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Empowering Underserved Students: Future Energy Workforce Members

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CLEAN ENERGY AMBASSADORS NETWORK

Directly engaged the disadvantaged community as part of the activities carried out after the Phase One award

- WSU Tri-Cities serves **largest % underserved students in STEM** of all WSU campuses
- Hispanic/LatinX students (**42.4%**), IPEDs minority (**57%**) and/or 1st generation (**55%**) **Over 70%** Pell-eligible incoming Freshman
- Students participated in energy-related career-building opportunities & community outreach

Positive outcomes in the disadvantaged community engaged in Phase Two

- **60%** pending or attained internship with energy sector
- **80+%** felt "high" sense of belonging in CEAN, believe in importance of mentorship & community engagement, grew knowledge & interest in clean energy technologies, believe importance of clean energy economy & better understand equitable solutions

Testimonials from community members receiving the benefits from the work undertaken in Phase Two

"I would love to continue to grow relationships with mentors and classmates. The continued mentorship throughout this project has helped to make that possible. Community engagement and working across programs has been fun." (CEAN Student Ambassador)

"I feel like being part of CEAN I feel more in-touch with how the industry works and feel less anxious about getting a job in that field or similar." (CEAN Student Ambassador)

"I have really enjoyed this program so far and it has opened my eyes to other kinds of opportunities I had not considered for my career path." (CEAN Student Ambassador)

"I think mentorship is a huge asset to students throughout their college programs - especially for first generation students--it's really important to include career-connected learning throughout undergrad studies." (CEAN Industry Mentor)

"I strongly believe that having this network will enhance student retention in technical programs." (CEAN Industry Mentor)

"This has been an excellent chance for students to make connections to future employers OR connect with mentors who can help connect them with future employers." (CEAN Industry Mentor)

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CLEAN ENERGY AMBASSADORS NETWORK

Demonstrated impact achieved in the disadvantaged community engaged in Phase Two

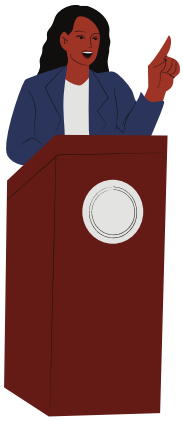
- During 2022-2023 semesters, 344 students, 25 industry mentors and faculty advisors, and over 300 community members were impacted

The competitor clearly describes how the positive outcomes from the efforts undertaken in Phase Two of the prize connect back to one or more of the goals of the prize

During Phase 2, WSU Tri-Cities IEI Prize team successfully met the following IEI Prize and CEAN joint goals:

- Enabled clean energy, climate innovation and entrepreneurship programming at WSU Tri-Cities
- Increased participation of students from disadvantaged communities in clean energy and climate-smart jobs (e.g. internships, co-ops, future employment)
- Fostered innovation related to just and equitable clean energy deployment through activities focusing on community-centric networks and community needs (CEAN program)
- Identified, funded activities and student engagement in program focused on just and equitable benefits to disadvantaged communities (supported Justice40 goals)
- Enabled development of replicable clean energy transitions that deliver just and equitable benefits to disadvantaged communities (supported of Justice40 goals)

The CEAN program promoted community-based, inclusive connectivity and networking towards clean and net-zero-carbon energy technology by directly funding disadvantaged communities. This program aligns with the DOE Prize Challenge and Justice40 goals at a micro/macro-scale and furthers WSU Tri-Cities "preferred future" to ensure students experience a strong career-connected, transformative, supportive industry opportunities and pathways in climate and clean energy.



How we built trust and strengthened relationships with the community

- Expanded outside of the university ecosystem, built trust & relationships along with opportunities for future engagement through CEAN activities (e.g. Community Classroom events, regional presentations, workforce development strategies for underserved populations, etc.)
- Community Partners (EIR & TCHCC) thrilled with 2022-2023 program and are excited for next phase with goal of increased networking with Hispanic/LatinX community

DOE Resources & Connector Support for Phase Two

- DOE Connector, Positive Deviancy
- VentureWell
- DOE DC Summit & Quarterly team meetings
- Webinars by CEBN & U of Arizona's Center for Innovation
- DOE/Chanceé Lundy's needs assessment
- NWX (Oregon IEI team)

Thank You Partners & Contributors

- Dept. Of Energy Inclusive Energy Innovation Prize
- Entrepreneurs in Residence (Paul Carlisle)
- Tri-Cities Hispanic Chamber of Commerce (Martin Valadez & Raul Contreras)
- WSU's Institute for Northwest Energy Futures
- WSU Tri-Cities Energy/Climate UCORE Cirriculum Faculty Team
- Tri-Cities' Clean Energy/Climate Sector
- WSU Tri-Cities TRIO STEM
- Student Success Lab- WSU Tri-Cities
- Jade Garrett- Positive Deviancy (DOE IEI Prize Connector)

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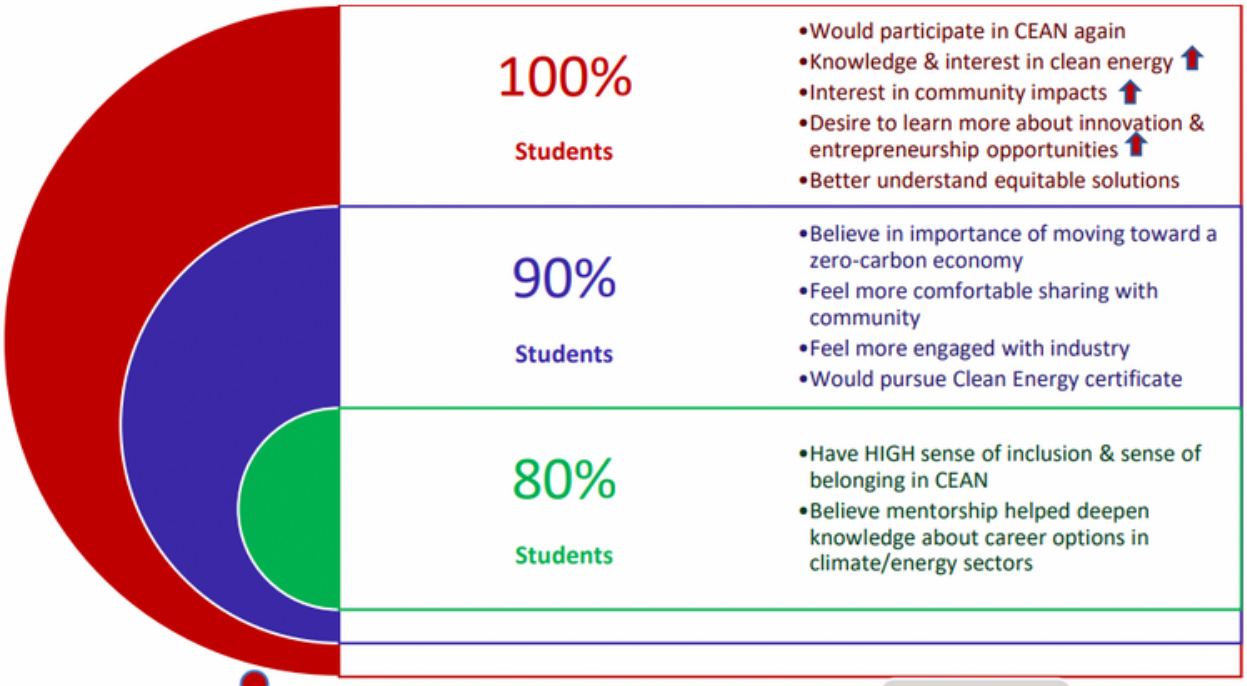
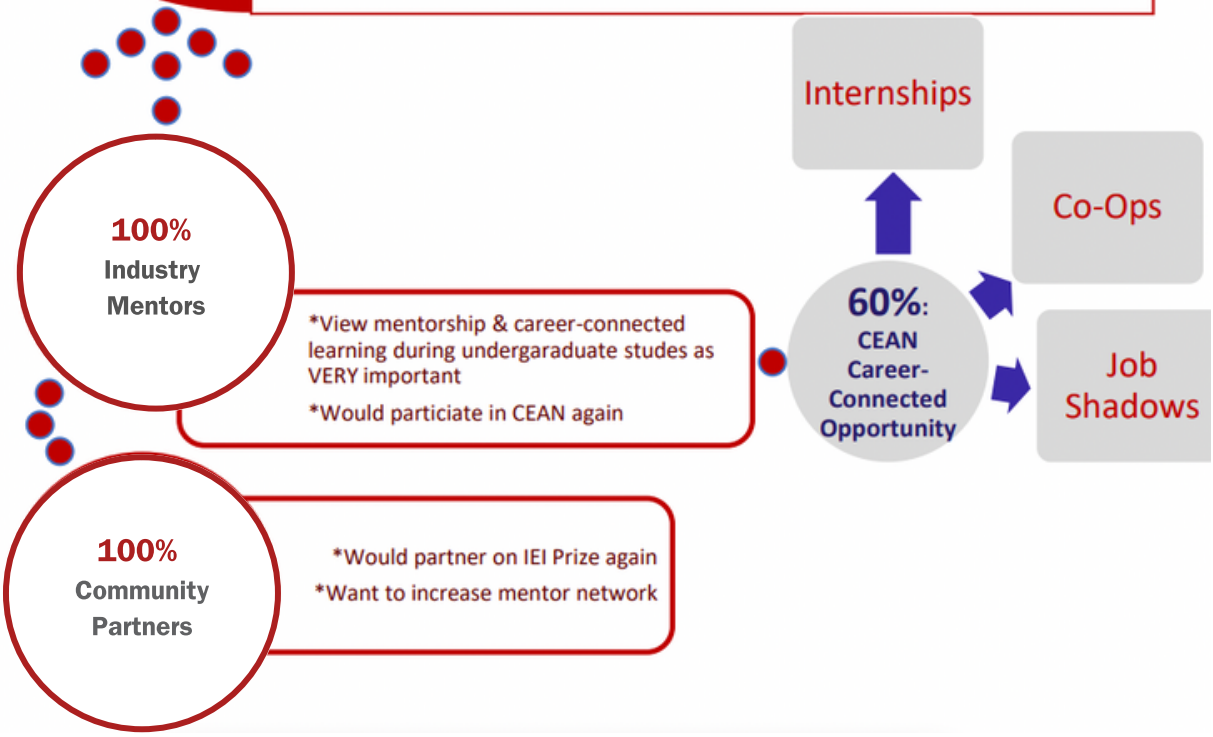
CLEAN ENERGY AMBASSADORS NETWORK

CEAN Outcomes and Survey Results





April 2023 Research Symposium: CEAN Team Posters

WASHINGTON STATE UNIVERSITY TRI-CITIES CLEAN ENERGY AMBASSADORS NETWORK

WASHINGTON STATE UNIVERSITY

Why I became an ambassador...

With climate change being a prevalent topic, more than ever, I wish to collaborate with a like-minded yet diverse group of people on the matter. The opportunity being here in my home, the Tri-Cities, also motivated me to join since I want to become a part of the Tri-Cities legacy as a frontier in renewable energy. –Student Ambassador (Spring 2022)

NEW ACADEMIC PROGRAM

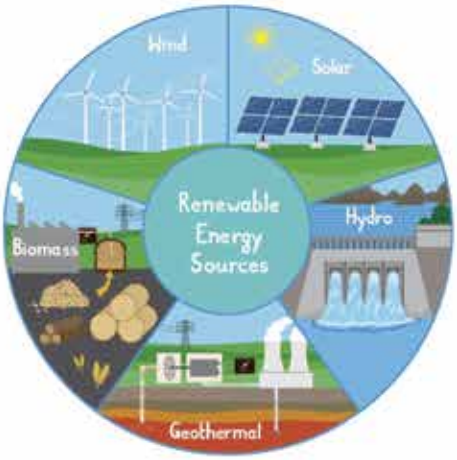
New curriculum for WSU Tri-Cities' Clean Energy Ambassadors Network (CEAN) incorporates student research/innovation teams ("incubators") working with WSU faculty, industry mentors & their peers to address local challenges related to climate change & its impact on disadvantaged communities. *Part of Dept. of Energy's Inclusive Energy Innovation Prize*

NETWORK FRAMEWORK

Tiered-mentorship model: 35 student ambassadors, 3 network team assistants/mentors, 21 industry mentors, 5 faculty mentors, WSU/community partners (EIR, TCHCC)

INDUSTRY MENTORSHIP + COMMUNITY OUTREACH

WSU Tri-Cities Entrepreneurs in Residence (EIR) & Tri-Cities Hispanic Chamber of Commerce (TCHCC) worked together to recruit a diverse group of industry mentors for CEAN. Action items included working together to make announcements in existing industry & community events/meetings, distribution of fliers & running email & social campaigns.



WHAT ARE AMBASSADORS WORKING ON?

- Innovation in clean energy & climate
- Community engagement & outreach
- Just & equitable energy development according to Justice40 Goals

PROJECT TOPICS:

- Evaluation of energy-grid balance & future electric vehicle charging station increases
- Potential of offshore wind energy
- K-12 access to clean energy education + internships + opportunities + awareness
- Production, impact & sustainability of current/prospective clean energy technologies
- Environmental impacts of current & upcoming (hydrogen & SMRs) green technology
- Potential for Hanford WTP boiler electrification
- Equity & access of low-income houses & communities to switch to clean energy
- Community outreach to inform about clean energy & net-zero economy outlook
- Potential for bioremediation to remove microplastics from the ocean
- 3-D printing of carbon-neutral modular housing

THANK YOU PARTNERS & CONTRIBUTORS!

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- Tri-Cities Hispanic Chamber of Commerce (Martin Valadez & Raul Contreras)
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- Jade Garrett- Positive Deviancy (DOE IEI Prize Connector)

Tri-Cities Hispanic CHAMBER OF COMMERCE

Inclusive Energy Innovation Prize

PROGRAM GOALS/OUTCOMES

PROGRAM EVALUATION:

80%+ of ambassadors report *high sense of inclusion in CEAN Program & WSU Tri-Cities*

80%+ of ambassadors believe *mentorship helped deepen their knowledge about real-world career options in climate science & clean energy sectors*

90% of ambassadors believe in *importance of clean energy generation & moving toward a zero-carbon economy*

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- https://justenergy.com/blog/nuclear-energy-guide-atomic-power/
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- https://www.forbes.com/sites/mikescott/2019/09/09/companies-continue-todrive-demand-for-clean-energy/?sh=689fb1ab6e41
- https://americanmadechallenges.org/challenges/inclusiveenergyinnovation/index.html

WASHINGTON STATE UNIVERSITY TRI-CITIES CLEAN ENERGY AMBASSADORS NETWORK

CEAN Learn: K-5 Educational Resources

Educating future generations about current energy problems and solutions

J. Ruesch, I. Lomeli

WASHINGTON STATE UNIVERSITY

Project Team

Ambassadors: Iratze Lomeli and Josephine Ruesch
Mentors: Derek Nelson, Sonny Virakpanyou, Adrianna Miller, Judith Morrison, and Jillian Cadwell
DTC Team: Nick Craven, Madison Kilbury, Brandon Nguyen, and Nina Pulido

WHAT IS CEAN?

A new curriculum for WSU Tri-Cities' Clean Energy Ambassadors Network (CEAN) incorporates student research/innovation teams ("incubators") working with WSU faculty, industry mentors, and their peers to address local challenges related to climate change and its impact on disadvantaged communities. *Part of Dept. of Energy's Inclusive Energy Innovation Prize*

NETWORK FRAMEWORK

Tiered-mentorship model: 35 student ambassadors, 3 network team assistants/mentors, 21 industry mentors, 5 faculty mentors, WSU/community partners (EIR, TCHCC)

PROJECT TOPICS:

- K-5 access to clean energy education and awareness
- Access to free and easy-to-use lesson plans for teachers
- Incorporating fun activities into clean energy education
- Learning about the environmental impacts of current & upcoming clean energy technology
- Equity & access of low-income houses & communities to switch to clean energy
- Community outreach to teachers, parents, and students.

Justice 40 goals:

- Alleviating the race and poverty barriers for clean energy education
- Educating about fossil fuels and nonrenewable energy
- Demonstrating the basic components of clean energy plants and how they function.

Our goal- Our goal was to create an easy-to-use website for K-5 students and teachers to begin building a foundation about clean energy. We also wanted to spread awareness and make learning more accessible for all age ranges. We wanted to include plenty of graphics and activities to keep people of all ages. We know that understanding energy production is crucial in assessing its impact on the environment and want everyone to be able to make informed decisions about future energy initiatives.

PROGRAM OUTCOMES

History: Understand the impacts of past energy generation/climate practices on underserved populations.
Business Basics: Entrepreneurship, imposter syndrome, how to leverage university services (career/advising).
Technology Education: Develop an understanding of the cultural, social, economic & potential effects of technology.
Science: Understand the importance of natural resources & need to conserve them; common environmental issues, both natural & human-induced.
Career/Industry: Understand current industry opportunities (mentorship, internships, co-ops).

The process-We began our project by establishing what information we wanted to cover and compiling our sources. At the same time, we began racing out to the DTC department and working with industry mentors. We learned about creating effective lesson plans with clear objectives, planning resources and materials, engaging students, instructing/presenting, student practice, wrapping up, and evaluating lesson plans. We interviewed local elementary school teachers and children about their preferences for the website. Once it was finished by the DTC team, we continued to make small changes and are in the process of having it play tested by a variety of teachers, teachers in training, children, and parents.

PARTNERS & CONTRIBUTORS!

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- WSU Tri-Cities TRIO STEM
- Student Success Lab- WSU Tri-Cities
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THANK YOU!

To work on these projects and more, please visit us at https://ceanlearn.wordpress.com/

Tri-Cities Hispanic CHAMBER OF COMMERCE

Mason Jar Solar Lights for Kids

Supplies

- Wide Mouth Mason Jars
- Solar Path lights
    - Some lights will not fit in the top of the mason jar, so be sure to test it first.

Steps for Mason Jar Solar Lights

1. Take the solar path light apart by gently twisting the top off of the base. Remove the paper strip that protects the battery, as directed with the light instructions.
2. Place the solar panel in the sun for a full day
3. Fit the solar panel piece in the top of the mason jar. It should fit snuggly.
4. Use it as a night light, emergency light, or picnic illumination.

Clean Energy Career Path Awareness:

M. Jordan, L. Gomez

It is important to market Clean Energy to 6 - 12

CLEAN ENERGY Firm and Career programs

PNNL

FIRST TECH CHALLENGE

TRI-TECH SKILLS CENTER

GEAR UP WASHINGTON STATE

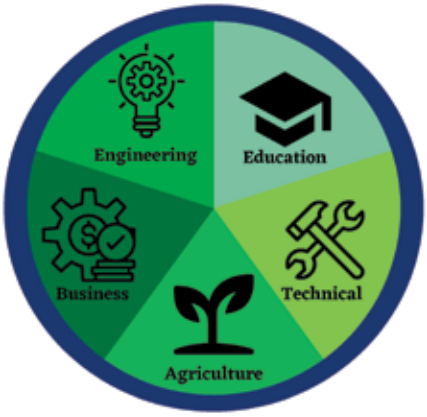
ENERGY NORTHWEST

Current Avenues to opportunities

- PNNL and Energy Northwest high school internships
- International FIRST TECH challenge
- Tri-Tech Technical career center
- Sustainable technology classes

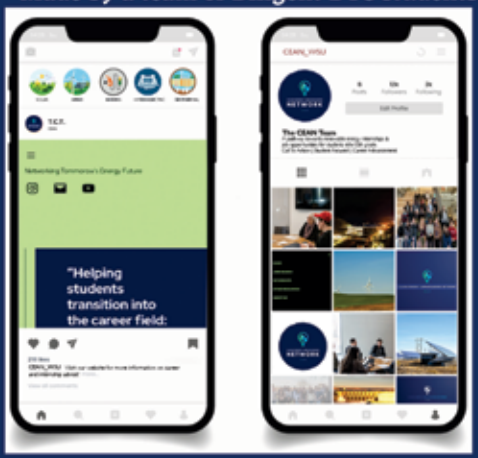
Clean Energy Inspirations

- High school career centers
- Career outreach programs
- Most companies have outreach offices
- High school and beyond plans



Awareness Solution

- Made by a team of Diligent DTC students



Example of Outreach in our community

- Sustainable energy as a high school class
- Career outreach programs
- Company outreach in high schools
- Columbia Generating Station or Ice harbor

Poster for Datebase

Contiuned Research:

- More recognition for other job paths in Clean Energy (Education, Economics, Creative Marketing)
- Relationship between industry and education
- Focus on business, education, and technical jobs

Justice40 Goals

- Increasing job awareness
- Easy-to-access information
- Connections to firms and industry
- Recongintion beyond engineering

Mentors: Jarrod Franson, Paul Carlisle John C Kennedy, Adriana Miller, Judith Morrison, Sarai Lopez, Jillian Cadwell,

DTC team: Newt Ernst, Israel Sacramento
Connections Team: Manuella Christelle Tossa, Andrew Anothney Chavarria, Sarai Lopez

Cited Resource:
Website: "College & Career Center." Hanford High, https://hanford.rsd.edu/academics/collegecareercenter., "Career & College Center." Richland High, https://richland.rsd.edu/academics/college-career-center. , "Career Center." Kennewick High School, https://kennewick.ksd.org/learn/career-center. , "First Tech Challenge." FIRST, 12 May 2022, https://www.firstinspires.org/robotics/ftc. , Energy Northwest, https://www.energy-northwest.com/whoweare/joinourteam/Pages/Careers.aspx., "PNNL Careers." PNNL Careers, https://careers.pnnl.gov/. , Pasco High School / Overview, https://www.psd1.org/pascohighschool.
Interviews: Map a Career in Clean Energy." Energy.gov, https://www.energy.gov/eere/education/map-career-clean-energy. , "Richland High School Interview." 16 Mar. 2023. , Received by Timmary D Staigle, Entry Level Careers and Internships, 14 Mar. 2023. , "Stem Education." STEM Education, https://www.pnnl.gov/stem-education., Site, Brian. "Hanford High School." 22 Mar. 2023.
Other: "Tri-Tech: 2023-24 Catalog." Tri-Tech: 2023-2024 Catalog.

CEAN Opportunities

Looking for a job in clean energy? Scan the code below and begin your journey towards a cleaner future!

https://ceancareers.wordpress.com

WASHINGTON STATE UNIVERSITY TRI-CITIES HYDROGEN ENERGY: A CLEANER ALTERNATIVE

G. Aguiano, E. Bustamante, J. Martinez Garcia, R. Rich, J. Romero

WASHINGTON STATE UNIVERSITY

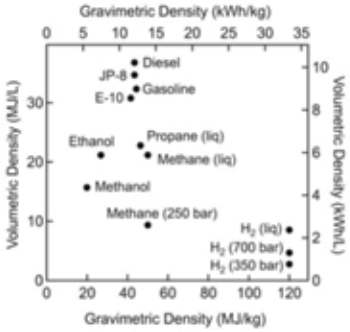
WHAT IS HYDROGEN?

HYDROGEN

- **Lightest of all gases**
- **Most abundant element** in universe
- **Can store energy** from many sources
- **Used in a fuel cell** to produce electricity
- **Currently produced** for industrial purposes
- **Not found by itself–** needs to be separated from other substances

WHY HYDROGEN?

- **Clean and renewable source of energy**
- **Highest energy content per weight of any fuel**
- **Can reduce greenhouse gas emissions**
- **Will diversify our sources of energy and increase energy security**
- **Reduce dependence on fossil fuels**
- **Create new job opportunities, improving the economy**
- **Current nuclear infrastructure can be repurposed for no-emission hydrogen production**

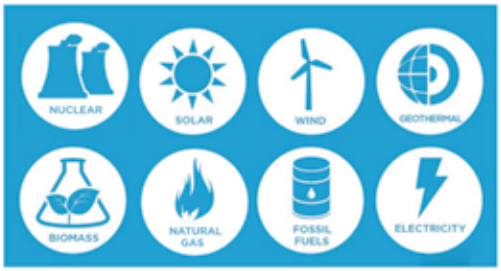


Energy Content

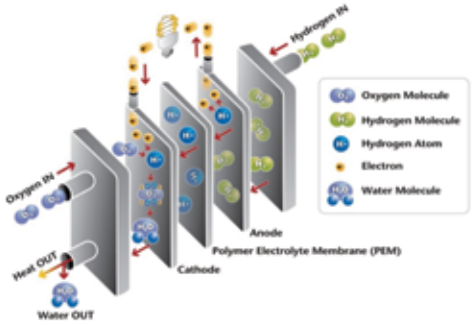
1 kilogram of hydrogen = 1 gallon of gasoline

Energy by Weight Approx. 3X more than gasoline | Energy by Volume Approx. 4X less than gasoline

SOURCES FOR PRODUCTION

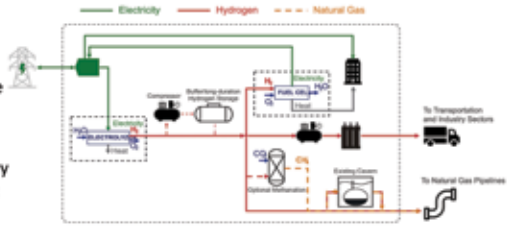


Hydrogen in. Electricity, Heat and Water Out.



PRODUCTION PATHWAYS

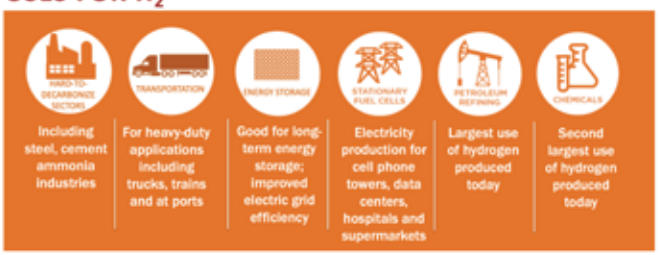
- Electrolysis - An electric current splits water into hydrogen and oxygen using an anode and cathode.
- Biological - In photolytic biological systems, microorganisms—such as green microalgae or cyanobacteria—use sunlight to split water into oxygen and hydrogen ions. The hydrogen ions can be combined through direct or indirect routes and released as hydrogen gas.
- Direct Solar Water Splitting - Photoelectrochemical systems produce hydrogen from water using special semiconductors and energy from sunlight.
- High-Temperature Water Splitting - High temperatures generated by solar concentrators or nuclear reactors drive chemical reactions that split water to produce hydrogen.
- Steam-Methane Reforming - A mature production process in which high-temperature steam (700°C–1,000°C) is used to produce hydrogen from a methane source, such as natural gas.

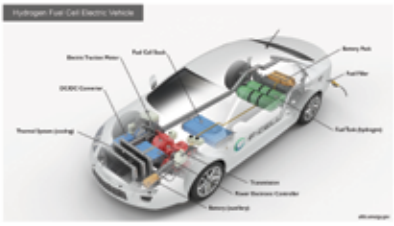


NINE MILE POINT NUCLEAR HYDROGEN PRODUCTION:

- 14.5 million cost shared project between the U.S. Department of Energy (DOE) and Constellation
- Constellation's new Hydrogen Generation System produces hydrogen without emissions
- Uses electrolysis to separate oxygen and hydrogen from water by using electricity produced at the plant
- The system started producing clean hydrogen in February to supply hydrogen for plant operations, replacing the trucked in deliveries it previously relied on
- Roughly 95% of the hydrogen produced in the US is currently sourced from fossil fuels, opening new market opportunities for nuclear energy
- This programs supports the Department's Hydrogen Shot goal of reducing the cost of hydrogen by 80% to $1 per 1kg in 1 decade.

USES FOR H_2



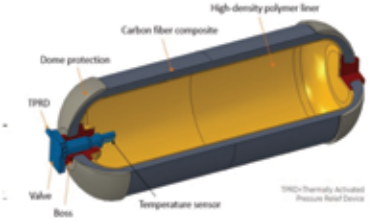


STORAGE

- **Hydrogen can either be stored as a gas or liquid.**
- **In gas form, hydrogen is stored in high pressure tanks of about 5,000 to 10,000 psi.**
- **In liquid form, hydrogen is stored at cryogenic temperatures.**
- **Can be stored on the surface of solids or within solids.**
- **Is lighter and has a higher energy density compared to lithium batteries.**

Other Notable Research Areas to consider:

- Price of hydrogen production vs current options
- Biproducts of hydrogen
- Transportation across the US
- Safety of using hydrogen as a fuel source
- Infrastructure needed for hydrogen production



Special Recognitions:

Jim Conca - CEAN Energy Mentor
Andrew Porter - CEAN Energy Mentor
WSU Tri-Cities DTC Team
Jillian Cadwell - Research Associate, Adjunct Professor of Civil Engineering WSU

WORKS CITED:

- Hydrogen.energy.gov
- www.nationalgrid.com
- https://www.cas.org

HYDROGEN POWER

HYDROGEN

WHY HYDROGEN?

Hydrogen, a highly versatile energy carrier, can be sustainably produced from an array of domestic resources. These resources include abundant natural gas, clean nuclear power, renewable biomass, and eco-friendly solar and wind power. With such diverse production methods at our disposal, the widespread adoption of hydrogen as a clean energy source is within our reach.

FUNDING

DEPARTMENT OF ENERGY

The U.S. Department of Energy (DOE) has announced its intention to provide $750 million in funding (as of Dec 16, 2022) for vital research and development initiatives, demonstrating its commitment to driving progress and innovation.

JOBS

EMPLOYMENT

The Hydrogen Shot initiative has the potential to create 700,000 jobs in the U.S. by 2030, with an estimated $140 billion in revenue. This presents a significant opportunity for employment growth across various industries, highlighting the economic benefits of hydrogen power.

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www.reallygreatsite.com

WORKING TOWARDS A BRIGHTER FUTURE

VISION AND MISSION

COST REDUCTION

Current hydrogen production and fuel cell technologies can be expensive, making them less competitive compared to other energy sources.

INFRASTRUCTURE DEVELOPMENT

The development of a widespread hydrogen infrastructure, including production, storage, and refueling facilities, is necessary to support the growth of hydrogen as a clean energy source.

BENEFITS

AVAILABILITY

Hydrogen exists in almost all plant matter and also occurs naturally in water.

ZERO EMISSIONS:

Hydrogen fuel cells produce only water and heat, making them an emissions-free alternative to traditional fossil fuels.

HIGH EFFICIENCY:

Fuel cells convert hydrogen into electricity with high efficiency, leading to lower energy waste compared to traditional combustion engines.

Hydrogen in WA

Washington's first hydrogen production plant is expected to go online in East Wenatchee in late 2022 or early 2023.

The Port of Seattle is studying whether it wants to get into the hydrogen fuel business.

The Washington state government is seeking $1 billion to $2 billion from the federal government to become one of four to eight regional hubs for the production and distribution of hydrogen as a fuel.

Uses of Hydrogen

- Oil refining, ammonia, methanol, and steel all use hydrogen in production.
- Shipping and aviation have limited low-carbon fuel options and are an opportunity for hydrogen-based fuels.
- Hydrogen boilers and fuel cells can help power modern homes.
- Hydrogen is one of the leading options for storing renewable energy and can be paired with other fuel sources to reduce coal power plant emissions.

Hydrogen Production

Electrolysis is a process that splits hydrogen from water using an electric current

Electrolysis itself does not produce any byproducts or emissions other than hydrogen and oxygen

Funding 123

1. U.S. Department of Energy, announced its intent to issue $750 million in function.
2. Inflation Reduction Act offers tax credits up to $3/kg to clean hydrogen producers.
3. Tax credits can also make green hydrogen cheaper to produce.

Hydrogen

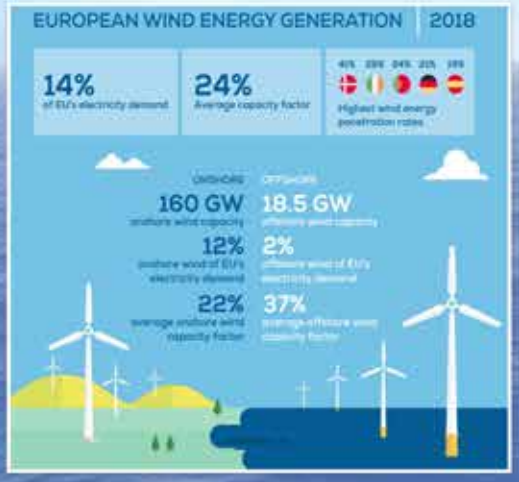
Get in the know about alternative energy solutions!

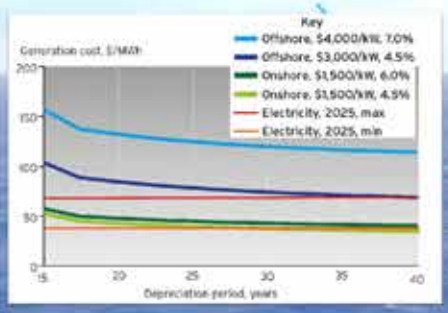
OFFSHORE WIND ENERGY

L. Moreno , K. Sidiqi

WASHINGTON STATE UNIVERSITY

Summary: Offshore wind power is a constantly renewable and infinite energy source & creates no harmful greenhouse gas emissions. Offshore wind energy has yet to be introduced to Washington state's energy supply. It is essential for Washington to embrace offshore wind energy due to the many economic, wildlife, environmental, global & personal benefits.





Justice 40 is the goal that 40 percent of the overall benefits of certain Federal investments flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution.
The use of offshore wind energy can bring cheap energy to low-income communities while helping combat the effects of global warming.

Benefits of onshore

- Maintenance is easier
- Half the price of offshore
- Does not harm marine life
- Up to 25 years lifespan
- Easier to build
- Be used by landlocked countries
- Transportation of energy is shorter
- Better conditions that reduce damage

Thank You Partners & Contributors!

Benefits of offshore

- Most energy needs are on the coast
- Turbines generate more energy
- Up to 30 years lifespan
- Capable of reducing hurricane wind speeds
- Cables can track development of earthquake
- Wind is stronger
- Turbines can act as a vertical reef for marine life.
- Can be constructed up to 14 miles from the shore
- More space for offshore turbines

Thank You Partners & Contributors!

- Alicia Mahon
- Jillian Cadwell
- Luis DeLaTorre (Poster Design)

Community Engagement

Ways that the community can help is by educating themselves on offshore wind energy, getting involved with the planning process, and to promote economic opportunities such as job creation, revenue generation and cheaper power costs.

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SUSTAINABILITY OF LITHIUM-ION BATTERIES AND ITS ALTERNATIVES

I. Medrano, N. Sanchez

WASHINGTON STATE UNIVERSITY

Williams SE. 2021 Oct 27. Making Justice40 A Reality. Black Voice News. [accessed 2023 Apr 15]. https://blackvoicenews.com/2021/10/26/justice40-the-push-for-justice40-to-community-empowered-and-accountable-environmental-equity/.

LITHIUM-ION BATTERIES IN LIGHT OF THE JUSTICE40 INITIATIVE

In 2022, the Biden-Harris Administration launched the Justice40 Initiative to increase investments toward delivering environmental justice and resources for disadvantaged communities (White House 2021). Aligning with the Justice40 goals' of mitigating the effects of **climate change** and investing in **clean energy & energy efficiency** are lithium-ion batteries (LIBs).

THE DISADVANTAGES OF LITHIUM-ION BATTERIES

Despite LIBs being the most popular choice of battery, the production and design of LIBs present several issues concerning:

Sustainability

- Current global refinery capacities and future LIB demands imply potential shortage of lithium and cobalt – two major LIB cathode metals – in the long-term decarbonization (Fu et al. 2020; Liu et al. 2022; IEA 2022).
- Potential supply shortages and production market dominated by China may increase LIB costs and thus demotivate investments into EVs (IEA 2021).
- Lithium and cobalt – two major LIB cathode materials – are extracted in high-risk areas for environmental, social, and governance risks so supply reliability is strained (Lèbre et al. 2020).

Life Cycle

- LIB manufacturing energy requirements and production incur a considerable contribution to global warming, ozone depletion, and ecotoxicity (Majeau-Bettez et al. 2011).
- With a complex battery chemistry and lack of battery recycling plants, over 8 billion tons of LIB waste may be generated by 2040, further deferring the efforts towards climate change mitigation and clean energy's benefits (Baum et al. 2022).

THE ALTERNATIVES: SODIUM-ION & LITHIUM-PHOSPHATE BATTERIES

Given the rising EV battery demand within the upcoming decade (IEA 2021) researchers have been investigating the potentials of 2 promising alternatives to LIBs in EV application:

Sodium-Ion Batteries (SIBs)	
Advantages	**Disadvantages**
• Abundant materials • Safer maintenance • Higher conductivity • Hypothetical faster charge time • Perform in cool temperatures without fault	• Depending on type of SIB, may be more expensive than current LIBs • More energy input in manmade labor • Poor life cycle

Sources: Nayak et al. 2017; Peters et al. 2016; Zhang et al. 2019; Abraham et al. 2020.

Lithium-Phosphate Batteries (LFPs)	
Advantages	**Disadvantages**
• Long lifespan • Little to no maintenance needed • Light weight compared to other batteries • Better discharge and charge efficiency	• Lower energy outputs • Expensive production cost • High chance of overcharging causing damage to battery cells • Flammable when exposed to high temperatures

Sources: Nayak et al. 2017; Peters et al. 2016; Yang et al. 2021

THANKS TO OUR PARTNERS AND CONTRIBUTORS!

- Dept. of Energy Inclusive Energy Innovation Prize
- Entrepreneurs in Residence (Paul Carlisle)
- Tri-Cities Hispanic Chamber of Commerce (Martin Valadez & Raul Contreras)
- WSU's Institute for Norwest Energy Futures
- WSU Tri-Cities Energy/Climate UCORE Curriculum Faculty Team
- Tri-Cities' Clean Energy/Climate Sector
- WSU Tri-Cities TRIO STEM
- Student Success Lab- WSU Tri-Cities
- Jade Garrett- Positive Deviancy (DOE IEI Prize Connector)
- Andrew Porter (Lead Design Engineer, Columbia Basin Consulting Group)

HOW DO SODIUM-ION AND LITHIUM-PHOSPHATE BATTERIES COMPARE TO LITHIUM-ION BATTERIES?

Based on the importance of their values in EV application, three parameters were selected to compare the batteries:

- **Specific energy density** – how much watts per kilogram can a battery store for the operation of an EV with a single charge
- **Material cost** – a major determinant for companies in pursuing certain battery production
- **Relative Environmental Impact** – the total categorization of each battery production and life cycle's impact on the environmental

LMO	$LiMn_2O_4$	aPHC	advanced PHC
LNCM	Li1.05(Ni0.6Co0.2Mn0.2)0.95O2	GWP	Global warming potential
LFP	$LiFePO_4$	FDP	Fossil depletion potential
NaVP	$Na_3V_2(PO_4)_2F_3$	MDP	Metal depletion potential
FSIB	future sodium-ion cathode	MEP	Marine eutrophication potential
sG	synthetic graphite	FEP	Freshwater eutrophication potential
nG	Low-cost (natural) graphite	HTP	Human toxicity potential
LTO	$Li_4Ti_5O_{12}$	TAP	Terrestrial acidification potential
PHC	phosphorus/hard carbon composite	GWP	Global warming potential

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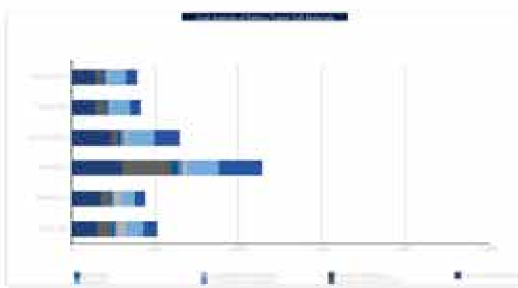

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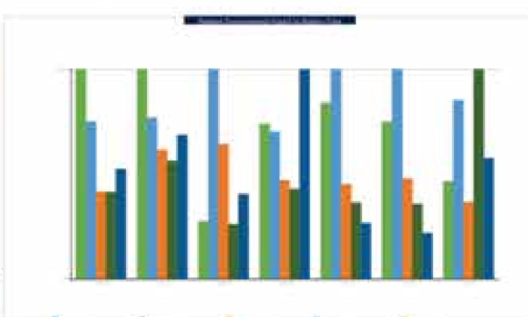

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CONCLUSION: SODIUM-ION BATTERIES MAY COMPETE WITH LITHIUM-ION BATTERIES

	Specific Energy Density (Wh/kg)	Cost ($)	Overall Environmental Impact (%)
LNCM (sG)	169.0	878	High
FSIB (aPHC)	165.8	781	Moderate
LFP (nG)	120.5	1196	High

After extrapolating the top contenders of each battery type, FSIBs with an aPHC electrode perform at a comparable level as LIBs at both the energy output and material costs. The lower environmental impact of SIBs gives SIBs an advantage over LIBs, however the current lower lifespan of SIBs needs to be overcome prior to its replacing of LIBs in the EV market (Nayak et al. 2017).

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SO… WHICH BATTERY GIVES US OUR CLEAN FUTURE?

Given that LIBs are already produced at a high production rate and offer high energy output, LIBs are here to stay, albeit with more sustainable extraction and production processes needed to comply with Justice40 goals.

Future SIBs with advanced phosphorus hard-carbon electrodes, however, may compete with LIBs in the EV sector in terms of costs and energy output. Further research is needed to bypass its poor life cycle and sustainably increase production while lowering its environmental impact.

That is not to say that alternatives, like SIBs and LFBs, do not offer a cleaner option for other applications, such as:

- Short-range EVs
- Electric bicycles
- Grid energy storage
- Solar devices

to circumvent shortage of LIB-related materials for increased EV production.

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COMMUNITY OUTREACH

Whether it be LIBs, SIBs, LFPs, or any other clean battery, EVs are key to the clean energy and climate change movement. To achieve the goals set by Justice40, community-focused projects must be in effect. Examples are, but not limited to:

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WASHINGTON STATE UNIVERSITY TRI-CITIES

What Is The Impact Of Electric Vehicle Charging Stations On Electrical Distribution Systems?

K. Simmons

WASHINGTON STATE UNIVERSITY

Washington state passes bill with goal to phase out gasoline cars REUTERS

Jay Inslee and the Washington State legislature passed legislation to ban 100% of fossil fuel vehicles by 2030.

The Problem?

•An evaluation of the current energy grid within a single neighborhood shows that an increase in electrical loads are inappropriately designed with the addition of electrical vehicles (Figure 1)

What is the most important upgrade?

The most effective upgrades would be:

•Upgrading the transformers located on power poles in older neighborhoods

• Pad-mounted transformers for underground power transmission to the home

•Pad transformers feed approximately three to four houses with 37.5-50 KVA transformers (most common with all electric houses)

• (See figure 2)

Residential Top View

Figure 2

Justice 40

Fortunately, we live in an area that Justice40 initiatives are not used as much as other areas of the US. With a population of 200,000, we still have about 10% of disadvantaged in Benton County. (See Figure 4) (ecology.wa.gov)

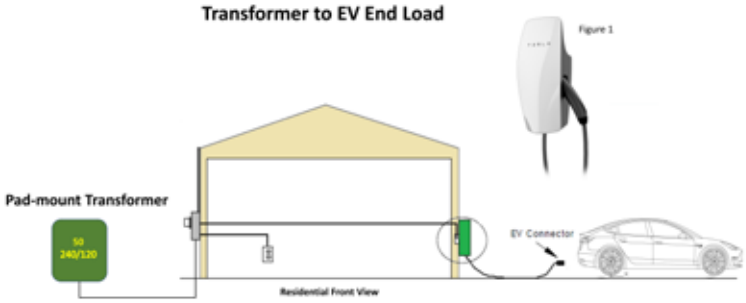
US electricity prices surging and more people than ever are struggling to pay the power company. More than 20 million American households have fallen behind on their utility bills, about 1 of every 6 homes, and the amount they owe has doubled since before the pandemic. (Bloomberg)

Total Population	Total Population Living in Disadvantaged Census	% of Disadvantaged Census Tracts in the
200.7k	12.7k	7%
	Benton County, Washington	

Figure 4

The Washington Clean Energy Transformation Act (CETA) provides safeguards to maintain affordable rates and reliable service. It also requires an equitable distribution of the benefits from the transition to clean energy for all utility customers and adds and expands energy assistance programs for low-income customers.

Transformer to EV End Load



Why should these upgrades happen?

These upgrades should happen:

• Installed vehicle chargers add about 10kW per household increasing demand

•Transformer rating increases the risks of shortening the life span of the transformer, outages and equipment failure (Figure 3)

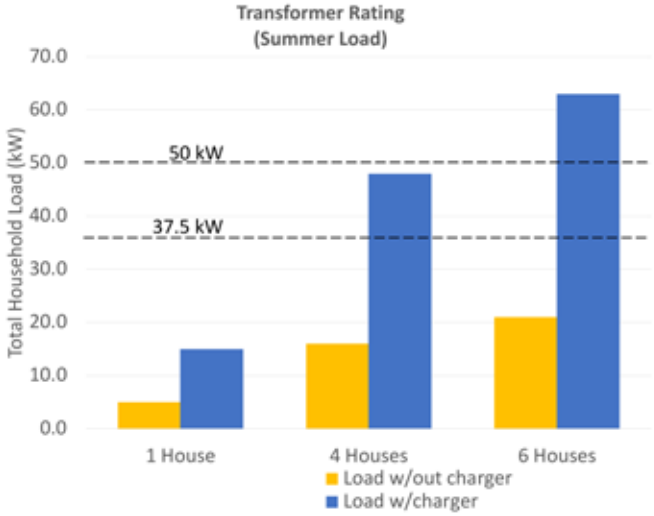


Figure 3

Community Engagement

•Community program about the first time costs of installing and owning an electrical vehicle

Conclusion

In conclusion, electrical utilities will need to upgrade transformers or reduce the amount of customers served from a single transformers. The transformer upgrades should happen in newer neighborhoods and phase out old transformers with the goal of 2030.

Special Thanks to:

•Blake Scherer Senior Engineer-Power Management at Benton PUD

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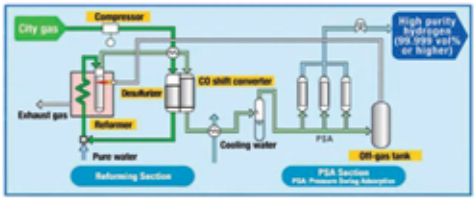
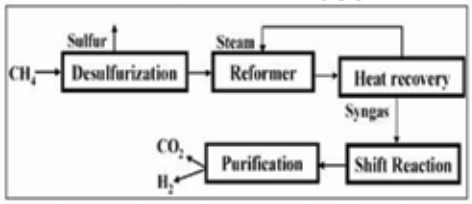
The benefits of Hydrogen Power and Micro Nuke Reactors

P. Riehl, Q. Norton

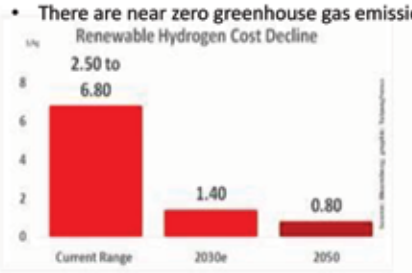
Hydrogen Power



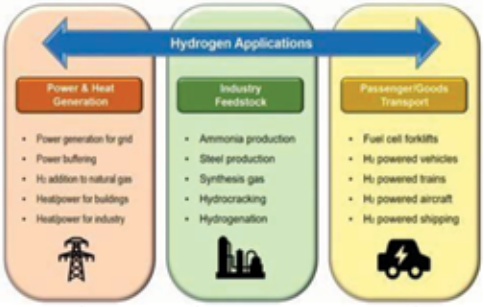
- 95% of the hydrogen used today is produced from natural gas (shown above). [4]
- Hydrogen is almost always found as part of a compound. However, it needs to be in pure H2 form to be used for electricity. [4]



- The natural gas reforming method for hydrogen occurs when burning methane (CH4) in air. This causes partial oxidation and produces hydrogen. [4]
- Hydrogen can also be produced through steam methane reforming, using natural gas at high temperature steam. [4]
- Both processes produce synthesis gas which then reacts with additional steam to produce a higher hydrogen content. [4]
- There are near zero greenhouse gas emissions. [2]



- Currently, hydrogen can cost $2.50 - $6.80 per kg to produce. [1]
- The goal is for the cost to go down to $2 per kg in 2025 and $1 per kg in 2030. [1]
- Hydrogen can produce 39 KWh/kg [2]



- Hydrogen is used as an energy carrier, and not as an energy source. [5]
- Hydrogen is placed into fuel cells that can produce electricity by combining hydrogen and oxygen atoms. The hydrogen reacts with the oxygen across an electrochemical cell similar to that of a battery to produce electricity, water, and small amounts of heat. [3]

COUGS

Justice 40 Goals

- Reduction of greenhouse gas (GHG) emissions and local air pollutants
- Increased energy efficiency programs and resources
- Deployment of clean energy, including renewable community energy projects

Community Goals

- Reach out to more rural areas about hydrogen and nuclear power.
- Getting people to do more research on their own about different forms of clean energy.

Thank You

Mentors:
Andrew Porter – Columbia Basin Consulting Group
Tim Nies - Energy Northwest

Clean Energy Ambassador Leadership:
Sarai Lopez
Andrew Chavaria
Manuella Tossa

Special Thanks To:
Jillian Cadwell

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Micro Nuclear Power

Standard Nuclear Plants

- Cost 15-30 billion dollars build
- Nuclear power is frequently cited as a critical component in the portfolio of technologies[9] aimed at reducing greenhouse gas emissions
- But rising construction costs and project delays have hampered efforts to expand nuclear capacity. [9]
- plants begun after 1970, the average cost of construction has typically been far higher than the initial cost estimate. [9]

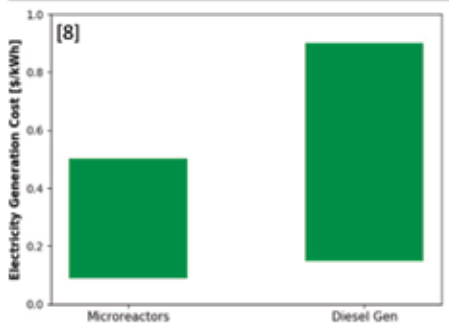
Design	Coolant	Power	Life	Powered Homes
eVinciTM	Liquid Sodium with Heat Pipes	200KW – 5MW	> 3 Years	200 – 5000 Homes
Aurora	Liquid Sodium with Heat Pipes	1.5 MW	20 Years	1500 Homes
Xe-Mobile	Helium	1 MW	3 Years	1000 Homes
NuScale	Light Water	1 – 10 MW	> 10 Years	1000 – 10000 Homes
Sealer	Liquid Lead	3 MW	30 Years	3000 Homes
U-Battery	Helium	4 MW	5 Years	4000 Homes
MMR	Helium	5 MW	20 Years	5000 Homes

Main factors

- how quickly I can be made and delivered to a location remote or in need do to disaster to continue providing power [6]
- Micro reactor can be produced in weeks. Compared to years for large reactors [7]

Nonetheless, because of the necessity of continuous fuel supply in diesel generators, microreactors cost of electricity is still expected to be competitive on the long term.

- Diesel generators (0.15 $/kWh and 0.60 $/kWh) and microreactors (0.14 $/kWh and 0.41 $/kWh).
- Similar with the Diesel one having a higher lower and upper bound. This is mainly due to the cost of the fuel (both of the product itself and of the transportation to remote areas). [8]



3D Printing with Carbon Sequestered Concrete

C. Hoover, Y. Montes, S. Muhammad

WASHINGTON STATE UNIVERSITY

TECHNOLOGICAL MATURITY:

3D printing:

Capable of use in conjunction with concrete mixes & pumps to create 3D printed housing units.

Carbon Capture: A storing process where CO2 is taken from the atmosphere & pumped deep underground into geological formations for storage.

Carbon sequestering: A process of capturing/storing CO2 artificially or naturally to be permanently. stored.

CARBON CAPTURE TECHNOLOGY METHODS:

Carbon Cure: A carbon sequestering company specializing in Precast, Reclaimed water & Readymix carbon sequestered concrete solutions. Their Readymix is the most promising solution for use with 3d printing methods and C02 reduction overall.

3,961,675 Truckloads delivered of Carbon Cure. 1,688,990 delivered in the last year.

250,416.6 Total metric tons of CO2 emissions saved. 100,156.5 metric tons of CO2 saved in the last year.

Carbon Cure concrete reduces and average 25 lbs./yd^3 (pounds per cubic yard) or 15 kg/m^3 (kilograms per cubic meter) of CO2.

Carbicrete:

- Another carbon sequestering solution
- Restricted to production of concrete blocks
- potential solution to excessive carbon created during concrete production.
- The adoption of carbicrete technology at a typical plant producing concrete masonry units (CMU's) has a profound environmental impact on an annual basis.

- 1,000,000 CMU's (concrete masonry units) Per year reduce CO2 emissions by...
- 1,000,000 kg of CO2 permanently embedded in CMU's.
- 2,000,000 kg of CO2 emissions avoided.
- Equivalent of 49,600 tree seedlings growing for 10 years!

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HTTPS://CARBICRETE.COM/. AND HTTPS://WWW.CARBONCURE.COM/
HTTPS://WORLDPOPULATIONREVIEW.COM/STATE-RANKINGS/HOMELESS-POPULATION-BY-STATE

FINANCIAL IMPACT

The chemical reaction that produces a ton of cement releases about 1/2 ton of CO2. $50 per metric ton.

The average housing price in WA. Is $522,000 in 2022.

350 Sq. Ft. 3D printed home is $4,000 to build & print

- Total retail price of $10,000.
- 2,000 Sq. Ft. is $200-$300 Sq. Ft. home
- Total is $450,000.

Purpose

We are using 3D printing in collaboration with carbon-sequestered concrete. To tackle the ongoing housing crisis & propose a method for eliminating excess carbon in our atmosphere.

JUSTICE 40

The Justice40 aims to benefit disadvantaged communities that are marginalized, underserved, and affected by climate change. 3D-printed houses can provide homes for underprivileged communities.

- Lower carbon emissions
- Reduce the cost of housing
- Providing homeless individuals, a safe environment

OUTREACH

•Inform the community

•Reaching out to the Energy & Environmental Alliance for Better Home and Better Future and the Home Builders Association of Tri-Cities

THANKS

Our team would like to thank Jillian Cadwell, Sarai Lopez, our mentor Rocco Luongo and all the other mentors who aided us in our CEAN Projects development.

ENVIORNMENTAL IMPACT

Waste material is a significantly increasing issue in the US, global waste is one of the leading causes of pollution.

- Building traditional homes accumulates tons of waste that leads to lowered land value, cleanup costs, and wasted resources.
- It also leads to climate change and contributes to greenhouse gas emissions. Construction of 3D homes runs a shorter supply chain and less construction with less engineering waste.

20,000 TONS OF CO2/ EQUIVALENT ABATED AND REMOVED

4,400 CUBIC METERS OF WATER SAVED

33,000 TONS OF LANDFILL AVOIDANCE

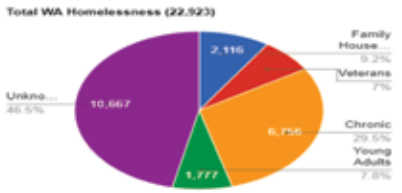
When 3D printing becomes more established, we'll begin to see the positive environmental effects of its implementation. Less construction waste, affordable homes, and low-income access to housing. 3D homes can be built exponentially faster than traditional homes; meaning more homes can be built in less time with less

HUMANITARIAN IMPACT

As the current cost of living continues to increase. Aside from environmental and housing sustainability, 3D printed homes are a means to help address the homelessness issue in the US. The cost of achieving this is high, but there are contributing ways as a community to team up and help low-income communities as well as homelessness.

A few goals that can be achieved with 3d modular homes are

- reduce the global housing gap
- reduce carbon emissions
- and new innovations



MARINE PLASTIC BIOREMEDIATION USING GENETICALLY MODIFIED MYCOPLANKTON

J. Brittain

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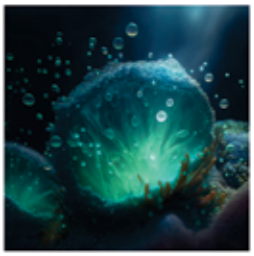


THE EFFECTS OF MICROPLASTIC ON THE PLANKTON ECOSYSTEM

Microplastics block out light passing through the photic zone, the ocean zone where 90% of photosynthesis and carbon capture occur. This along with the toxic chemicals that microplastics produce is killing phytoplankton. Phytoplankton form the basis for the marine food web, and currently take care of 50% of carbon capture on the planet. Historically phytoplankton took on up to 90% of carbon capture and it's estimated that because of microplastics the world's phytoplankton are only accomplishing about 1% of their carbon capture potential.

WHAT'S THE IDEA?

By selecting a mycoplankton that zooplankton will eat and editing it by implanting the genes for eating plastic, red bioluminescence, and blue bioluminescence, we can safely remove the plastic pollution from our ocean while turning the potential energy in the plastic into light energy for phytoplankton as well as food for zooplankton in the form of the mycoplankton.

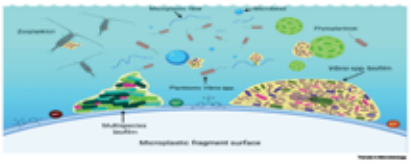
THANK YOU ADVISORS AND ALL THOSE THAT HELPED!

- Dr. Suh-Jane Lee
- Dr. Jillian Cadwell
- Clean Energy Ambassadors Network

Tri-Cities Hispanic CHAMBER OF COMMERCE

PURPOSE

This semester I set out to investigate the sustainable solutions for marine bioplastic remediation.



PLANKTON ECOSYSTEM

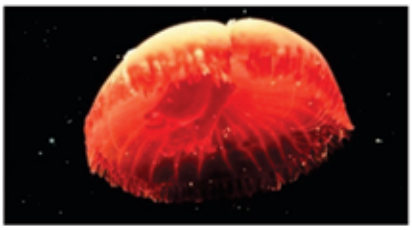
There are three kingdoms of plankton. Phytoplankton are plant based plankton, are the foundation of the marine food web. They use red and blue light to photosynthesize and produce a major portion of the world's oxygen. Zooplankton are animal based plankton and are the primary consumers of the marine food web. Mycoplankton are fungi based plankton and are the cleaners of the plankton ecosystem.

NEXT STEPS

1 CREATION OF ORGANISM (MYCOPLANKTON) AND TESTING VIABILITY TO SURVIVE
2 SMALL SCALE TESTING OF BYPRODUCTS CREATED BY THE ORGANISM
3 TESTING OF PHYTOPLANKTON BEING ABLE TO PHOTOSYNTHESIZE FROM THE LIGHT PRODUCED BY THE ORGANISM
4 TESTING HEALTH OF ZOOPLANKTON THAT FEED ON ORGANISM
5 TESTING OF SELF-CONTAINED ECOSYSTEMS WITH THE ORGANISM
6 TESTING OF SMALL SCALE RECYCLING FACILITIES

PLASTIC EATING FUNGI

There are already multiple species of fungi, such as oyster mushrooms and Pestalotiopsis microspore, which eat plastic. The gene for fungi to eat plastic has already been isolated. Were we to implant that gene into fungi planton (mycoplankton), we could safely use it for plastic bioremediation of the oceans. Bioremediation is the process of introducing an organism (whether engineered or naturally occuring) to clean up pollution.



COMMUNITY ENGAGEMENT:

To raise awareness, school children can take home kits with the organism in an aquarium to practice at home plastic recycling.

OTHER POTENTIAL APPLICATIONS:

- Small islands that don't have the facilities for plastic recycling and where transporting the plastic off island for recycling would be prohibitive, could use the organism to recycle the plastic into fish food which could be used to raise fish for the community.
- Because of the chemical structure of plastic, there's a possibility that the organism could be used to clean up oil spills
- The organism could be used with small aquariums for at home plastic recycling, turning consumer plastics into fish food and decorative lighting.
- Towns could use the organism to provide lighting to areas with fountains or water features.
- Mycoplankton can be also used for freshwater cleanup.
- Can be used to recycle plastics which are otherwise not able to be recycled or are not environmentally viable after they've been ground into microplastic or mechanically degraded.

JUSTICE 40 GOALS:

This project would help decarbonize the atmosphere and would give economically disadvantaged communities a sustainable solution to the disposal of plastic waste.

WORKS CITED:

- Effects of microplastics pollution on plankton: A review - PubMed (nih.gov)
- Bioremediation of Plastic Pollution to Conserve Marine Biodiversity (2020-2021) | Duke Bass Connections
- report on micro plastic and phytoplankton (gcefoundation.com)
- Bioremediation of Plastic Pollution to Conserve Marine Biodiversity (2020-2021) | Duke Bass Connections
- Disentangling the structure and function of mycoplankton communities in the context of marine environmental heterogeneity - ScienceDirect

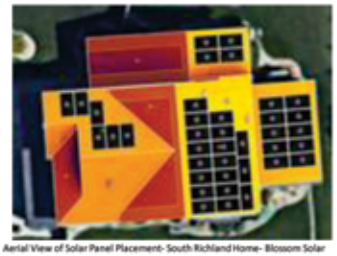
WASHINGTON STATE UNIVERSITY TRI-CITIES HOME IMPROVEMENT PROJECT: A STRIVE TOWARDS CLEAN ENERGY

E. Mitchell, R. Osman, S. Feria, A. Acharya

WASHINGTON STATE UNIVERSITY

Our Goal: Find ways to decrease energy burden on low-income communities through researching energy efficiency programs, rebates in place, and clean energy alternatives.

Our process: Performing case studies on our homes and identifying how to decrease our energy bill. In addition, we are looking for existing state and federal programs in place to support the process and typing out future legislation that should be put in place to support our goal.

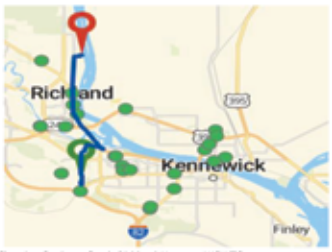


Aerial View of Solar Panel Placement- South Richland Home- Blossom Solar

SOLAR PANELS ASSESSMENT- SOUTH RICHLAND

Home size: 2,473 sq ft
Appliances: Electric appliances and gas heating
Average Utility Cost: $180

This home qualifies under loan requirements for solar panel installation and use. The cost to install the solar panels would be $51,330 and the average time it takes to earn the money back would be 15.6 years at $3.38 per watt (400 watts per panel for 38 panels). Over the next 20 years, this home could save $11,790 and meet about 88% of its energy needs.
Energysage.com, Blossom Solar Quote



EV Charging Stations- South Richland Home to WSU-TC- Afdc.energy.gov

ELECTRIC VEHICLE COMMUTE

There are 19 charging stations within 5 miles from the commute of 11 miles in South Richland to the WSU-TC Campus.

Switching from a used 2004 Toyota Corolla to a new 2024 Chevrolet Equinox, cost would be $80,000 or under to quality for a tax credit of $7,500.
-FuelEconomy.gov

THANK YOU TO OUR CONTRIBUTORS!

- DTC 476 Class
- Jillian Cadwell
- Jason Herbert- External Affairs New Nuclear Development
- Jacob Gonzalez- City of Pasco, Community, and Economic Development

THREE DIFFERENT APPROACHES TO CLEAN ENERGY- SOLAR & EV

Tiered-Energy model: Tiers to energy efficiency including the cost & incentives

Aggressive: The home is net-zero (production = consumption). Use solar panels with battery capacity, upgraded energy-star recognized appliances, commute with new EV, and use 240V home battery (4-10 hours full charge). Pay cash for solar panels for the immediate tax credit.

Total Cost: $106,656

Moderate: Installation of solar panels with no battery, upgraded energy-star recognized appliances, and purchase of used EV vehicle with 120V home battery (40-50 hours full charge). Take out loan for solar panels and apply for tax credit after 20 years.

Total Cost: $52,395*

Conservative: Use an EV ride-share. Upgraded energy-star recognized appliances. Follow utility tips for using less energy and follow energy-saving tips. Upgrading electrical meter and upgrading outlet and breaker box for EV charger. Research & financially prepare for solar and EV.

Total Cost: $2,300

FUTURE LEGISLATION

- After 2033, the ITC rate for solar decreases the installation cost from 26% to up to 30%. -ForbesHome
- Continual incentives for urbanized solar panels and purchase of EV vehicles.
- Making incentives available for non-aggressive approaches.
- Rebate or Incentive included during purchase for immediate application.
- User-friendly interface for current information on rebates and incentives.

FUTURE RESEARCH

- Incorporation of sustainability practices (such as less environmental degradation to produce solar farms)
- Universal platform that is user-friendly featuring all incentives and rebates, separated by zip code
- Extrapolation to apply to other homes from diverse income brackets in Washington State.
- Compare the cost of money being saved by using solar panels in conjunction with using EV vehicle.
- Appliance Inventory for homes, modern and old.

Aerial View of Solar Panel Placement- West Richland Home- Blossom Solar

SOLAR PANEL ASSESSMENT – WEST RICHLAND

Home size: 2,186 sq ft
Appliances: Standard energy efficiency models
Average Utility Cost: $235.45

This home qualifies under loan requirements for solar panel installation and use. At $3.20 per watt (370 watt per panel for 29 panels), the cost of the loan with and without battery is $34,295-$49,745 and will be paid over a 20-year span at a rate of 5.5%. Over the next 25-30 years, this home could meet about 46% of its energy needs. Energysage.com, Blossom Solar Quote

EV Charging Stations- West Richland Home to WSU-TC- Afdc.energy.gov

ELECTRIC VEHICLE COMMUTE

These are 9 available charging stations from the commute of 7.6 miles in West Richland to the WSU-TC Campus within 5 miles radius.

Switching from a used Subaru Outback 2019 to new Nissan Leaf S 2021, the cost would be $55,000 this would quality for a tax credit of $7,500.
-FuelEconomy.gov

JUSTICE 40 GOALS

- ✓ **Clean Transportation** - Access to affordable electric vehicles, charging stations, and purchase programs
- ✓ **Clean Energy & Energy Efficiency** - Reduction of Energy Burden household income spent on Home Energy
- ✓ **Affordable & Sustainable Housing** - Improved housing quality and safety

State rebate is half the sales tax off. $2500 tax taken off for Electric Vehicles.

Installing Level 2 charger, $300 compensation from the state after inspection.
-Benton REA

Pre-Owned EV Vehicle:30% off purchase price, must be $25,000 or less.
-FuelEconomy.gov

RC 30D-Form 8936. New EV can not exceed $80,000 for vans, sport utility vehicles, and pickup trucks and $55,000 for other vehicles(restriction on model apply) . The tax credit will pay $7500 at the time of purchase.
-IRS

REBATES

COMMUNITY ENGAGMENT

- Survey to identify community energy needs
- Home Builders Association Seminars
- Fliers from PUD

30% Solar Tax Credit till 2033 if the solar panels are owned and not under a loan/lease. Must complete IRS Form 5695.

Retail Sales Exemption Certificate- sales tax exemption on solar systems that generate up to 100 kilowatts (kW).

Energy-Star Recognized, Tax Credits
AC - $300, Heat Pumps $300, Natural Gas/Oil/Propane: $150, Air Circulating Fans: $50, Non-Solar Water Heater: $300, Windows/Doors/Skylights: 10% of cost (not including installation) $200-$500, Insulation: 10% of cost (up to $500 not included installation cost)
-Energystar.gov

WORKS CITED:

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- Benton REA
- Electricforall.org
- City of Richland: Energy services/electric-vehicles
- Electricforall.org/ev-charger-locations/
- IRS.gov: credits-for-new-clean-vehicles-purchased-in-2023-or-after
- Afdc.energy.gov
- https://rb.gy/pc03
- Energystar.gov: energy star home upgrade/make your home electric ready
- Fixr.com/costs/home-electric-vehicle-charging-station
- Energystar.gov/products/ask-the-experts/the-tax-credits-for-energy-efficient-upgrades-are-back
- FuelEconomy.gov
- WA State Department of Commerce: Energy Assistance Program
- Energytips.wa.gov
- Utc.wa.gov
- Programs.dsireusa.org
- Forbes.com/home-improvement/solar/solar-tax-credit-by-state/
- https://www.hbatc.com/fall-home-show.html

Featured Case Study

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Maecenas sit venenatis aliquet nunc nam scelerisque. Proin congue viverra risus placerat augue odio cras neque. Felis netus tincidunt sed hac urna. Lorem ipsum dolor sit amet, consectetur adipiscing elit. Maecenas sit venenatis aliquet nunc nam scelerisque. Proin congue viverra risus placerat augue odio cras neque. Felis netus tincidunt sed hac urna.Lorem ipsum dolor sit amet, consectetur adipiscing elit. Maecenas sit venenatis aliquet nunc nam scelerisque. Proin congue viverra risus placerat augue odio cras neque. Felis netus tincidunt sed hac urna.

News & Announcements

Solar Energy System Sales Tax Incentives

Solar Investment Tax Credit

Low-Income Home Energy Assistance Program (LIHEAP)

Interested in Making Your Home Energy Efficient?

Local Rebates Information

https://www.bentonpud.org/energy-programs/rebates/rebates

Requirements

* Some Rebates Are **REQUIRED** To Be Performed By An Approved Contractor

Washington State Tax Incentives

https://www.utc.wa.gov/regulated-industries/utilities/energy/conservation-and-renewable-energy-overview/washington-energy-independence-act-i-937/renewable-energy-incentives

Local Current Policies

https://www.bentonpud.org/About/Your-PUD/Overview/News

Other Resources

- https://www.bentonpud.org/
- http://energytips.wa.gov/default.asp?src=financing
- https://www.whitehouse.gov/cleanenergy/?utm_source=www.cleanenergy.gov

¿Está interesado en hacer que su hogar sea energéticamente eficiente?

Información De Reembolsos Locales

https://www.bentonpud.org/energy-programs/rebates/rebates

Requisitos

* Algunos Reembolsos Son REQUERIDOS Para Ser Realizados Por Un Contratista Aprobado

Incentivos Fiscales Del Estado De Washington

https://www.utc.wa.gov/regulated-industries/utilities/energy/conservation-and-renewable-energy-overview/washington-energy-independence-act-i-937/renewable-energy-incentives

Políticas Locales Actuales

https://www.bentonpud.org/About/Your-PUD/Overview/News

Otros Recursos

- https://www.bentonpud.org/
- http://energytips.wa.gov/default.asp?src=financing
- https://www.whitehouse.gov/cleanenergy/?utm_source=www.cleanenergy.gov

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5 likes

cean ***story of house etc***. lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

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Do Want To Reduce Your Energy Bill?

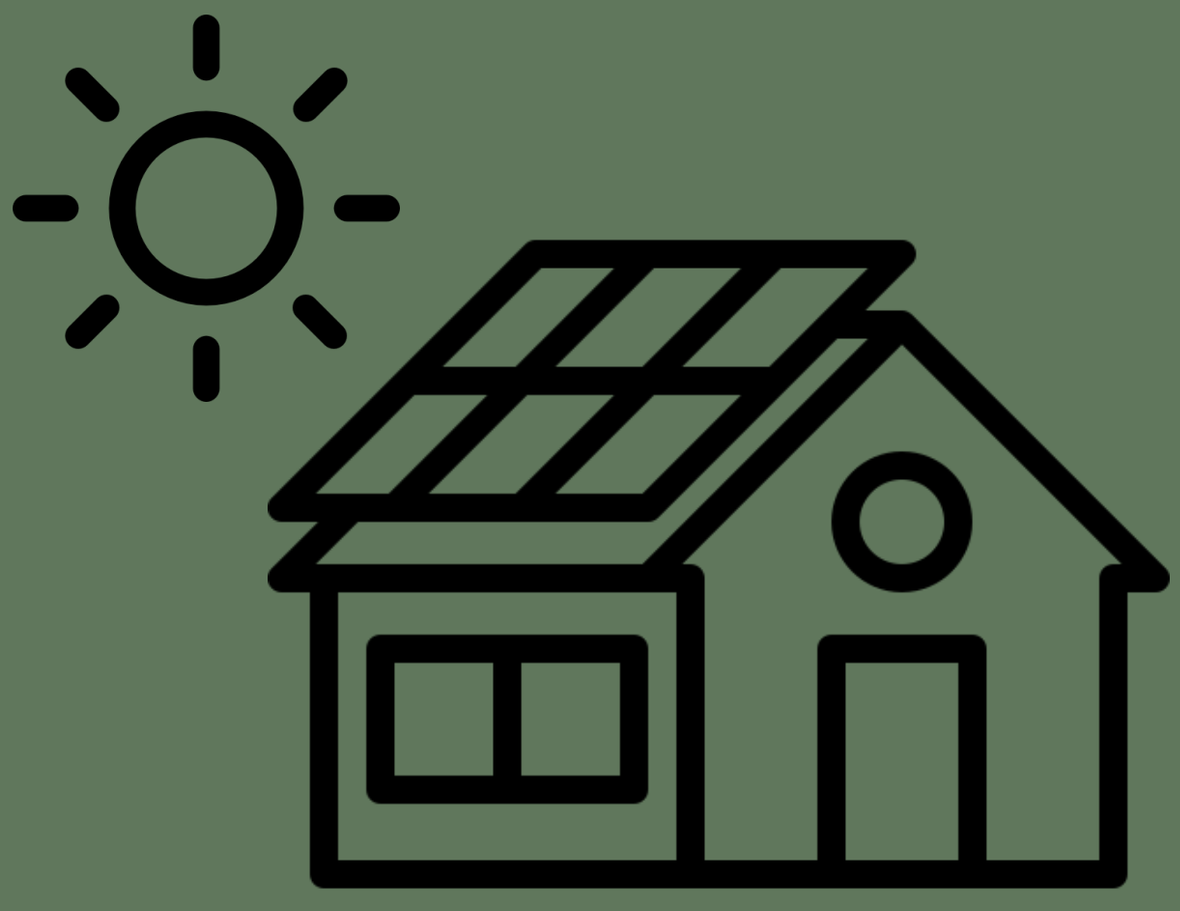
Installing Solar Panels Could Save The Average Consumer An Estimate Of $1,500 Each Year.

Swipe For More Information About
The Solar Investment Tax Credit

CEAN

What is the **Solar Investment Tax Credit?**

A **30% Tax Credit** That Allows A Person Who Installs **Solar Panels** On The Roof Of Their Home To Claim A Dollar-For-Dollar **Reduction** For Their Income Taxes



HANFORD SITE VIT. PLANT BOILER ELECTRIFICATION

C. Berry, I. Martinez, S. Virk, K. Zimmerman
Mentor: Elaine Porcaro, P.E. DOE Hanford Chief Engineer

WASHINGTON STATE UNIVERSITY

HANFORD HISTORY

- Constructed in 1943 to help produce plutonium for World War 2
- The Hanford site was active during the Cold War due to high tensions between the U.S. & the Soviet Union
- DOE's largest environmental clean up project

Hanford Site January 1960

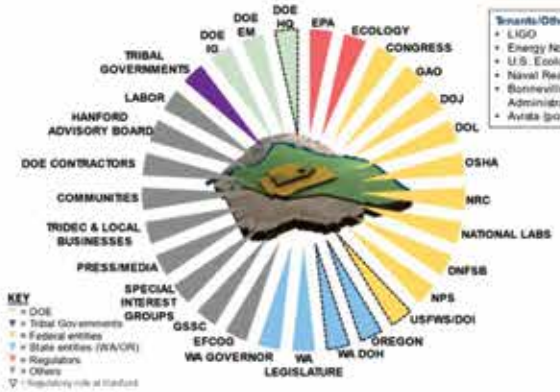
BASIC WASTE TREATMENT PROCESS

- Two main types of waste to be treated at the Hanford site:
  - Low Activity Waste (LAW)
  - High Level Waste (HLW)
- Currently working on the first vitrification facility to process LAW & constructing the HLW vitrification facility.
- Facilities rely on steam for heat & Effluent Management Facility evaporator
- Currently uses diesel powered fire tube boilers to create steam

JUSTICE 40 GOALS

- Decrease energy burden in disadvantaged communities (DACs)
- Decrease environmental exposure and burdens for DACs
- Increase clean energy enterprise creation and contracting (MBE/DBE) in DACs
- Increase energy resiliency in DACs
- Converting boilers to electric creates cleaner air for surrounding communities.
- Less demand for diesel
- Increase in efficiency for clean-up at the Hanford site

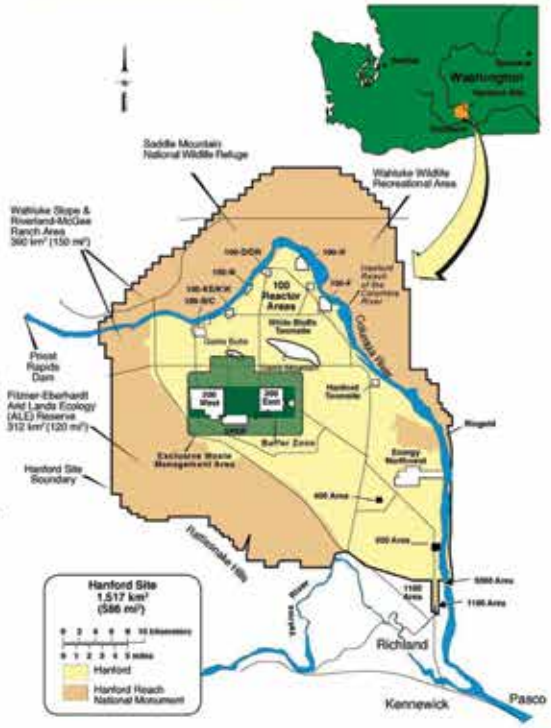
STAKEHOLDERS



Tenants/Others:
- LIGO
- Energy Northwest
- U.S. Ecology
- Naval Reactors
- Bonneville Power Administration
- Avista (power lines)

RESEARCH QUESTION

- Current steam boilers used to process waste are fueled by diesel which is expensive and produces more carbon emissions than comparable energy sources
- How would converting Hanford site steam boilers to electric power help reduce carbon emissions, cost and improve the surrounding communities?



Capital Cost Estimate 2023 Dollars

Quantity	Item	Unit Price	Unit	Total
2	Boilers	$783,500	each	$4,701,000
1	Steam Plumbing	$160,000	LS	$160,000
			Sub Total:	$4,861,000
10%	Mobilization (rounded up)			$486,100
30%	Contingencies (rounded Up)			$1,458,300
	Estimated Construction Costs:			**$6,805,400**
20%	Engineering and administration			$972,200
	Estimated Total Project Costs:			**$7,777,600**

Cost Estimate for New Boiler Installation

Hanford Site WTP Steam Plant

CONVERTING BOILERS TO ELECTRODE BOILERS

- Estimated 150,000 lb./hr. steam requirement
- Boilers must be sized appropriately
- Future facility must be built to handle supplemental waste

Waste Treatment Plant Diesel Tank

COST ESTIMATE

- Estimated 4.8 million gallons/year of fuel for LAW and HLW operations
- Estimated 150 million gallons of diesel for LAW for 60-year mission
- Estimated $23 million per year for diesel fuel use and transportation
- New substation estimated at $3 million to power electrode boilers if required (LAW)
- $6.8 million per year for total electricity usage for LAW and HLW electrode boilers
- Project cost for Waste Treatment Plant operations is estimated at $115 million
- Estimated savings of $16 million per year with electric boilers
- Initial expense of boiler installation recouped with savings within 7 years
- Electricity is cheap ($0.04 per KWH); Diesel is expensive ($4.75 per gal, delivered)
- Possible future fuel taxes could increase costs even further

COMMUNITY ENGAGEMENT

- Informing the community of the many benefits of converting Hanford site steam boilers to electric power
- The local communities around the Hanford site are major stakeholders in the DOE's mission
- Engagement would include holding public forums and keeping stakeholders aware of ongoing changes in the project
- Public Involvement Opportunities; Hanford.gov

CARBON EMISSION REDUCTION

- Estimated reduction of 4 times the amount of MTCO2e for conversion of electrode boilers for LAW alone
- 50,000 MTC02e savings/year
- 3 million MTC02e savings/60-year mission

THANK YOU TO

- Elaine Porcaro, P.E. DOE Hanford Chief Engineer
- Christian Seavoy, Site Energy Manager, HMIS
- Blake Scherer, P.E. Senior Engineer – Power Management, Benton PUD
- Jillian Cadwell, Research Associate and Adjust Professor of Civil Engineering, WSUTC
- Cleaver-Brooks Inc; Boiler Estimations

CONCLUSION

- Boiler electrification helps drastically reduce carbon emissions compared to diesel boilers
- Cleaner energy helps improve quality of life for disadvantaged communities
- The cost of boiler conversion can be recouped in less than 10 years
- Boiler electrification helps improve the speed at which the DOE is able to clean up the Hanford site

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- Sizing A Sussman Electric Steam Boiler | Sussman Electric Boilers (sussmanboilers.com)
- Hanford Net-Zero report - DOE
- Elaine Porcaro – P.E. DOE Hanford Chief Engineer
- Model HSB Electric Boiler | Cleaver-Brooks (cleaverbrooks.com)
- https://www.energy.gov/diversity/justice40-initiative
- https://www.hanford.gov/page.cfm/Outreach/PublicCommentOpportunities

STRATEGIES FOR COMMUNITY ENGAGEMENT AROUND RENEWABLE & NUCLEAR ENERGY

A. Hothi, I. Marroquin, P. Pawar, E. Ogunmokun

WASHINGTON STATE UNIVERSITY

MEET THE TEAM!

- (PICTURED LEFT TO RIGHT): P. PAWAR, I. MARROQUIN, E. OGUNMOKUN, AND A. HOTHI

BACKGROUND

- WE NOTICED THAT THERE IS A LACK OF UNDERSTANDING IN OUR COMMUNITY ABOUT NUCLEAR ENERGY AND CLEAN ENERGY IN GENERAL.
- NUCLEAR ENERGY IS CLOSE TO HOME
  - THE TRI CITIES IS DEPENDENT ON HYDROELECTRIC ENERGY, SO IT IS IMPORTANT FOR PEOPLE TO UNDERSTAND CLEAN ENERGY AND THE FUTURE OF NUCLEAR ENERGY.
- OUR GOAL IS TO REACH OUT TO OUR COMMUNITY THROUGH THIS CAMPUS TO EDUCATE THE PUBLIC ABOUT CLEAN ENERGY.
- OUR TARGET AUDIENCE FOR THIS OUTREACH PLAN ARE UNDERGRADUATE STUDENTS AND HIGH SCHOOL STUDENTS
- WE PARTNERED WITH WSU TRI CITIES' DTC 476 CLASS TO CREATE INSTAGRAM POSTS / POSTERS THAT WE INTEND TO USE DURING OUR OUTREACH

SO... WHAT'S OUR PLAN?

PROJECT TOPICS:

- COMMUNITY OUTREACH TO INFORM ABOUT NUCLEAR ENERGY
- STRTEGIES FOR ENGAGING THE COMMUNITY, PARTICULARLY UNDERSERVED POPULATIONS, AND JUSTICE40 GOALS

PROJECT OUTCOMES →

- MARKETING/OUTREACH MATERIALS SUCH AS VIDEOS, POSTERS, AND QR CODES

JUSTICE40 RELATED COMMUNITY ENGGAGEMENT:

- INCREASING AWARENESS FOR STUDENTS OF ANY BACKGROUND TO INTERNSHIP OPPORTUNITIES
- OPEN CONVERSATION BETWEEN AMBASSADORS AND TC STUDENTS GRADE 9-CAREER, ESPECIALLY WITH STUDENTS WHO ARE PART OF A DISPERSED COMMUNITY (IMMIGRANTS, NATIVE AMERICANS, RURAL STUDENTS, & DREAMERS)

SCAN TO SEE DTC 476 REELS:

KEY POINTS IN OUR CEAN RESEARCH:

- NUCLEAR ENERGY IS THE CLEANEST AND LEAST EXPENSIVE TO RUN
- VERY COST EFFECTIVE COMPARED TO FOSSIL FUELS
- SAFER TO PRODUCE

INDUSTRY INTERNSHIPS + SHADOWING OPPORTUNITIES

- **PACIFIC NORTHWEST NATIONAL LABS**
  - UNDERGRADUATE INTERNSHIPS
  - GRADUATE INTERNSHIP
  - HIGH SCHOOL BUSINESS & RESEARCH INTERNSHIPS
- **ENERGY NORTHWEST**
  - HIGH SCHOOL WORK-BASED LEARNING
  - UNDERGRADUATE INTERNSHIP
  - GRADUATE ENGINEER POSITIONS

ADVOCATING AT WSU: TRI CITIES:

- INNOVATION IN CLEAN ENERGY AND CLIMATE
- COMMUNITY ENGAGEMENT AND OUTREACH
- JUST & EQUITABLE ENERGY DEVELOPMENT ACCORDING TO JUSTICE40 (J40) GOALS

OUTREACH IN ACTION:

Tri-Cities Hispanic CHAMBER OF COMMERCE

Inclusive Energy Innovation Prize

THANK YOU!

- Dept. of Energy Inclusive Energy Innovation Prize
- Entrepreneurs in Residence (Paul Carlisle)
- Tri-Cities Hispanic Chamber of Commerce (Martin Valadez & Raul Contreras)
- WSU's Institute for Norwest Energy Futures
- WSU Tri-Cities Energy/Climate UCORE Curriculum Faculty Team
- Tri-Cities' Clean Energy/Climate Sector
- WSU Tri-Cities TRIO STEM
- Student Success Lab- WSU Tri-Cities
- Jade Garrett- Positive Deviancy (DOE IEI Prize Connector)

WORKS CITED:

Energy Northwest Career Page

PNNL Careers Page

Energy Northwest Nuclear Energy Info Page

Department of Energy, Office of Nuclear Energy


Support
CEAN
Clean Energy
in the Tri-Cities
"State and federal legislation are driving resources to create the conditions that support energy innovation, from advanced nuclear and hydrogen, to solar and wind."
Follow us for more

Apoyar

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La Energia Limpia en Tri-Cities

" La Legislacion Estatal y Federal Esta Impulsando los Recursos Para Crear las Condiciones que Apoyan la Innovacion Energetica, Desde la Energia Nuclear Avanzada y el Hidrogeno Hasta la Energia Solar y Eolica."

Siguenos Para mas Informacion

CEAN UPDATE

https://tricities.wsu.edu/energy

Local Clean Energy Oppurtunites in the Tri-Cites

"State and federal legislation are driving resources to create the conditions that support energy innovation, from advanced nuclear and hydrogen, to solar and wind."

ACTUALIZACION DE CEAN

https://tricities.wsu.edu/energy

Oportunidades Locales de Energia Limpia en Tri-Cities

" La Legislacion Estatal y Federal Esta Impulsando los Recursos Para Crear las Condiciones que Apoyan la Innovacion Energetica. Desde la Energia Nuclear Avanzada y el Hidrogeno Hasta la Energia Solar y Eolica "