



Fort Worden State Park, Aerial View (Photo Credit: © Nick Reid 2014)

The Renewable Nations Institute at **Fort Worden**

CENTER FOR U.S.-JAPAN COOPERATION ON ENERGY AND CLIMATE

A proposed Technical Support Unit (TSU) for the Japan-U.S. Clean Energy Partnership

The Renewable Nations Institute (Institute) and the Fort Worden Public Development Authority (FWPDA) entered a Memorandum of Understanding (MOU) dated 28 January 2022 to assess the viability of the Institute to become a contributing resident partner of the Lifelong Learning Center at Fort Worden State Park (Port Townsend, Washington).

The Institute proposes to develop a Technical Support Unit (TSU) in service to the Japan-U.S. Clean Energy Partnership (JUCEP). The JUCEP is co-chaired by the United States Department of State (DOS) and Ministry of Economy, Trade, and Industry (METI) of the Government of Japan.

In response to the JUCEP's call for urgent climate action, this Preliminary Assessment (Part 1) offers a Concept Narrative for the proposed TSU to launch with a cohort of 100 paid Summer Youth Employment Training (SYETP) interns in New York City (July 2022 - August 2022) and 100 paid resident Work-Learning-Service interns at Fort Worden (August 2022 - July 2023).

Preliminary Assessment: Part 1, Concept Narrative

20 May 2022



**RENEWABLE NATIONS
INSTITUTE**

Note: This Preliminary Assessment is available for public review as specified in *The Fort Worden Lifelong Learning Center Public Development Authority Public Records Act Administrative Policy* (dated 26 May 2021), and in compliance with the State of Washington Public Records Act (PRA) of 1972.

Foreword



Part 1, Concept Narrative, describes an initiative to establish a proposed Technical Support Unit — the Center for U.S.-Japan Cooperation on Energy and Climate — at Fort Worden State Park in service to the Japan-U.S. Clean Energy Partnership (JUCEP).

— Richard Lukens, Vice President & Managing Manager, Renewable Nations L3C



16 May 2022

Board of Directors
Fort Worden Lifelong Learning Center Public Development Authority (FWPDA)
C/O David Timmons, Executive Director
210 Battery Way, Port Townsend, WA 98368

Re: Preliminary Assessment

Mr. David Timmons,

Please accept this Preliminary Assessment: Part 1, Concept Narrative, in partial fulfillment of the Memorandum of Understanding by and between the FWPDA and the Renewable Nations Institute.

Part 1, Concept Narrative, provides an opportunity for our leadership teams to review the opportunity for the Institute, in collaboration with the Okinawa Institute of Science and Technology Foundation (OIST Foundation), to establish a proposed Technical Support Unit (TSU) — the Center for U.S.-Japan Cooperation on Energy and Climate (Center) — in service to the Japan-U.S. Clean Energy Partnership (JUCEP).

The opportunity has emerged since the signing of the Memorandum of Understanding (MOU) by and between the FWPDA and the Institute on 28 January 2022.

Subsequently, the concept has been embraced by representatives of the Government of Japan and consortium partners of the Institute. The Institute intends to open dialogue with various JUCEP stakeholders within the U.S. Government.

In the context of this opportunity that the Preliminary Assessment: Part 1, Concept Narrative, is a planning document pursuant to the following objectives:

1. Execute a voluntary public-private partnership agreement with the JUCEP;
2. Initiate an “on-boarding” process for key enabling consortium partners of the Institute; and
3. Secure a comprehensive planning grant and initial funding for a proof-of-concept pilot program, including a Summer Youth Employment Program (SYEP) in New York City and Work-Learning-Service internship program in-residence at Fort Worden.

While this Preliminary Assessment: Part 1, Concept Narrative, is under review by the Board of Directors of the FWPDA and other stakeholders, including representatives of the JUCEP, the Institute will continue to work in good-faith to execute this plan in close cooperation with the FWPDA management team and the OIST Foundation.

Respectfully submitted,

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PS: This Preliminary Assessment is intended for stakeholder review.

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Fort Worden State Park, Building 225 (Photo Credit: FWPDA)

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— John Cromwell, Vice President, Renewable Nations Institute

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Executive Summary



Fort Worden State Park ,Officers Row (Photo Credit: FWPPDA)

The Renewable Nations Institute offers proven, quality educational programs that reflect a real and bold vision that *millions of young leaders can influence consumers to make dramatic reductions of energy consumption and related CO₂ and GHG emissions in their communities aided by energy survey technology and simulation software coupled with artificial intelligence (AI).*

— Allan E. Baer, President, Renewable Nations Institute

This Preliminary Assessment: Part 1, Concept Narrative, is a first draft of the proposed activities of the Renewable Nations Institute at Fort Worden. The primary objectives of this document are to: engage in planning with the Fort Worden stakeholder community; on-board consortium members of the Institute; and open dialogue with representatives of the U.S.-Japan Clean Energy Partnership (JUCEP), as the proposed Center is intended to serve as a Technical Support Unit (TSU) of the JUCEP.

A revision of this document will be released after June 30, 2022, along with a completed Preliminary Assessment identifying committed consortium members, site requirements at Fort Worden, program capital and operating budgets, and supplemental services to the JUCEP.

Section 1.1 of the Concept Narrative describes the context from which the JUCEP emerged: the U.S.-Japan Summit Meeting between President Joseph R. Biden, Jr. and Prime Minister Suga Yoshihide on April 16, 2021. The Summit launched the *“U.S.-Japan Global Partnership for a New Era,”* a renewed U.S.-Japan Alliance featuring two new integrated initiatives: the U.S.-Japan Climate Partnership and the Competitiveness and Resilience (CoRe) Partnership.

The JUCEP, co-chaired by the United States Department of State (DOS) and the Ministry of Economy, Trade, and Industry (METI) of Japan, is tasked with ensuring that Japan and the U.S. will lead the world in the transition to a “sustainable, inclusive, healthy, green global economic recovery.”

Following the Summit and JUCEP meetings, the U.S.-Japan Council and the Okinawa Institute of Science and Technology Foundation (OIST Foundation) initiated a public webinar series on *“Japan’s and the United States’ Quest to Achieve a Carbon-Free Power Sector,”* as described in Section 1.2, sponsored by the Cabinet Office of Japan.

The series featured distinguished panelists, including:

- Dr. Steven Chu, Nobel Laureate in Physics (1997) and former U.S. Secretary of Energy (January 2009-April 2013), and William R. Kenan Jr. Professor of Molecular and Cellular Physiology at Stanford University Medical School; and
- Mr. Tatsuya Terazawa, Chairman & CEO of the Institute of Energy Economics Japan (IEEJ), Senior Specially Professor at the Tokyo University of Science, former Vice-Minister for International Affairs at the Ministry of Economy, Trade, and Industry (METI) of Japan, and Executive Secretary to former Prime Minister Yoshihiko Noda.

Emerging from the series of webinars was the identification of the need for a permanent bilateral technical support unit (TSU) to the Japan-U.S. Clean Energy Partnership (JUCEP). On April 29, 2022, at an event co-hosted by Honorable H.E. Mikio Mori, Ambassador and Consul General of Japan in New York, the President of the Renewable Nations Institute announced the intent of the Institute, in collaboration with the OIST Foundation, to enter a voluntary public-private partnership with the JUCEP to develop the proposed Center at Fort Worden to advance the JUCEP mission.

Section 1.3 highlights the urgent need for a projected investment of USD 130 trillion in EERE technologies through 2050 to limit median global temperature rise to below 1.5°C to 2°C to prevent irreversible, catastrophic climate change. The Section also states the Center’s intent to *stimulate* USD 1 trillion in annual investments in EERE projects worldwide.

Section 1.3 also highlights the urgent need for job growth in the supply-side clean energy sector (100 million jobs by 2050) and job growth in the demand-side energy sector (24.3 million jobs by 2050). The global education sector is currently not prepared to meet this growth challenge.

Section 1.4 describes the Institute’s efforts to address the energy services workforce pipeline challenge by developing a Service-Learning and Work-Learning-Service *“education-based workforce”* and replicating the proven, peer-reviewed *“Productivity-Centered”* Service-Learning and Work-Learning-Service pedagogies of the Institute globally in collaboration with the United Nations and the JUCEP.

The Institute proposes to launch an integrated secondary and post-secondary education workforce program at Fort Worden to expand the professional, certified energy efficiency workforce globally in greater numbers and years earlier than currently feasible.

The program will attract, motivate, and retain youth — **targeting minority youth in compliance with U.S. federal Justice40 objectives** — for energy efficiency education and careers by putting advanced energy data collection, modeling, and simulation tools in the hands of teachers, students, and interns to create meaningful models of energy consumption, and to help consumers achieve electricity cost savings and reduce carbon dioxide (CO2) emissions from building power loads.

Two cohorts of student interns will work in tandem throughout the year to master the required skills for pre-audit benchmarking of building power loads, including HVAC systems, interior and exterior lighting, refrigeration and water heating, and power plug and process loads (PPLs), and produce investment-grade energy efficiency project proposals in collaboration with licensed mechanical, electrical, and plumbing engineers (MEPs) serving as adjunct faculty of the Institute and its academic partners.

The key to successfully launching the integrated Service-Learning and Work-Learning-Service programs is the development of an emerging technology platform utilizing the EMPEQ Fast Site Survey™ App developed by Empowering Equity, a women, minority, and disabled-veteran owned business enterprise. The EMPEQ tool deploys AI (artificial intelligence) to remove the barrier to early entry in the energy efficiency workforce by eliminating the need for vast reservoirs of knowledge and experience to conduct the initial audit phase of an energy efficiency retrofit project.

Participating U.S. Department of Industrial Assessment Centers (IACs) will be integrated into the Work-Learning-Service internship program. IACs have conducted over 19,984 energy efficiency assessments with more than 149,618 associated recommendations, resulting in total lifecycle avoided energy cost savings of \$47.4 billion for U.S. industry clients.

The Institute will advance the IACs model by developing investment-grade EERE proposals, providing turnkey construction and project financing in partnership with private sector energy services companies (ECOs) and climate finance partners, and generating program-related revenue based upon an annual fee of 5% of the verified annual avoided energy cost savings.

Within three to five years of Center operations, the self-generating revenue model of the Institute will achieve financial sustainability for the Center, full scholarships for student interns at the Center, and private sector subsidies for Center technical support services to the JUCEP.

Section 1: Concept Narrative



Together we pledge to demonstrate that free and democratic nations, working together, are able to address the global threats from COVID-19 and climate change while resisting challenges to the free and open rules-based international order.

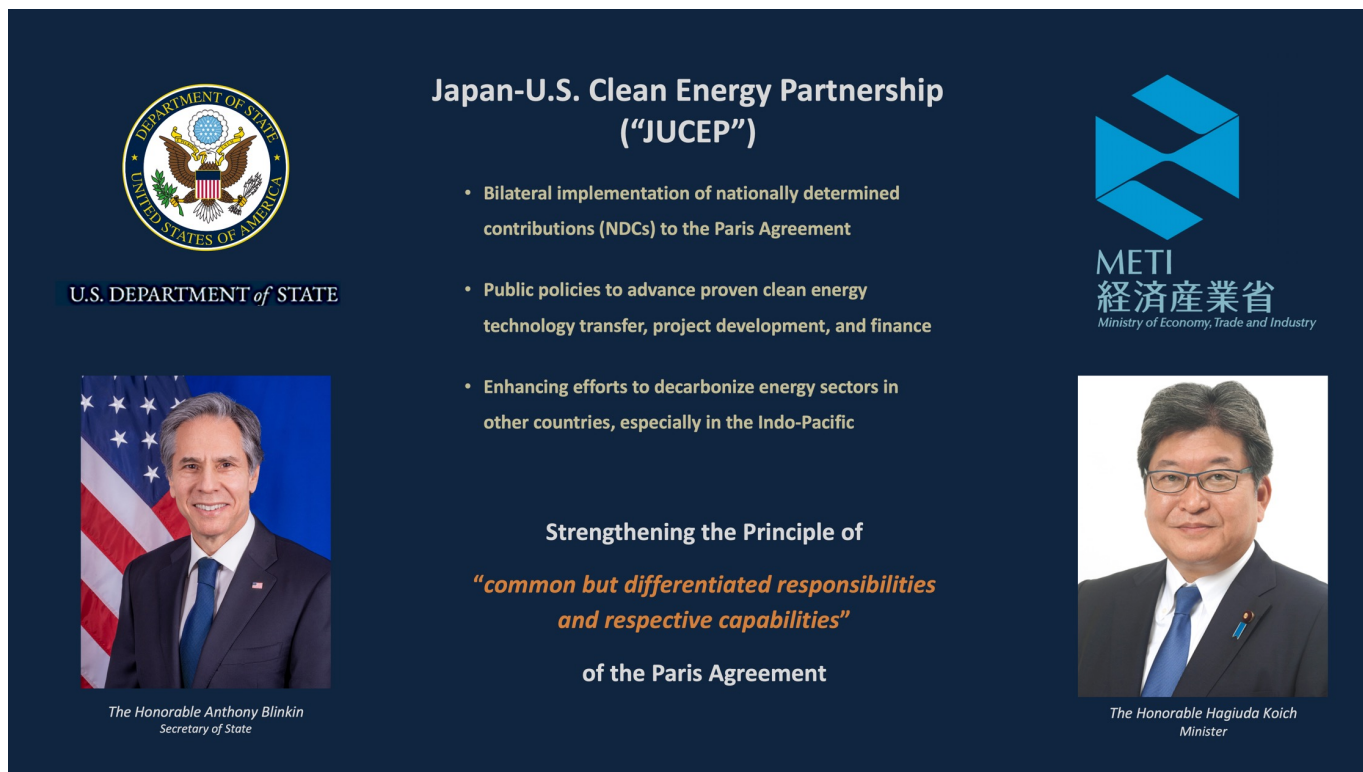
— President Joseph R. Biden and Prime Minister Suga Yoshihide
U.S.- Japan Joint Leaders' Statement

Section 1.1: Japan-U.S. Clean Energy Partnership (JUCEP)

April 16, 2021, at the U.S.-Japan Summit Meeting at the White House, President Joseph R. Biden, Jr. and Prime Minister Suga Yoshihide jointly announced the “U.S.–Japan Global Partnership for a New Era” (see Section 1, Concept Narrative photo, pg. 8), ushering in a renewed U.S.-Japan Alliance with two new integrated initiatives — the U.S.-Japan Climate Partnership and the Competitiveness and Resilience (CoRe) Partnership.

These integrated initiatives are managed by the Japan-U.S. Clean Energy Partnership (JUCEP), Figure 1.1. Japan-U.S. Clean Energy Partnership (JUCEP), co-chaired by the United States Department of State (DOS) and the Ministry of Economy, Trade, and Industry (METI). The JUCEP is tasked with ensuring that Japan and the U.S. will lead the world in the transition to a “sustainable, inclusive, healthy, green global economic recovery.”

Figure 1.1. Japan-U.S. Clean Energy Partnership (JUCEP)



Source: The Renewable Nations Institute (2022)

Japan-U.S. Clean Energy Partnership (JUCEP):

The JUCEP launched on 10 June 2021, with a virtual meeting co-chaired by the DOS and METI. The meeting included representatives from the U.S. Department of Commerce; Department of Energy; U.S. Department of Treasury; U.S. International Development Finance Corporation; U.S. Trade and Development Agency; U.S. Agency for International Development; Export-Import Bank; Japanese Ministry of Economy, Trade and Industry; Japanese Ministry of Foreign Affairs; Japanese Ministry of Finance; Japan Bank for International Cooperation; Nippon Export and Investment Insurance; Japan Oil, Gas and Metals National Corporation; Japan International Cooperation Agency; and the New Energy and Industrial Technology Development Organization of Japan.

The JUCEP co-chairs — Secretary of State Anthony Blinkin and Minister Hagiuda Koich — shared the view with meeting attendees that U.S.-Japan cooperation will contribute to green growth, advance shared climate goals under the Paris Agreement, and help achieve net zero greenhouse gas emissions globally by 2050.

The co-chairs further committed the JUCEP to focus global stakeholder cooperation and targeted cooperation in the Indo-Pacific region to:

- 1) Address climate change – which has become a global crisis now more urgent than ever.
- 2) Support competitive energy markets, which are indispensable to ensuring a clean, secure and sustainable energy supply;
- 3) Facilitate universal access to affordable, clean, and reliable energy services needed to help eradicate poverty, reduce health and environmental impacts of fossil fuel use, drive economic growth and recovery, as well as reinforce global energy security; and
- 4) Engage Indo-Pacific partners to encourage rapid deployment of clean energy and drive the decarbonization of their economies, reflecting the principles of the Climate Partnership, by accelerating diverse, ambitious, and realistic transition paths towards net-zero emissions.

The JUCEP will engage private sector and government experts in the United States and Japan, and regional partners in the Indo-Pacific and around the world. The JUCEP aims to identify and increase commercial opportunities that support investment environments that promote decarbonization that fosters a realistic and ambitious energy transition with universal access to clean energy services.

JUCEP will mobilize private sector engagement and catalyze all available policy implementation tools from both countries in a whole of government approach. The goal is to accelerate sustainable, private sector-led clean energy investments in technologies from the United States and Japan with a view to achieving sustainable development and energy security in the Indo-Pacific . . . and globally.

JUCEP National Task Force by Country:

Key cooperation areas under JUCEP include but are not limited to:

- 1) **Renewable Energy:** Geothermal, wind, solar, hydropower, and critical minerals.
- 2) **Grid Modernization:** Grid stability, energy management technology including battery storage, and transmission.
- 3) **Nuclear Energy:** Advanced technologies such as small modular reactors and light water reactors.
- 4) **Decarbonization Technologies:** Carbon Capture, Usage and Storage (CCUS) technology, Carbon recycling and abatement technologies, as well as advanced fuels like ammonia, hydrogen, and others.

Figure 1.2. Japan-U.S. Clean Energy Partnership (JUCEP), National Task Force by Country



Source: The Renewable Nations Institute (2022)

Accelerating Climate Action:

The JUCEP National Task Force for Japan and the U.S. agree that the findings of the International Panel on Climate Change (IPCC) are compelling; the world must accelerate climate action. *"We have the tools to fight the climate crisis in every part of the economy, but time is running out."*

The National Task Force for each nation are focused on rapidly reducing CO₂ and related GHG emissions. The U.S. government intends to lead by example: procuring 100% carbon-free electricity (CFE) by 2030; 100% zero-emission light-duty vehicle acquisitions by 2027; 100% zero-emission vehicle (ZEV) acquisitions by 2035; and net-zero emissions building portfolio by 2045, including a 65% emissions reduction by 2030.

In October 2020, the Japanese government declared its goal to realize carbon neutrality by 2050. In April 2021, a policy was announced to set a new GHG reduction target for FY 2030, aiming to reduce CO₂ and related GHG emissions by 46% from FY 2013 levels.

In January 2020, the government of Japan formulated the "Environmental Innovation Strategy" (decided by the Japan Integrated Innovation Strategy Promotion Council on 21 January 2020). The Environmental Innovation Strategy seeks to establish innovative technologies that will enable Japan to achieve "Beyond Zero" and to reduce 100% of the accumulated amount of CO₂ and related GHG emissions since the Industrial Revolution.

Section 1.2: Center for U.S.-Japan Cooperation on Energy and Climate

To support the bilateral implementation and achievement of the U.S.-Japan Climate Partnership, the Cabinet Office of Japan and the U.S. Embassy in Japan sponsored a series of webinars, seminars, and receptions to explore public-private partnership options to achieve a carbon-free power sector in Japan and the U.S. The events were co-hosted by the U.S.-Japan Council (USJC), the Asia Society, the Okinawa Institute of Science and Technology Graduate University (OIST), the OIST Foundation, the Pacific International Center for High Technology Research (PICHT), and the Renewable Nations Institute.

Featured speakers included: (i) Dr. Steven Chu, Nobel Laureate in Physics (1997), former U.S. Secretary of Energy (January 2009 – April 2013) and William R. Kenan Jr. Professor of Molecular and Cellular Physiology at Stanford University Medical School; (ii) Mr. Tatsuya Terazawa, Chairman & CEO of the Institute of Energy Economics Japan (IEEJ), Senior Specially Professor at the Tokyo University of Science, former Vice-Minister for International Affairs at the Ministry of Economy, Trade, and Industry (METI) of Japan, and Executive Secretary to former Prime Minister Yoshihiko Noda; and (iii) Momoko Nagasaki, Executive Officer at Tokyo Electric Power Company Holdings.

Figure 1.3. U.S.-Japan Council Webinar Series



Source: U.S.-Japan Council, OIST Foundation, Renewable Nations Institute (2022)

Concept Paper for U.S.-Japan Cooperation on Energy and Climate:

Emerging from the series of webinars, seminars, and receptions was the identification of the need for a permanent bilateral technical support unit (TSU) to the Japan-U.S. Clean Energy Partnership (JUCEP).

On 22 March 2022, the Renewable Nations Institute drafted a confidential concept paper for a Center for U.S.-Japan Cooperation on Climate and Energy as an anchor educational and research program at the Center for Lifelong Learning at Fort Worden. The concept paper was distributed to the leadership of the OIST Foundation, the Fort Worden Public Development Authority (FWPDA), and the Renewable Nations Institute's academic and cross-sectoral consortium management team.

Consensus was reached to proceed with the development of a proposed TSU and to publicly announce the pursuit of a proposed Center at Fort Worden to key stakeholders in the governments of the U.S. and Japan.

On April 29, 2022, at an event co-hosted by the Ambassador and Consul General of Japan in New York, H.E. Mikio Mori, the OIST Foundation and the Renewable Nations Institute announced the intent to pursue voluntary public-private partnership agreements with the DOS and METI to provide technical assistance and decision support in service to the JUCEP.

The Institute, in collaboration with the OIST Foundation and the FWPDA, will host a series of seminars, workshops, and conferences to bring together governmental organizations from the U.S. and Japan with academic and cross-sectoral partners of the Institute and the FWPDA.

The purpose of the seminars, workshops, and conferences will be to advance the concept for the proposed Center for U.S.-Japan Cooperation on Energy and Climate through early-stage development.

Organizational Structure:

The Institute has aggregated a multi-sector consortium (Consortium) under the umbrella of the Renewable Nations L3C, a special purpose vehicle (SPV). Consortium partners have the capacity to develop, finance, equip, operate, and maintain the proposed Center for U.S.-Japan Cooperation on Climate and Energy (Center).

The Consortium consists of 14 Academic Partners and 25 Cross-Sectoral Partners, including Tier R1 doctoral universities, university-based innovation district developers, climate finance institutions, mission- and impact-driven investors, architectural firms, instructional technology designers, non-profit research organizations, and leading for-profit technology companies at the cutting-edge of building information management (BIM) systems.

Academic Partners have a combined total enrollment of 382,000 students, a combined operating budget of \$109.5 billion, and combined endowment of \$82.6 billion. The combined market capitalization of Cross-Sectoral Partners exceeds \$2.5 trillion. Assets under management by Finance Partners exceeds \$3 trillion. See Figure 1.4, Structure of the Proposed Center for U.S.-Japan Cooperation on Energy and Climate (pg. 13) for a partial listing of Consortium Partners.

With the release of this Preliminary Assessment: Part 1, Concept Narrative, the initial on-boarding process for Institute Consortium Partners will commence. The initial on-boarding process will be completed by July 30, 2022.

Management Structure:

The Renewable Nations Institute proposes to function as the secretariat for the Consortium and to provide the following roles in the development, management, and on-going operations of the proposed Center:

1. **Consortium Development:** The Institute will recruit and maintain multisector membership in the Consortium consisting of higher education institutions, research institutes, multilateral development banks, private philanthropies, financial institutions, private industry, trade unions, civil society stakeholders, and others.
2. **Real Estate Development:** In collaboration with the FWPDA, the Institute will support the planning, designing, financing, engineering, constructing, retrofitting, preserving, furnishing, and equipping the proposed Center facilities at Fort Worden.
3. **Program Operations and Facility Management:** The Institute will oversee day-to-day operations and maintenance (O&M) of leased facilities, including but not limited to academic programming, research and development, and all other permitted uses, i.e., as allowed per lease agreement with the FWPDA.
4. **ESCO Finance Management:** The Institute will develop a special purpose vehicle (SPV) to finance for Work-Products (investment-grade energy efficiency and renewable energy project proposals developed by the Institute's paid Work-Learning-Service interns in collaboration with full-service energy services contractor (ESCO) project partners serving in the capacity as adjunct faculty at the Center.
5. **Client Recruitment:** The Institute will recruit and market to domestic and international clients for TSU services at all program levels.

Fort Worden Integrated Partner Economy:

The Washington State Parks and Recreation Commission (Commission) and the FWPDA have established an integrated partner economy to the benefit of Resident Partners at the Lifelong Learning Center at Fort Worden State Park.

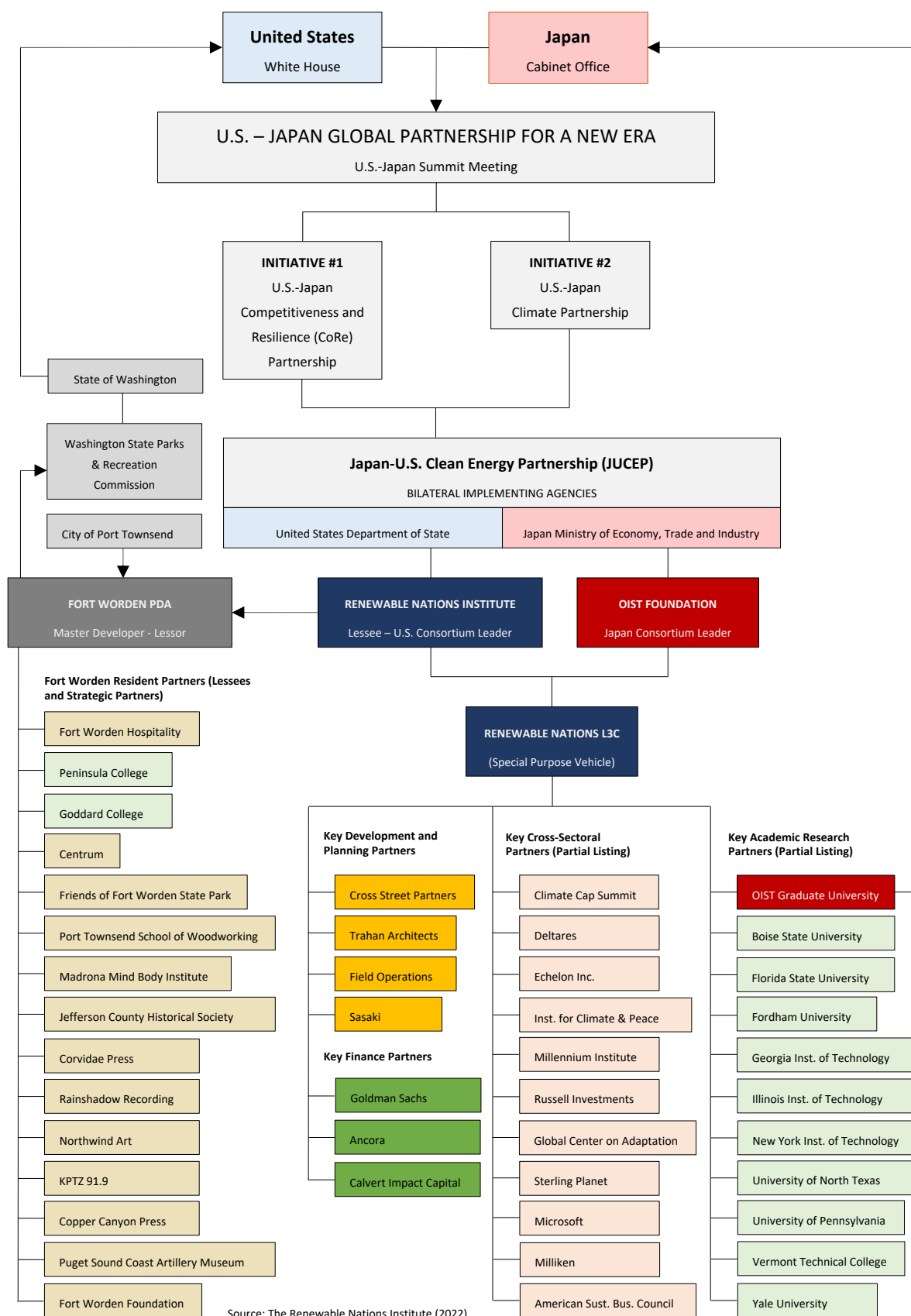
The management and operations plan for the proposed Center for U.S.-Japan Cooperation on Energy and Climate (Center) will be designed in a manner to optimize impact to the integrated partner economy, as follows:

1. **State of Washington:** Institute seeks to optimize the impact on the Commission's objectives for the development of a Lifelong Learning Center at Fort Worden as reflected in the State strategic framework, referred to as "*Priorities of Government*," and will report the results to the Commission annually in compliance with the Priorities of Government Strategic Framework. Government priorities for the State of Washington within the *Priorities of Government Strategic Framework* are to improve student achievement in elementary, middle, and high schools, and to improve the value of post-secondary learning, especially for minority communities.
2. **Jefferson County:** Jefferson County and the greater Olympic Peninsula region are undergoing economic transition and recovery from the socioeconomic impacts of the COVID-19 Pandemic. The Institute will collaborate, as feasible, with Jefferson County, the City of Port Townsend, and related local, regional, and state economic development entities to align the proposed Center's workforce development initiatives with regional economic development priorities, specifically in the context of regional sustainable energy development and associated workforce training requirements.
3. **Resident Partners:** The Institute will adhere to the principles of an integrated partner economy at Fort Worden to the degree to which the operations and services will be planned to leverage the mission, operations, and services of current and future Resident Partners at Fort Worden. The goal is to strengthen the "partnership economy" through a blend of complementary service offerings specifically targeted to clients of the Institute's program-related conference services. The Institute will conduct its business planning in such a manner as to collaborate with the FWPDA and Resident Partner organizations to coordinate program planning, marketing support, customer service support, scheduling, and facility management and utilization.

Center Stakeholder Diagram:

Figure 1.4, Center for U.S.-Japan Cooperation on Energy and Climate — Stakeholder Diagram (pg. 13, below), provides a draft conceptual diagram (subject to change) for prospective project stakeholders, including bilateral JUCEP administration, Consortium members of the Institute, Resident Partners of the FWPDA, the FWPDA, and all relevant governmental organizations pertaining to jurisdictional authority of the development and use of the Fort Worden State Park and the Lifelong Learning Center at Fort Worden.

Figure 1.4. Center for U.S.-Japan Cooperation on Energy and Climate - Stakeholder Diagram



Section 1.3: Focal Areas in Service to the JUCEP

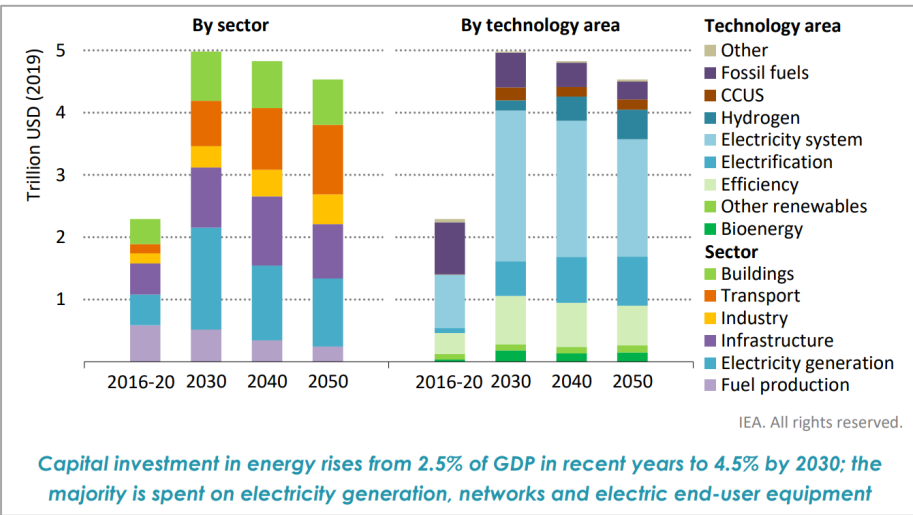
Global Investments in the Energy Transition:

According to the International Energy Agency (IEA), annual investments in energy (primarily fossil fuels) has been just over USD 2 trillion globally on average over the last five years. In order to limit median global temperature rise to below 1.5°C to 2°C, a projected annual investments of USD 7.2 trillion in energy efficiency and renewable energy (EERE) technologies are required from 2022 through 2030, and USD 3.5 trillion annually from 2031 through 2050 (updated 2022 estimates). This represents an estimated total investment of USD 130 trillion through 2050. See Figure 1.5, Annual average capital investment in the Net Zero Energy (NZE) Scenario through 2050 (previous estimated investments as of 2019-2020):

The Center’s climate finance research agenda will seek to develop new business models that mobilize private sector financing by advancing public-private-partnership models that unlock large-scale investment capital in emerging markets through closer cooperation between EERE developers, private investors, public financial institutions, and governments.

Research emphasis will include incentivized policy reforms and functional regulatory frameworks across end-use, energy infrastructure, electricity generation, and low-emissions fuels to achieve annual investment targets as defined by the IEA in the NZE pathway.

Figure 1.5. Annual Average Capital Investment in the Net Zero Energy (NZE) Scenario through 2050



Source: International Energy Agency (2020), *Net Zero by 2050: A Roadmap for the Global Energy Sector*

Impact of the Center Climate Finance Research Agenda:

In alignment with the scale of the JUCEP global impact to lead the world in solving the climate crisis, the Consortium will endeavor to **stimulate** USD 1 trillion in annual investments in EERE projects worldwide.

EERE projects will be accomplished by providing technical assistance to existing international entities, including Green Climate Fund (GCF). The GCF is charged by the United Nations Framework Convention on Climate Change (UNFCCC) to address climate finance at-scale.

In 2010, the UNFCCC established the GCF. In 2011, it designated the GCF as the operating entity of the UNFCCC’s finance mechanism (Mechanism) under the Principle of “common but differentiated responsibilities and respective capabilities” of the Paris Agreement. The Principle requires developed countries to provide \$100 billion annually through 2050 to assist developing countries in implementing the objectives to limit global warming from between 1.5°C to 2 °C above pre-industrial levels by the interquartile period of 2045 to 2050.

The Mechanism is accountable to the UNFCCC Conference of Parties (COP), which decides on its policies, program priorities, and eligibility criteria for funding.

In addition to providing guidance to the GCF, the UNFCCC has established two special funds, the Special Climate Fund (SCCF) and the Least Developed Countries Fund (LDCF), managed by the Global Environment Facility (GEF) and the Adaptation Fund (AF).

The Center will develop technical assistance and decision support services designed to assess the financial risks of JUCEP investments managed by the GCF, the SCCF, the LDCF, the AF and/or the GEF. The aim of Center technical assistance and decision support services to the JUCEP is to accelerate annual investments in EERE projects worldwide through 2050, as projected in the NZE pathway.

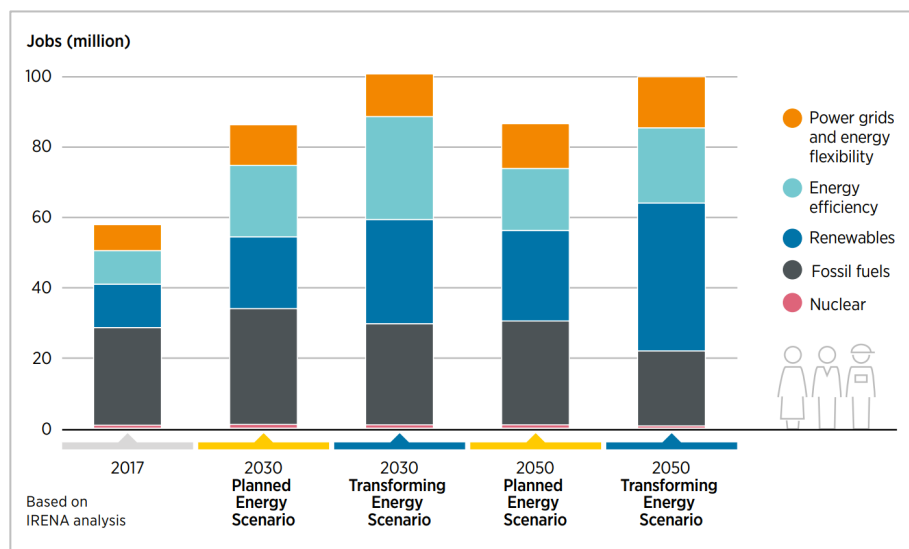
Government investment is essential to attract unprecedented amounts of private capital to bring new clean energy technologies to market. To attract the unprecedented amounts of private capital for diverse technology solutions needed to limit global warming to 1.5°C to 2 °C by 2050, it is critical for governments to develop investment and regulatory frameworks to assure equitable distribution of benefits across all sectors of society. This will require unprecedented inclusion and cooperation from stakeholder communities.

Supply-side Energy Workforce Transformation:

According to “Employment in the Energy Sector, Status Report 2020,” a publication of the Joint Research Centre (the “JRC”) of the European Commission, global employment in the supply-side energy sector reached nearly 58 million in 2017. About 29 million of these jobs are in the fossil fuel industries, approximately 9.8 million in new renewables. The balance of 19.2 million jobs are in nuclear and other legacy energy systems, including power grids.

The International Renewable Energy Agency (IRENA) projects that jobs in the supply-side energy sector comprising of transition-related technologies (renewable energy, energy efficiency, power grids, energy flexibility, fossil fuels, and nuclear power) could reach 100 million by 2050 (see Figure 1.6, Energy Sector Job Growth: Reaching 100 million in 2050, below). New renewables — solar, wind, and biomass — are projected to rise from 9.8 million jobs to 30 million by 2030, and to 42 million by 2050.

Figure 1.6. Energy Sector Job Growth: Reaching 100 million in 2050



Source: IEA (2020), *Net Zero by 2050: A Roadmap for the Global Energy Sector*

Demand-side Energy Workforce Transformation:

In the demand-side energy sector, employment in the energy efficiency segment is projected to grow from 3.3 million jobs in 2020 to 24.3 million by 2050, an increase of 21 million.

An industry survey of 60,000 general and operational facility managers in the U.S. conducted by the Oak Ridge National Laboratory exposed the need for advanced energy management training to currently employed facilities managers. Survey results indicated the following:

- 1.7% of general and operational facility managers track energy data, set energy efficiency and renewable energy goals, and invest in projects.
- 15% sporadically track energy data but fail to set goals or invest.
- 83% reported little to no knowledge of energy management.

Extrapolating from U.S. Bureau of Labor Statistics (BLS) data on general and operational facilities managers, an estimated 14 million managers worldwide require greater knowledge of energy efficiency.

The rapid expansion of the demand-side energy workforce is critical to meet the UNFCCC’s target to achieve a 50-52% reduction from 2005 levels in economy-wide net greenhouse gas pollution by 2030, as recommended by the IPCC in order to limit median global temperature rise to below 1.5°C to 2°C by the interquartile range of 2045-2055.

Challenges to Energy Workforce Transition:

Underlying the Transforming Energy Scenario are significant changes in the composition of employment and, by extension, changes in the structure, organization, and execution of workforce preparedness in both the formal and informal education sectors.

According to the 2020 U.S. Energy and Employment Report (USEER) published by the National Association of State Energy Officials (NASEO), and the Energy Futures Initiative (the “EFI”), energy workforce hiring difficulties are experienced by virtually all supply-side and demand-side segments. This problem is further exacerbated as the industry adapts to changes due to structural reform and emerging technologies that are driving market transformation.

Over 84% of employers across supply-side and demand-side segments in the U.S. reported difficulty hiring qualified workers over the last 12 months, an increase of over 7 percentage points (2017-2018 data). The USEER states the primary issues are “modernization of infrastructure and change in generation mix requiring new skills that are on two- and five-year cycles” and the “lack experience, training, and technical skills” in the available pool of workers. Challenges to energy workforce transition in the developing world are further exacerbated by the absence of workforce preparedness for emerging EERE technologies in both the formal and informal education sectors.

Section 1.4: Educational Service - Delivery Model and Pedagogy

Service-Learning, Work-Learning-Service Internships:

The Renewable Nations Institute signed a Memorandum of Understanding (MOU) with the Fort Worden Public Development Authority (FWPDA), dated 28 January 2022, with the intent to establish The Renewable Nations Institute at Fort Worden with proposed Service-Learning, Work-Learning-Service, and Program-related Conference Services (ref: MOU, Section 2.1-2.3, The Institute's Academic and Conference Programming), as follows:

MOU 2.1. Service-Learning: The Institute will develop and operate online Service-Learning programs at Fort Worden that engages middle and secondary school students in a course of study and community service to educate the public on the United Nations Sustainable Development Goals ("SDGs"). The course of study shall comprise of 100 hours of online academic study over a period of one academic year followed by a minimum of 60-hours of community service, or (b) a two-week summer residency program at Fort Worden followed by 60-hours of online academic study and a minimum of 60-hours of community service over a period of one academic year. Students who successfully complete either course of study will be designated "United Nations Junior Ambassadors." (Ref: UNDESA Partnership Commitment #SDGAction13739)

MOU 2.2. Work-Learning-Service: The Institute will develop and operate a residential Work-Learning-Service program at Fort Worden engaging post-secondary students in a course of study resulting in the development and implementation of Work-Products for multi-sector stakeholder clients of the Institute. Work-Products will include, but may not be limited to: (a) development, maintenance, and operation of online Service-Learning curricula on the SDGs; (b) decision support services for "Enabling Actions in Energy Planning and Policies, Capacity Building and Knowledge Sharing" targeted to urban and rural communities throughout the U.S., and low- and middle-income member countries of the United Nations; and (c) investment-grade energy efficiency and renewable energy (EERE) project proposals for multisector domestic and international clients of the Institute. The course of study shall comprise of two options: (i) a two-semester certificate- and/or credit-bearing residency at Fort Worden with a minimum 160-hours paid internship; or (ii) a four-semester certificate- and/or credit-bearing residency at Fort Worden with a minimum 320-hour paid internship. Students who successfully complete the four-semester, credit-bearing course of study will receive an Associate of Science in Sustainable Energy Development and the designation of "United Nations Junior Fellow." (Ref: UNDESA Partnership Commitment #SDGAction13739.)

MOU 2.3. Program-related Conference Services: In conjunction with online and residency certificate- and credit-bearing Service-Learning and Work-Learning-Service academic programming (Items 2.1 and 2.2, above), the Institute will offer program-related conference services to Institute clients designed in a manner as to contribute to the integrated resident partner economy at Fort Worden, as referenced in the Fort Worden State Park Long Range Business and Operating Implementation Plan.

Pedagogical Framework:

Since 1979, the Institute embraces constructivist and constructionist pedagogies, which adhere to the following principles:

- That learning is an interactive, socially contextualized process of constructing knowledge rather than acquiring it.
- That knowledge is constructed or "contextualized" based upon the learner's personal experiences and the hypotheses of their social environment.
- That learners iteratively test hypotheses through social negotiation.
- That each learner has a unique interpretation and construction (or reconstruction) of the knowledge process.

The early foundation of constructivist and constructionist pedagogies began with the principles of *social development theory* espoused by Lev Semyonovich Vygotsky (1896–1943). Social development theory argues that social interaction precedes development, and that consciousness and cognition are the end-product of socialization and social behavior.

John Dewey (1859–1952) advanced constructivist and constructionist pedagogies arguing that education and learning are social and interactive processes, and that a school is a social institution through which social reform can and should take place by preparing students to be reflective, autonomous and ethical beings capable of arriving at social truths through critical and inter-subjective discourse based in social inquiry. Problem-Based Learning (PBL), a method used widely in education today, incorporates Dewey's ideas pertaining to learning through active inquiry.

Jean Piaget (1896–1980), who coined the term *Constructivism*, argues that mechanisms by which information from the environment and ideas from the individual interact result in internalized structures developed by learners. Piaget identified that the social processes of assimilation and accommodation are essential for individuals constructing new knowledge from their experiences.

Paulo Freire (1921–1997), who coined the term *Conscientization* — the process of developing a critical awareness of one's social reality through reflection and action — is fundamental to the process of constructing new knowledge. Hence, learning is a critical process which depends upon uncovering real problems and actual needs, affirming that men and women are beings in the process of becoming, and transforming themselves and society.

Seymour Papert (1928–2016), who advanced the psychological theory of *Constructivist Learning*, held the view that learning is a reconstruction of knowledge rather than as a transmission of knowledge. Constructivist Learning embraces idea that ***learning is most effective when part of an activity the learner experiences as constructing a meaningful product.***

Building upon constructivist and constructionist pedagogies, the Institute's emerging pedagogical practice is referred to as *Productivity-Centered Service-Learning* (K-12) and *Productivity-Centered Work-Service-Learning* (secondary and post-secondary).

Productivity-Centered Service-Learning and Education for Sustainability in the K-12 Education Sector:

The social construct of *sustainability* is transforming teaching and learning. K-12 education institutions globally are integrating sustainability across the curriculum, driven (in-part) by the emergence of Next Generation Science Standards (NGSS) led by the National Research Council (NRC), the American Association for the Advancement of Science (AAAS), and the National Science Teachers Association (NSTA).

NGSS were developed by 26 U.S. partner states, hundreds of NGSS-aligned higher education institutions (HEIs), and professional organizations. The NGSS are internationally benchmarked — reflective of the expectations that other leading nations have set for their students — and are emerging as a global standard for science education.

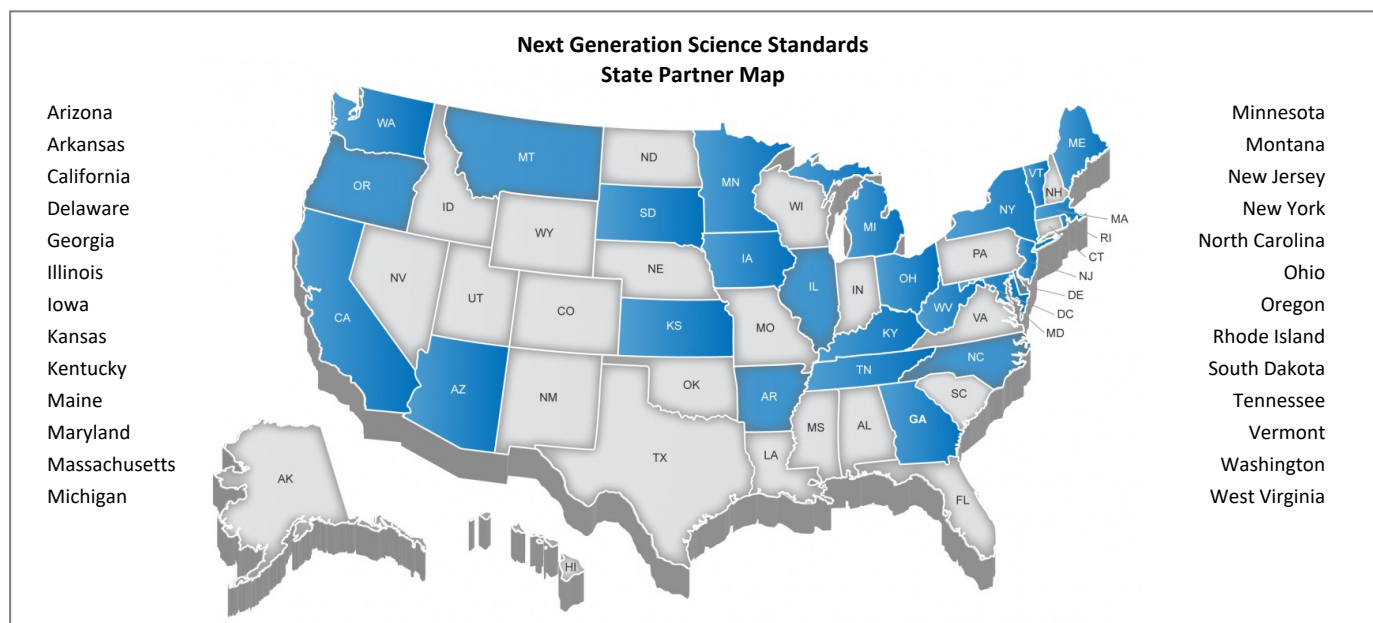
The focus of the NGSS is to help prepare students to join the workforce of the future. Key themes within the NGSS are sustainability and resiliency in the context of the socioeconomic and environmental impacts of global warming and the concept of coupled human and natural systems (CHANS). The teaching methods required by NGSS are based on Constructivism and Constructivist Learning pedagogies to engage learners.

Since its inception in 1996 as a Science, Technology, Engineering and Mathematics (STEM) instructional technology research organization, the Institute, in collaboration with multiple domestic R1 and R2 Doctoral Universities and international HEIs, has conducted peer-reviewed Constructivism and Constructivist Learning research focused principally on sustainability in the context of the socioeconomic and environmental impacts of global warming and CHANS.

The Institute's *Productivity-Centered Service-Learning* and *Productivity-Centered Work-Service-Learning* pedagogies that emerged during this research phase convey the elemental understanding of sustainability as a "measure" or "indicator" of the impact of econometric productivity on primary productivity, general defined as ecosystems services.

Productivity-Centered Service-Learning and *Productivity-Centered Work-Service-Learning* are emerging Constructivism and Constructivist Learning pedagogies that engage students in learning that a results in the creation of meaningful "work-products" that achieves sustainability (positive feedback) across coupled human and natural systems (CHANS).

Figure 1.7. Next Generation Science Standards, State Partner Map



Source: Achieve (2022)

K-12 Middle School Service-Learning Program:

The Renewable Nations Institute aims to advance its middle and high school Constructivism and Constructivist Learning-based pedagogies in the context of online *Action-based Research* programs operated from Fort Worden. Action-based Research is a participatory, democratic process concerned with developing practical knowledge in the pursuit of worthwhile human purposes, grounded in a participatory worldview emerging at a given historical moment. Service-Learning is a Constructivist Learning activity that seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally, to their communities.

The Center will engage youth in middle school and secondary school (and in the informal education sectors) worldwide in an online and community-based, Service-Learning platform, the Green Earth Corps, to support public education and the dissemination of information on the 17 integrated Sustainable Development Goals (SDGs), and on actionable CO₂ and GHG emissions mitigation strategies. The Green Earth Corps (GEC) Service-Learning platform has been proven through more than a decade of peer-reviewed research to increase public knowledge about the risks of global warming and to enhance public acceptability of measurable action on various proposed CO₂ and GHG emissions mitigation strategies.

The Green Earth Corps (GEC):

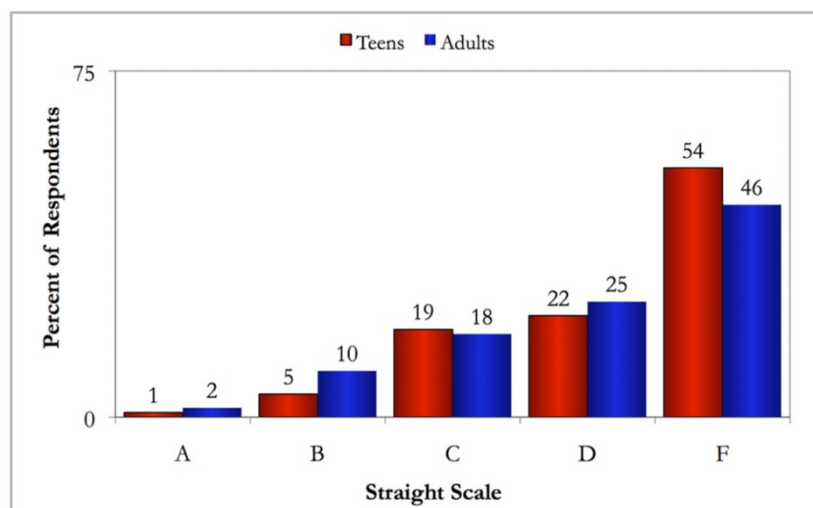
The Green Earth Corps (GEC) is an Action-based Service-Learning initiative designed to support public education and disseminate information on the SDGs as a means to improve public acceptability of climate-resilient development pathways and support consumer-driven actionable CO₂ and GHG emissions mitigation strategies.

The GEC was developed by the Institute under Project ERGAL (Renewable Energy Galapagos, 2002-2009). Each year from 2006 to 2018, more than 450 to 1,000 students from hundreds of school districts in 7 U.S. states and 52 nations participated in peer-reviewed GEC research projects developed, designed and/or operated by the Institute and its collaborating R-1 research-based universities — University of Vermont (UVM) and University of North Texas (UNT) — with funding from the National Science Foundation (NSF).

The foundational research conducted by the Institute and its university-based collaborators demonstrates the capacity of the GEC Service-Learning initiative to empower youth to hold the general public accountable for improving their attitudes, knowledge, beliefs, and intentions toward climate change (Figure 1.8. Grading Teens' and Adults' Knowledge of Climate Change).

Despite the critical need for changes in climate change-related consumer behavior worldwide, the general public knows little about the issue, less about what they can do, the barriers to action they confront, or the factors that motivate wide-scale behavioral changes. Subsequent studies and surveys by UNDP, the Yale Project on Climate Change Communication, and Institute collaborating universities produced similar results.

Figure 1.8. Grading Teens' and Adults' Knowledge of Climate Change



Source: Yale Project on Climate Change Communication, 2011

Peer-Reviewed Research, Middle-Schoolers Out-to-Save the World:

Middle Schoolers Out-to-Save the World (M-SOS-W) (2008-2012) and Going Green! Middle Schoolers Out-to-Save the World (2013-2019) were National Science Foundation (NSF) research grants (#DRL-083376 and #DRL-1312168) in which each school year approximately 650 sixth graders from middle schools in California, Hawaii, Louisiana, Maine, North Carolina, Texas, and Vermont monitored home energy use under supervision of their teachers.

The data collected by students were used to develop optimum scenarios for conserving energy and reducing the production of carbon dioxide (CO₂) and greenhouses gas (GHG) emissions in their communities. Students and teachers used online software tools to record and analyze their data and create projections of future energy use based on assumptions of policy changes and communicated their results to the general public within the project via information communication technologies (ICTs).

Data from 1,576 middle school students provided accurate and reliable information concerning the "intentionality" of students, teachers, and energy consumers to make dramatic reductions of CO₂ and related GHG emissions in their communities when educated on the socioeconomic and environmental impacts of climate change.

Peer-Reviewed Research, Global Challenge Award:

The Global Challenge Award (2006-2009) engaged over 3,000 high school students from around the world, including students from developing countries, working in eLearning teams to create innovative solutions to address global climate change, and to present their solutions and its global business potential to a panel of industry professionals.

The ITEST grant award was complemented by a MacArthur Foundation grant award which provided a K-16 partnership framework that supported over 230 young women and minority high school students from around the world for three years to develop the knowledge, skills, and personal vision to see science, technology, engineering, and mathematical (STEM) studies as feasible and desirable choices for college majors.

M-SOS-W and the Global Challenge Award are peer-reviewed, Action-research programs that support the claim that the Institute offers proven quality educational programs that reflect a real and bold vision that ***"millions of young leaders can influence consumers to make dramatic reductions of energy consumption and related CO₂ and GHG emissions in their communities."***

Section 1.5: Integrated Service-Learning / Work-Learning-Service Program

Secondary and Post-Secondary GEC Program Integration:

The Institute is proposing to launch an integrated secondary and post-secondary Green Earth Corps (GEC) workforce development program at Fort Worden focused on energy efficiency industry workforce development. The programs aim to expand the professional, certified energy efficiency workforce in greater numbers and years earlier than currently accessible.

The program will attract, motivate, and retain youth — targeting minority youth — for energy efficiency education and careers by putting advanced energy data collection, modeling, and simulation tools in the hands of teachers, students, and interns to create meaningful models of energy consumption, and to help consumers achieve electricity cost savings and reduce carbon dioxide (CO2) emissions from building power loads.

The Institute will operate the program concurrently in two cohorts: (i) a Service-Learning cohort consisting of high school students; and (ii) a Work-Learning-Service cohort of consisting of paid post-secondary interns in-residence at Fort Worden.

These two cohorts will work in tandem throughout the year to master the required skills for pre-audit benchmarking of building power loads, including HVAC systems, interior and exterior lighting, refrigeration and water heating, and power plug and process loads (PPLs), to producing investment-grade energy efficiency project proposals in collaboration with licensed mechanical, electrical, and plumbing engineers (MEPs) serving as adjunct faculty of the Institute and its academic partners.

The Service-Learning cohort will complete 100-hours of online training on issues related to energy and climate, learn to use energy modeling software, and complete 60-hours of community service conducting pre-audit energy efficiency services on commercial and institutional buildings in their communities. Upon successful completion of the Service-Learning curriculum, students be eligible for a Summer Youth Employment Program (SYEP) managed by the Institute in designated urban communities.

Key to successfully launching the integrated programs is the development of an emerging technology platform utilizing the EMPEQ Fast Site Survey™ App (see Figure 1.9, EMPEQ Fast Site Survey™ App, below) developed by Empower Equity, a women, minority, and disabled veteran-owned business enterprise.

The EMPEQ Fast Site Survey™ App deploys AI (artificial intelligence) to remove the barrier to early entry in the energy efficiency workforce by eliminating the need for vast reservoirs of knowledge and experience to conduct the initial audit phase of an energy efficiency retrofit project.

The EMPEQ App uses a proprietary One-Click™ camera feature of a web-connected mobile device (smartphone) to capture nameplate data for building power plug loads (PPLs) and building-integrated (hardwired) equipment (heating and cooling, controls, lighting, etc.) The device then transfers the data to a central CPU, where it is catalogued in a format to assist in project decision support by diverse upstream project stakeholders.

Figure 1.9. EMPEQ Fast Site Survey™ Tool App Interface

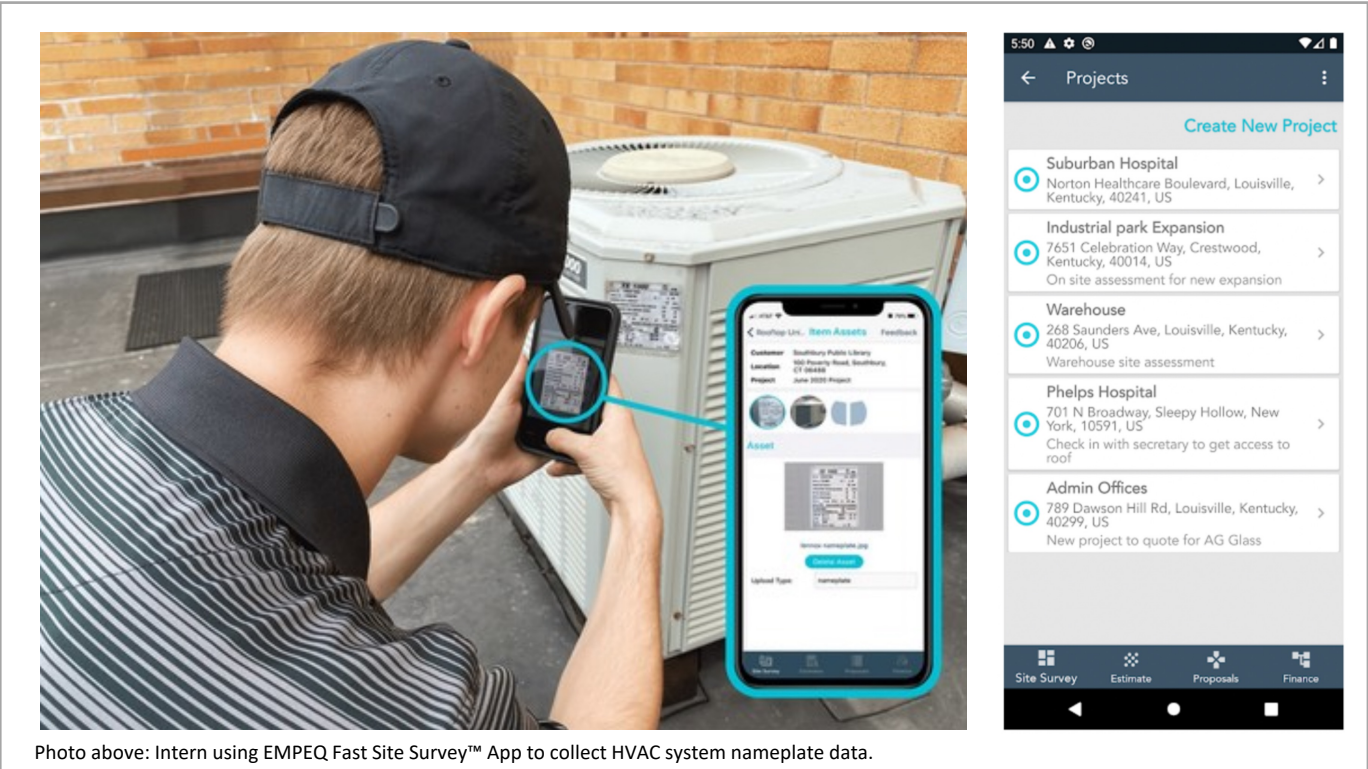


Photo above: Intern using EMPEQ Fast Site Survey™ App to collect HVAC system nameplate data.

Source: Empower Equity, Inc. (2021)

Service-Learning Curriculum:

The GEC Service-Learning curriculum focuses pre-teen and teen enthusiasm for activity in the direction of solving real-world problems associated with energy and climate, while also promoting knowledge of and interest in science, technology, engineering and mathematics (STEM).

The program will consist of two parts:

1. **Course of Study:** Online and/or in-class course of study to educate the general public on the United Nations (UN) Sustainable Development Goals (“SDGs”). The course of study shall comprise of 100 hours of academic study over a period of one academic year focusing on energy and climate: *SDG-7: Ensure access to affordable, reliable, sustainable, and modern energy for all*; and *SDG-13: Take urgent action to combat climate change and its impacts*.
2. **Community Service:** Minimum of 60-hours of community service using advanced data collection tools, the EMPEQ Fast Site Survey™ App (see page 16, Figure 1.9, EMPEQ Fast Site Survey™ App) and other energy modeling software to build accurate, scientifically important models of energy consumption and CO₂ emissions in communities under the guidance of teachers.

Summary of Curriculum Goals and Objectives:

Goal 1. To interest and prepare middle- and high-school students to participate in the science, technology, engineering, and mathematics (STEM) workforce of the future (targeted to careers in energy services).

Objective 1.1: Provide students with energy survey software and train them to conduct a consumer appliance survey in their own homes and in their communities. **Expected Outcome:** Accurate surveys of electrical power equipment and consumer appliances will be produced for an appropriate number of homes, small businesses, and schools. Data on projected energy use will be aggregated in a database for teacher and student use, and to share with a growing network of schools around the country and the world.

Objective 1.2: Have students use information technology applications (spreadsheets, database packages, visualization tools, and simulators) to aggregate and clean individual data for future analysis, then participate in IT-intensive analyses of the data under the guidance of the teacher. **Expected Outcome:** A deeper understanding of the many forms of representations of the relationships among the variables in complex data sets. Data visualizations will be made available for teacher and student use in national and international networks of schools. Data will be made available to the professional research community, including national energy research laboratories.

Objective 1.3: Conduct class exercises to analyze the aggregate student data with an emphasis on “what if” projections of the financial and environmental implications of: a) doing nothing, or b) implementing specific, promising solutions on a wider scale. **Expected Outcome:** Students will gain greater interest in and deeper understanding of STEM-related activities. They will how such activities impact society, the economy, and the environment and gain greater interest in STEM-related careers in energy services.

Goal 2. To foster knowledge, skills, and dispositions in middle- and high-school students, their families, and their teachers that enable both awareness and on-going monitoring of home and community energy consumption for the purpose of producing model-based projections and data-driven decision support regarding home and community energy expenses and environmental impact.

Objective 2.1: Train teachers in the following skill sets: using information technology software tools to foster teamwork and collaboration over distance; assessing student outcomes utilizing data available from national laboratories and other data sources; participating in global collaborations; and using games and simulations to facilitate STEM learning. **Expected outcome:** A new middle school curriculum unit on energy monitoring as a decision support service for climate change mitigation set in the context of a global scientific inquiry.

Objective 2.2: Bring students and teachers together with project staff using video conference software early during school year to discuss purpose of program and to train them on the use of equipment for energy monitoring. **Expected outcome:** Increased knowledge and skills of teachers and students in planning, implementation techniques, and optimization modeling in the context of the diversity of energy supply and demand scenarios.

Objective 2.3: Have students monitor power grid energy consumption of individual appliances in their homes and local communities to identify major sources of power consumption by end-use. **Expected outcome:** Increased knowledge of personal and community power consumption as individual skills in data collection, aggregation, and presentation are developed.

Objective 2.4: Implement school-to-home and school-to-community communication linkages with parents and the general public to promote dialog and ongoing involvement during the school year. **Expected outcome:** Consumer attitudes toward energy conservation and knowledge of strategies for conservation and climate change mitigation will improve.

Objective 2.5: Have students and teachers together develop power consumption optimization models that would enable targeting specific changes in existing consumption practices and projecting the effect of implementing behavioral changes on environmental concerns such as CO₂ level in the atmosphere. **Expected outcome:** Student and teacher attitudes and behavior toward energy conservation and knowledge of strategies for conservation and climate change mitigation will improve.

Objective 2.6: Examine the change in student dispositions towards seeking a career in STEM-related disciplines, including information technology. **Expected outcome:** The proportion of students involved in the program who will consider a STEM related career will be greater than those who do not participate in the program.

Goal 3. To produce model scenarios and activities that can be disseminated to educators nationwide, enabling classrooms beyond the immediate project to prepare STEM workforce participants for the future.

Goal 3, Continued:

Objective 3.1: Develop web-accessible collection of lesson materials to be made available to the broader educational community.

Expected Outcome: A well-defined curricular model for energy consumption modeling in which middle schoolers can make significant contributions through local use of sensors and participation in a data-sharing network.

Objective 3.2: Develop a repository of energy-consumption data profiles for at least four sites per student retrievable by educators in the broader community and configured in a web-2.0 environment such that educators outside the Service-Learning community can contribute comparative data energy sets to the repository. **Expected Outcome:** Exemplary data profiles of energy consumption modeling for multiple sites in the U.S., which could be used by middle- and high-school educators at any location for comparative studies with their classes.

Objective 3.3: Have students report on their findings in scholarly forums and workshops, such as NSTA (National Science Teacher Association) conferences and/ or webcasts conducted by the project staff. **Expected Outcome:** Increase in student confidence and competence in scientific inquiry skills; increased interest in STEM careers (including energy services) and increased interest in professional development opportunities for science teachers.

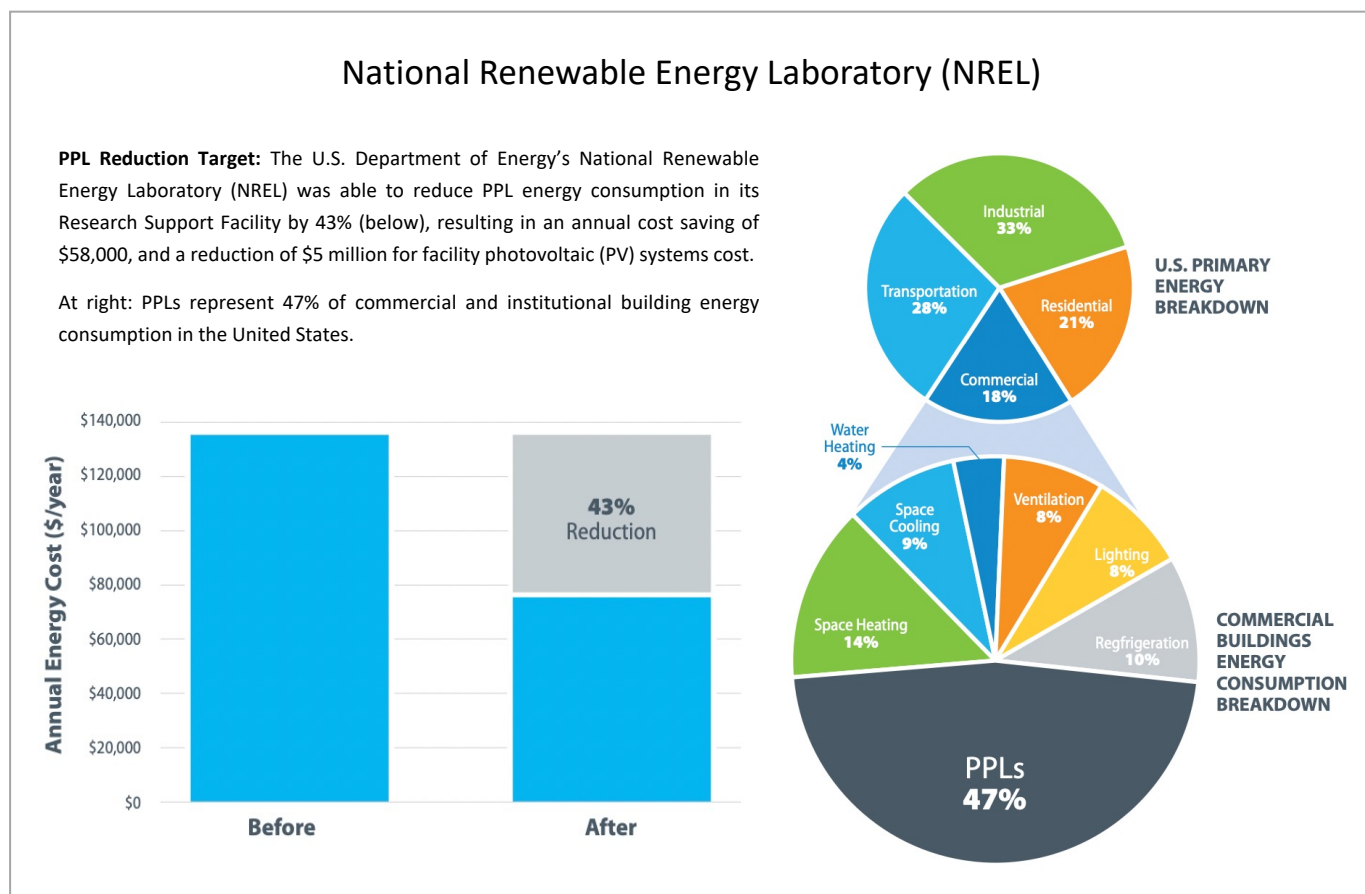
GEC Targeted Energy Reductions:

Plug and process loads (PPLs): Student surveys will target plug and process loads (PPLs) and hardwired loads. PPLs are defined as all plug-in and hardwired loads in a building that are not associated with heating, ventilating, and air conditioning (HVAC), lighting, water heating, or other major equipment needed for basic building operation. This includes all plug-in equipment and appliances, as well as processes for cooking, computing, and internal transportation.

Plug and process loads (PPLs) account for 47% of U.S. commercial building energy consumption (EIA 2020) (see Figure 1.15, Assessing and Reducing Plug and Process Loads (PPLs) in Office Buildings). The percentage of total building energy use from PPLs is increasing; by 2029, the percentage of PPL energy consumption is anticipated to increase to 51%.

Minimizing these loads is a significant challenge for due to a combination of factors, i.e., consumer awareness of PPL loads, knowledge of intervention strategies, high cost of labor, unfavorable economics due to long payback periods, and inability to secure conventional ESCO financing for PPL efficiency measures. Due to these consumer and market challenges, the Institute argues that achieving significant energy consumption and CO₂ emissions reductions from PPLs in the U.S. commercial and institutional building sectors is the unique domain of youth through community service, Service-Learning, and SYEP programs.

Figure 1.10: Assessing and Reducing Plug and Process Loads (PPLs) in Office Buildings



Source: National Renewable Energy Laboratory (2020)

Proposed Proof-of-Concept Pilot Project:

The Institute, in collaboration with multiple enabling partners, will develop and operate two proof-of-concept pilot projects to demonstrate the efficacy of Service-Learning students and Work-Learning-Service interns to successfully deploy EMPEQ's Fast Site Survey™ App to identify PPLs.

1. An academic partnership with Syracuse University (NY) to establish workforce training and data collection protocols for EMPEQ's Fast Site Survey™ App. Syracuse is a U.S. Department of Energy Industrial Assessment Centers (IACs) site and a 2009 IACs Center of Excellence Award winner. See Industry Assessment Centers (IACs) (see pg.26).
2. A proposed GEC Summer Youth Employment Program (SYEP) In New York City with a cohort of 100 paid student interns (ages 16-24) in collaboration with EMPEQ, Syracuse University, the Children's Aid Society of New York, and the City of New York Department of Youth and Community Development (DYCD).

The academic partnership with Syracuse University to establish workforce training protocols for EMPEQ's Fast Site Survey™ App is anticipated to be completed prior to the proposed launch of the SYEP in New York City scheduled for July-August 2022. The SYEP pilot is pending full program funding.

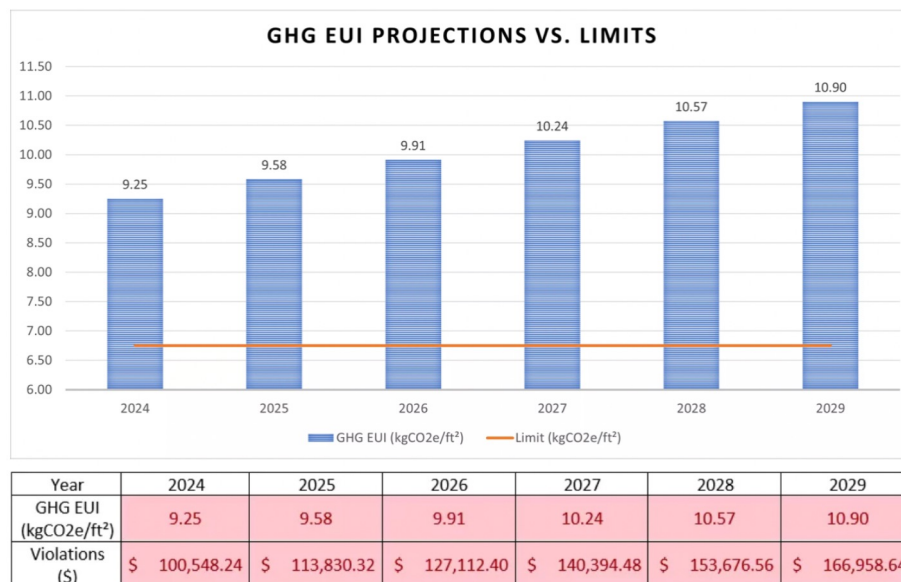
SYEP Objectives:

The GEC Summer Youth Employment Program (SYEP) In New York City will provide 26-hours of employment for a period 6-weeks for a cohort of up to 100 paid interns earning \$15 per hour. The SYEP interns will be trained on the data collection protocols for EMPEQ's Fast Site Survey™ App to conduct pre-audit service for benchmarking building for compliance under Local Law 84 (LL84), Local Law 133 (LL133), and Local Law 97 (LL97) of the New York City Climate Mobilization Act (CMA).

Beginning in 2024, LL97 statutes levy financial penalties on owners of buildings over 25,000 gross sq. ft. subject to LL84 and LL133 (Energy Benchmarking) for failure to meet specified carbon emission limits. These local laws cover over 60,000 buildings and will have a disproportionate impact on low-income and minority populations as building owners seek to recover cost burdens due to financial penalties for non-compliance.

During the 6-weeks SYEP project term, GEC interns will educate the public on CMA statutes for compliance with energy benchmarking for "Covered Buildings" buildings greater than 25,000 sq. ft., conduct CMA-related pre-audit activities to provide an inventory of "as-built" specifications for LL84 and LL133 compliance and engage building owners with CMA-certified MEP professionals to expedite LL97-required annual reporting and CMA compliance planning.

Figure 1.11. Local Law 97, Sample Non-Compliance Violation Fee Schedule



Source: Cotocon Group (2021)

Projected Outcomes of the SYEP:

The projected outcomes of the SYEP are to: (a) create a STEM education pipeline for the energy efficiency services sector; (b) establish new labor category in the global energy efficiency industry; (c) lower the barrier for minorities to enter the energy efficiency labor market; (d) develop the potential to create millions of new entry-level jobs in the global energy efficiency industry through future program replication at-scale; (e) and dramatically reduce CO2 emissions from the burning of fossil fuels at a temporal scale consistent with New York City's 1.5°C Climate Action Plan.

Integration with Work-Learning-Service Cohort at Fort Worden:

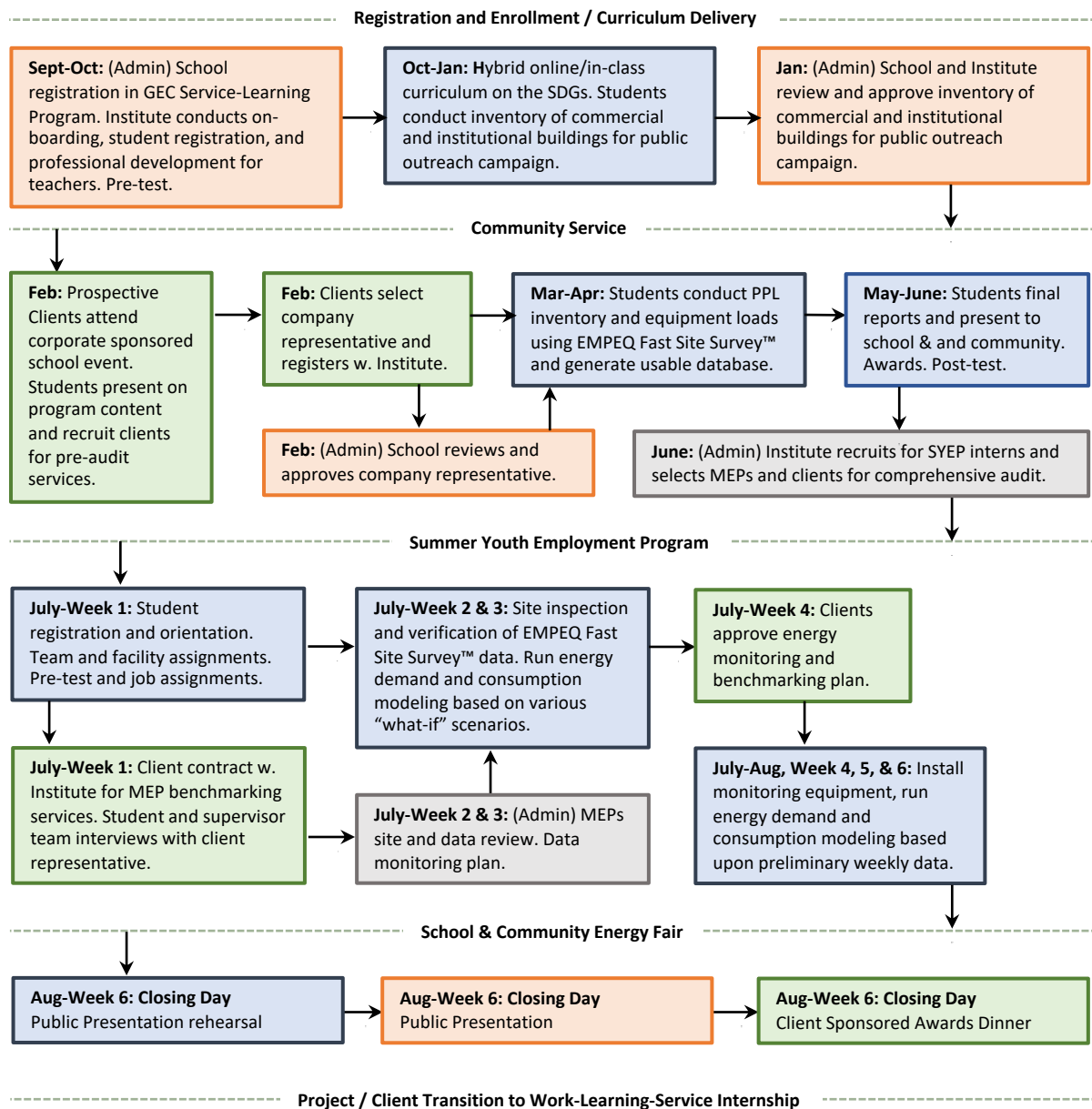
The proposed cohort of Work-Learning-Service interns at Fort Worden will utilize "as-built" specifications produced by SYEP interns for LL84 and LL133 energy (and CO2) benchmarking compliance to develop investment-grade energy efficiency project proposals in collaboration CMA-certified MEP engineers. The Institute will collaborate with its climate finance consortium partners to develop a commercial property assessed clean energy (C-PACE) fund under NYC Local Law 96 to finance energy efficiency projects for affiliated energy services contractors (ESCOs).

Figure 1.12: Service-Learning Project Flow Diagram

Color Key:



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(See Figure 1.18: Work-Learning-Service Internship Project Flow Diagram, pg. 28)

Note: Institute program coordination will be managed remotely from Fort Worden. Institute/Partner refers to the SYEP managed by Institute in collaboration with local Partners. School/District assumes district-wide program with individual school/teacher instructional supervision. Student/Intern refers to the student pathway from volunteer Service-Learning to paid SYEP Work-Learning-Service intern. (Students enrolled in Service-Learning and SYEP for multiple years are designated as team leaders.) Client/MEP refers to private sector engagement – client contract services and MEP contract services. Client accounts are transitioned to Work-Learning-Service internship program at Fort Worden for full-service, turnkey investment-grade energy service contract (ESCO) development. MEPs are transitioned to Work-Learning-Service program as adjunct faculty.

Source: Renewable Nations Institute (2022)

National Program Replication:

According to the U.S. Corporation for National and Community Service *National Student Learning and Community Service Survey*, 83% percent of all high schools in the U.S. were reported to require community service, and 46% percent were reported to require Service-Learning.

School-based community service and Service-Learning engage 15.5 million youth — 55% of young people ages 12 to 19 — in approximately 1.3 billion hours of community service each year. Moreover, youth that engage in school-based community service and Service-Learning are more apt to participate in a Summer Youth Employment Programs (SYEP).

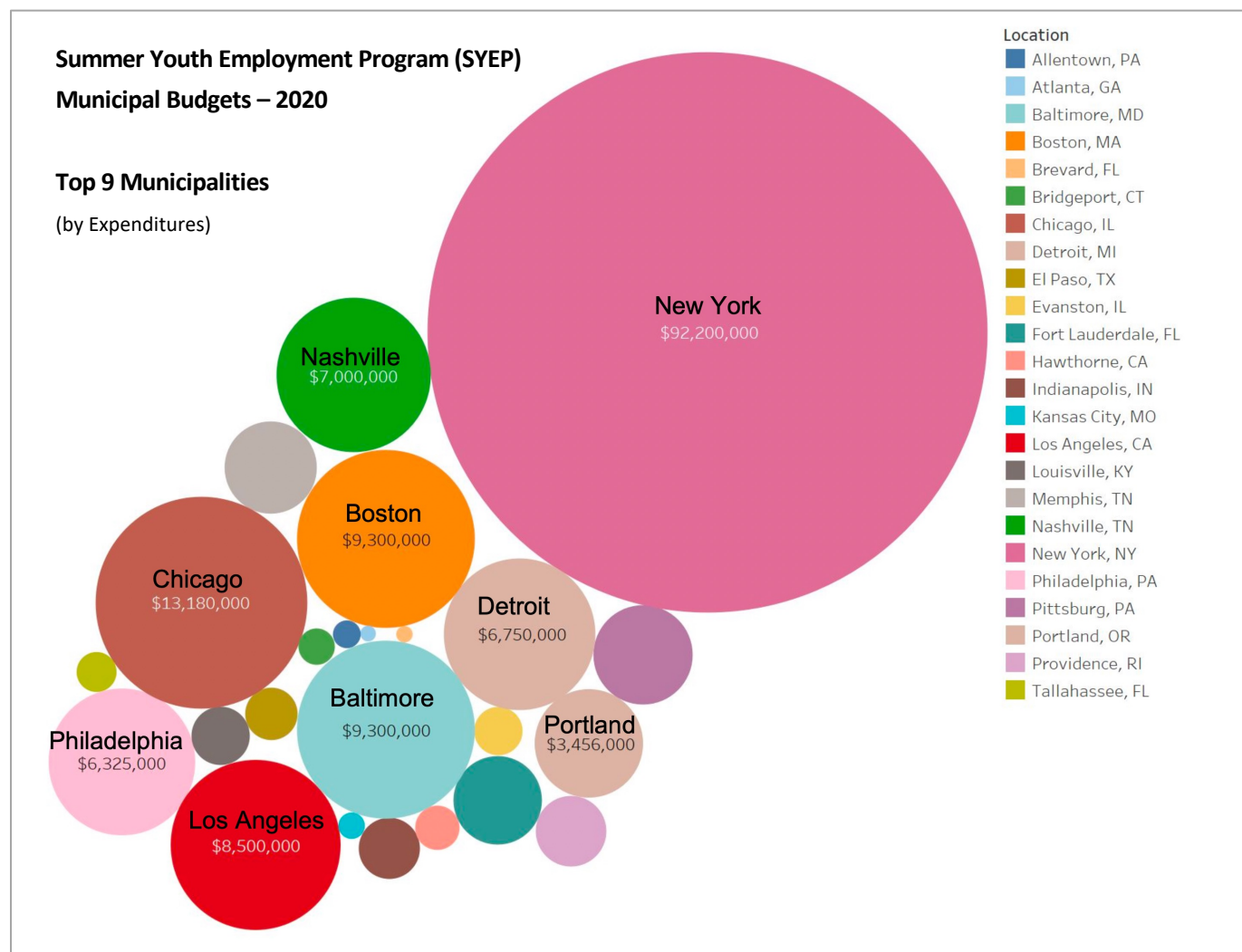
A literature review of studies, reports, and peer-reviewed research suggests school-based community service and Service-Learning are key indicators for participation in SYEP and advanced educational and career success.

Building upon the peer-reviewed Service-Learning research conducted by the Institute in collaboration with the University of Vermont (2006-2009) and the University of North Texas (2008-2019), the Institute will launch a national research project in U.S. municipalities nationwide in 2023, beginning with the top 9 SYEP programs, as identified in Figure 1.14, 2020 Municipal Summer Youth Employment Program Budgets, below.

The Institute embraces the notion that school-based community service, Service-Learning, and SYEP represent a viable education and career pipeline for the energy services sector.

Center research activities will advance peer-reviewed research regarding service-to-career pathways by assessing the apparent causality between school-based community service, Service-Learning, SYEP participation, and student education and career choices.

Figure 1.13. 2020 Municipal Summer Youth Employment Program Budgets



Source: U.S. Department of Energy (2022)

Work-Learning-Service at Fort Worden:

The cohort of Work-Learning-Service interns at Fort Worden will be enrolled in a certificate-bearing energy efficiency and renewable energy (EERE) education program modeled after U.S. Department of Education Work College statutes and the Industrial Assessment Centers (IACs) administered through the Advanced Manufacturing Office under the Office of Energy Efficiency and Renewable Energy at the Department of Energy, and U.S. Department of Education Work-College statutes under Title 34, Subtitle B, Chapter VI, Part 675, Subpart C, §675.41 (2018).

Work-College statutes require: (a) that at least one-half of all students enrolled on a full-time basis participate in a comprehensive paid Work-Learning-Service program for at least five hours each week, or at least 80 hours during each period of enrollment; (b) that learning objectives, evaluation and a record of work performance as part of the student's college record; (c) that programmatic leadership by personnel at levels are comparable to traditional academic programs; (d) that the Work-Learning-Service supervisors have an educational role; and (e) that consequences for student non-performance are similar to the consequences in a regular academic program. (GPO, 2018).

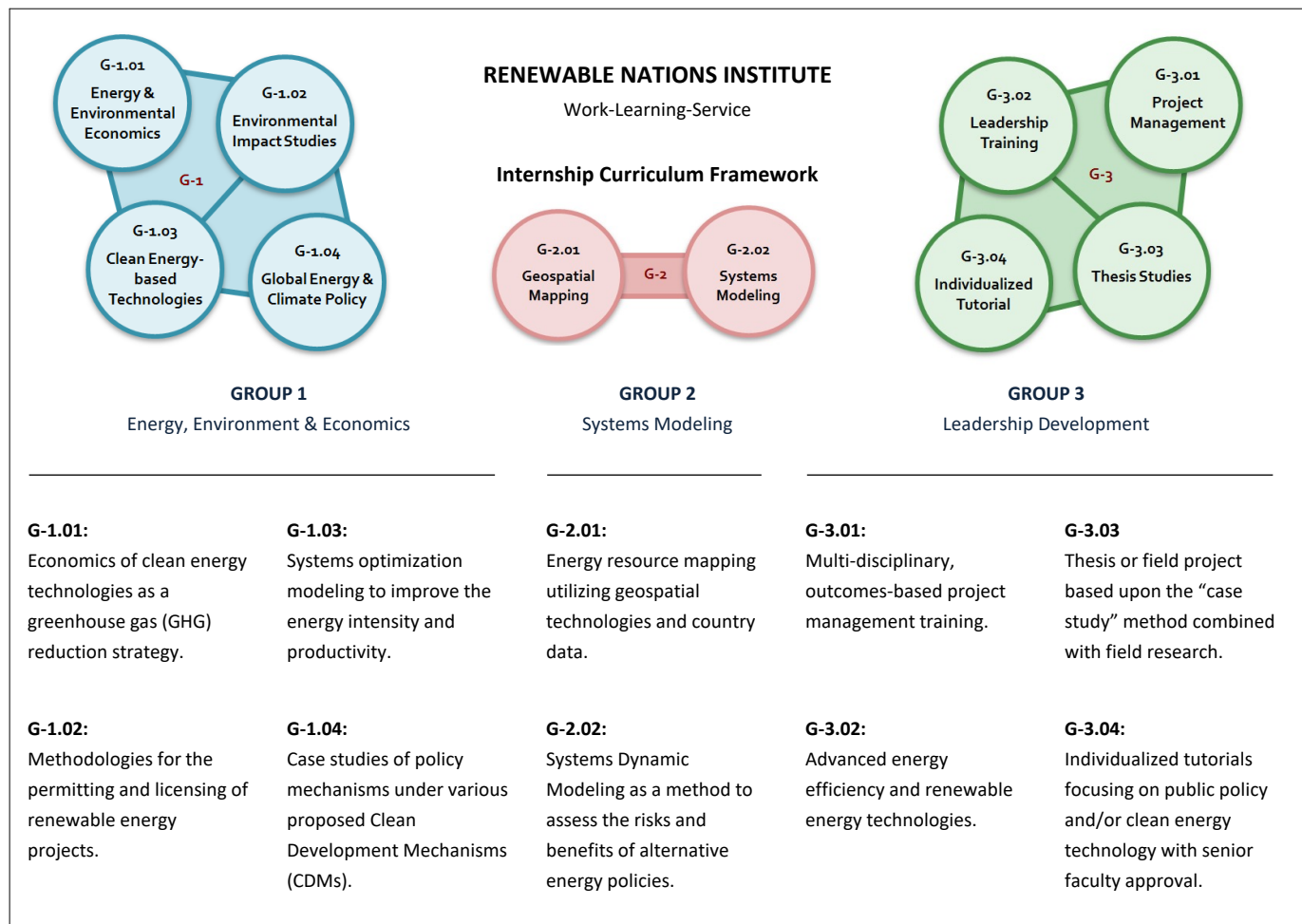
Work-Learning-Service Curriculum:

Credit-bearing courses and degree-granting academic programs offered at the Center will be managed by accredited academic members of the Consortium under a master articulation agreement governing the transfer of credits between Consortium members and/or other colleges and universities.

Accredited academic consortium members will design instructional courseware under the general curriculum framework developed by the Institute, as described in Figure 11, Work-Learning-Service Curriculum Framework, below. Work-Learning-Service curriculum will be delivered by accredited academic Consortium members utilizing a variety of formats, including lectures, workshops, seminars, field surveys, tutorials, traditional and non-traditional classroom and laboratory settings, residency and low-residency academic programming, and distance learning.

The Institute will manage non-accredited, certificate programs, professional development services, and Work-Learning-Service internship activities, including the supervision of Work-Products (or deliverables) to the JUCEP and other clients of the Institute.

Figure 1.14. Work-Learning-Service Curriculum Framework



Source: Renewable Nations Institute (2022)

Industry Assessment Centers (IACs) Integration:

Industrial Assessment Centers (IACs), formerly called the Energy Analysis and Diagnostic Centers (EADCs), were created by the Department of Commerce in 1976 in response to the oil embargo and rising energy costs. It was specifically focused on helping small and medium-sized manufacturing facilities cut back on unnecessary costs from inefficient energy use. The IACs were largely responsible for creating today's energy services contract (ESCO) industry.

Today, the U.S. DOE Industrial Assessment Centers (IACs) help small and medium-sized US manufacturers save energy, improve productivity, and reduce waste by providing no-cost technical assessments conducted by university-based teams of engineering students and faculty. IACs provide industry clients with a comprehensive report with specific details on all opportunities for improving energy efficiency and cost savings identified during an assessment, including applicable rebates and incentives.

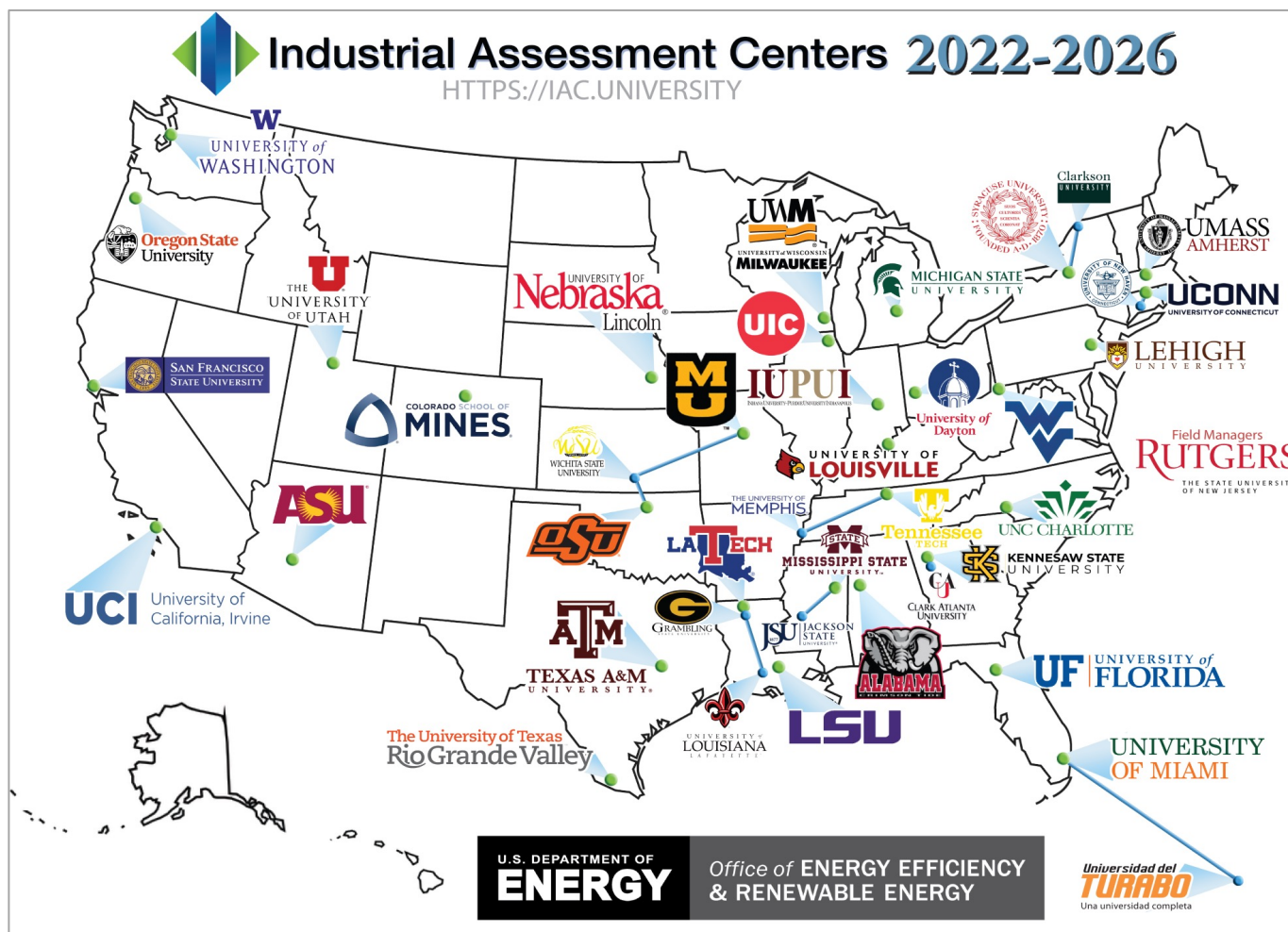
The IACs program has conducted over 19,984 assessments with more than 149,618 associated recommendations, with an average recommended yearly savings of \$137,326 per recommendation. The total lifecycle avoided cost savings of implemented recommendations exceed \$47.4 billion. (See page 27, IACs Avoided Cost Savings Performance Data.)

The IACs program management maintains a comprehensive searchable database of Assessments and Recommendations performed by the IACs. The IACs Database can be searched by Assessments (Industry Type, Size, Year, Energy Costs, Products), by Recommendations (Type, Savings, Cost, Implemented), and/or by Industry Type (SIC and NAICS).

A Recommendation Index is available for all assessment recommendation codes (ARC). Recommendation Implementation Rates (RIRs) can be charted by center, years, or state. The database is available to the public and can be downloaded for integration other software programs for energy analysis, including the EMPEQ Fast Site Survey App and CPU software Interface.

Prospective Renewable Nations Academic partners, including Boise State University, Georgia Institute of Technology, Syracuse University, University of Florida, and University of Idaho, are current or former university-based IACs. These institutions have the capacity to provide the technical services required for the Institute to establish and refine workforce training curriculum, data collection protocols, database integration, assessments and recommendations for the developing energy efficiency investment-grade proposals for institute clients.

Figure 1.15. University-based Industrial Assessment Centers (IACs): 2022-2026



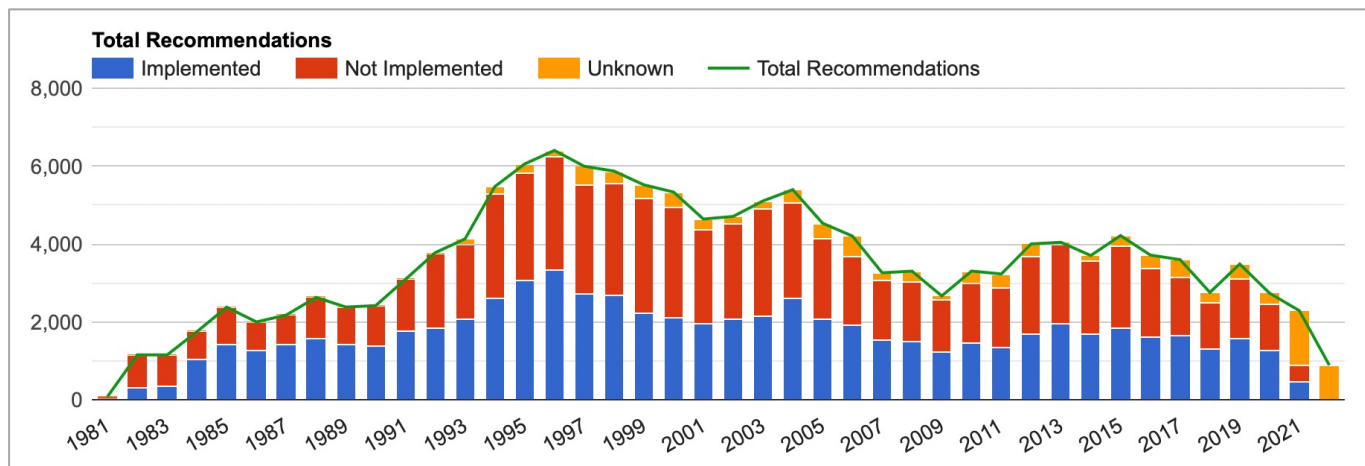
Source: U.S. Department of Energy (2022)

IACs Avoided Cost Savings Performance Data:

The IACs maintain statistics on projected annual avoided cost savings on Assessments and Recommendations performed by the IACs. Figure 1.13. Status of IACs Recommendations, below, charts 149,618 Recommendations by implementation rates, indicating an overall implementation rate of 46.4%.

Figure 1.14, Average Recommended Savings per Assessment, shows the average avoided energy cost savings performance of 69,393 implemented Recommendations at \$45,564, a total cost savings of \$3.2 billion (rounded). Assuming a 20-year lifecycle for energy efficiency equipment, the lifecycle avoided energy cost savings are estimated at \$47.4 billion.

Figure 1.16. Status of IACs Recommendations



Source: U.S. Department of Energy (2022)

Figure 1.17. Performance Statistics of IACs Recommendations

149,618 Recommendations 7.5 Recommendations Per Assessment					69,393 Implemented Recommendations 3.5 Implemented Per Assessment				
Average Recommended Savings Per Assessment*	Cost (\$) Savings	Usage Reduction	Unit	% Usage Reduction	Average Implemented Impacts Per Assessment*	Cost (\$) Savings	Usage Reduction	Unit	% Usage Reduction
All Energy	\$82,693	13,065	MMBtu	8.3%	All Energy	\$28,680	4,635	MMBtu	3.0%
- Electrical	\$46,414	852,510	kWh	10.1%	- Electrical	\$16,048	282,682	kWh	3.3%
- Natural Gas	\$20,232	3,715	MMBtu	6.9%	- Natural Gas	\$6,845	1,375	MMBtu	2.5%
Waste	\$8,665				Waste	\$2,484			
Productivity/Other	\$45,966				Productivity/Other	\$14,401			
TOTAL	\$137,324				TOTAL	\$45,564			

Source: U.S. Department of Energy (2022)

Renewable Nations Program-Related Revenue Model:

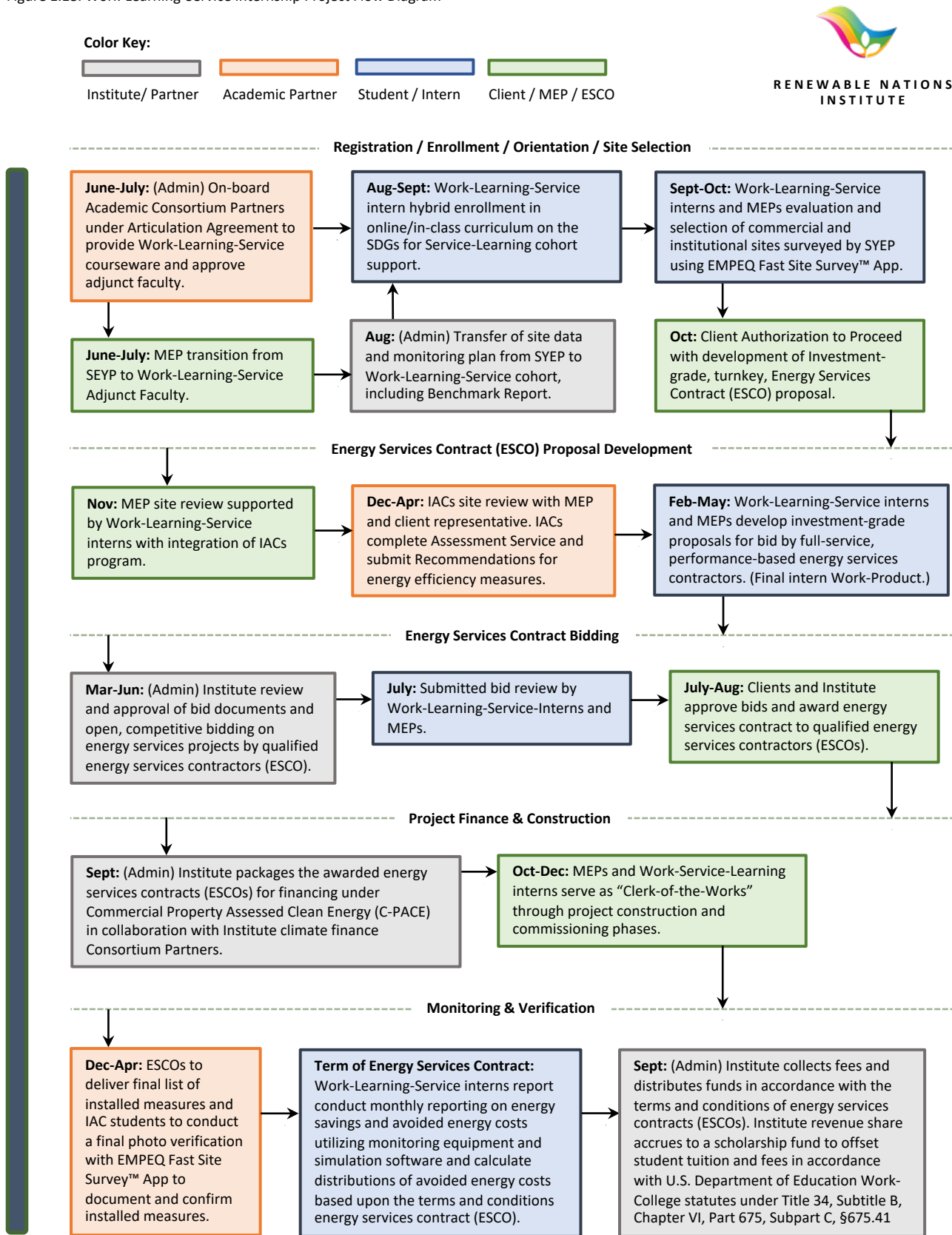
The average avoided energy cost savings of \$45,564 represents the direct costs of technology interventions (hard costs). The balance of system (BOS) or soft costs, including energy services contractor (ESCO) overhead and profit, labor costs, project financing, energy monitoring and verification of savings, warranty insurance, maintenance, and fees — are not calculated in average avoided energy cost savings projected by the IACs.

Assuming an industry standard of BOS costs at 1.33 times hard costs, the average turnkey ESCO cost would total \$106,000 and represent a project payback period of 2.33 years.

The Institute's program model will differ from the IACs program as follows:

1. The Institute, in addition to the Assessment services, will provide turnkey construction and project financing under C-PACE in partnership with private sector ESCOs and climate finance partners.
2. The Institute will generate program-related revenue based upon an annual fee of 5% of the verified annual avoided energy cost savings for a specified term under the energy services contract (ESCO), thereby achieving financial sustainability for Institute programs.

Figure 1.18: Work-Learning-Service Internship Project Flow Diagram



Source: Renewable Nations Institute (2022)

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