislature:* June 2022 - Current

- *Colorado Science and Engineering Policy Fellowship*
- Worked under Senator Chris Hansen and Senator Bob Rankin at the Colorado State Capitol
- Crafted effective policy grounded in science and engineering, specifically drafted legislation promoting the usage of Regenerative Agricultural Practices in the State of Colorado
- Presented findings and final draft of legislation and surrounding research to the Colorado Water Conservation Board.
- Helped to increase the presence of individuals in public policy that come from a science and engineering background and develop the next generation of policy and science leaders in Colorado and beyond.

Graduate Auditor/ Justice 40 Lead: *Rocky Mountain Industrial Assessment Center*: Jan. 2022 – Jan. 2023

- Energy Auditor for commercial and manufacturing sites in the Denver Metro area
- Trained undergraduates on assessment techniques and equipment management
- Lead on the Justice 40 community identification protocols for the center
- Data processing and visualization for audit recommendations.

Research and Development Intern: *CARELab*: June 2020 – August 2021

- Designed and fabricated a motor characterization test bench for 30+ 3d printed components with a brushless DC motor
- Tolerance testing of Additive Material parts
- Biomedical engineering around low-cost assistive design.
- DSPACE and Simulink control system integration of virtual modeling space

Instructional Assistant: *SFSU School of Engineering*: August 2020 – August 2021

- Teaching Assistant for the Control Systems and Mechatronics courses at SF State
- Designed a Wi-Fi Teleoperation and Motor Encoder Lab for ENGR 415

Stockroom Machinist: *SFSU School of Engineering*: January 2020 – August 2021

- Organization and execution of daily operations
- Diagnosed and repaired lab equipment
- Collaborative action in assisting with the student capstone project ideas
- Created calibration tools for CAM operations
- Designed and fabricated mechanical parts

STEM Lead Tutor: *Campus Academic Resource Program*: October 2018 – January 2020

- Created academic tutoring equipment and experiments to provide aid to the tutoring center
- Chemistry tutor for Gen Chem 1 & 2
- Math Tutor for Pre-Algebra to Differential Equations
- Physics Tutor for Physics 1 to Modern Physics
- Engineering Tutor for Statics to Fluid Dynamics

PUBLICATIONS:

- Quintero, D., & Lopez, S., & Perticari Pesci, N. (2022, August), *Adapting through a Pandemic: Creating a Hands-On Mechatronics Laboratory with Team-Based Collaboration for Remote Learning* Paper presented at 2022 ASEE Annual Conference & Exposition, Minneapolis, MN. https://peer.asee.org/41728

SKILLS

- **INDUSTRY KNOWLEDGE:** Computer-Aided Design, Microcontrollers, Rapid Prototyping, Data Analysis, Event Planning, Additive Manufacturing, Strategic Communications, Team Management, Manufacturing, Control Systems Design, Community and Stakeholder Engagement, Machine Learning, Community Based Research, Energy Auditing and Efficiency
- **TOOLS AND TECHNOLOGIES:** Python, Simulink, MATLAB, SOLIDWORKS, EAGLE, AutoCAD, dSPACE, Fusion 360, GREET, MOVES, SAM, REopt, Office Suite
- **LANGUAGES:** Spanish Bi-literacy

Appendix

The cost estimate below has been developed in conjunction with Dr. Hansen from the Idaho National Laboratory. The expectation is that the work will be performed by resources from the Argonne National Laboratory and the Idaho National Laboratory. The timeline for the project is approximately 12 months. Task B and C are dependent on the results of Task A however they can be performed in parallel.

Voucher Project Schedule and Cost Estimate

				High-Level Task Breakdown				
Project Milestones	**Description**	**Months Duration (After Start of Project)**	**DOE Lab Cost by Task**	**Labor**	**Materials**	**Travel/Other**	**Company Cost Share by Task**	**Total Project Cost by Task**
Task A	Craig Coal Plant Infrastructure Assessment and Utilization	6	$150,000	$140,000	$0	$10,000	$50,000	$200,000
Task B	Economic Dispatch Optimization Model	4	$115,000	$115,000	$0	$0	$25,000	$140,000
Task C	Regional jobs/economy impact study	4	$115,000	$115,000	$0	$0	$25,000	$140,000
Task D	Report Generation and Presentation	2	$20,000	$10,000	$0	$10,000	$0	$20,000
TOTALS			**$400,000**	**$380,000**	**$0**	**$20,000**	**$100,000**	**$500,000**
				76%	**0%**	**4%**		

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.