PA House Majority Policy Committee Hearing

Pennsylvania's Next Economic Opportunity: Hydrogen, Carbon Capture and Jobs of the Future
August 30, 2022, at 2 p.m.
Western Pennsylvania Operating Engineers
250 Operators Way, New Alexandria, PA 15670

Testimony provided by
Richard A. DiClaudio

President and CEO of the Energy Innovation Center Institute, Inc., ("EICI")
a 501C3 organization created to advance sustainability and resiliency
for humans and energy systems located in Pittsburgh, PA.
(See Rich's bio and the information on the EICI supplied separately for more details)

My name is Rich DiClaudio, and I am an energy professional with 40 years' experience investing and managing energy and energy technology assets. My team and I have directed over $3.6 billion in investments.

I also helped create and run one of the largest and most effective minority focused workforce development programs in the Commonwealth, the Energy Innovation Center Institute.

Today, I'm here to talk about the currently ongoing energy transition with a specific focus on both hydrogen and carbon capture particularly as they relate to Pennsylvania.

As in the past, we find ourselves positioned to play a key role in this transition. And we do so from the vantage point of possessing one of the world's largest reserves of natural gas, some of the most extensive, but aging infrastructure systems, proximity to huge markets, and the most skilled and engaged energy, infrastructure, and manufacturing labor forces in the world.

Fossil fuels have allowed man to perform work in highly efficient ways. This work has created enormous wealth including building the huge and successful middleclass of the U.S. and most western societies.

Now that same society has determined that we need to reduce and eventually eliminate our emissions from the use of fossil fuels while transitioning to more sustainable cleaner energy sources.

The emerging solutions sets to these objectives will be different in different places, but they must always balance the tension between abandoning the jobs, income, and lifestyle the fossil fuel industry has created with the ongoing societal desire to transition to more sustainable and cleaner fuels.

Additionally, we cannot rely solely on our current resources and ignore the need to innovative competitively – if we do, we will be left behind and over time this will cost our economy and weaken our state. Further, adding hydrogen to our region's energy mix will attract outside investments, help create new jobs, and even increase prosperity more equitably. Working to secure the investments and jobs associated with a regional hydrogen hub will also help ensure Pennsylvania's critical role in the ongoing global energy transition. Meanwhile Japan, India, South Korea, China, and France are investing heavily in hydrogen vehicles.

Making, moving, and consuming hydrogen is currently quite expensive. Doing so with reduced or zero carbon emissions is even more costly. Depending on the type of hydrogen produced the costs can range from the equivalent of $35 to $80 per mcf.

These costs, and their negative impact on jobs must be considered when discussing the benefits of hydrogen. Particularly the benefits to reduce the use of oil as transportation fuel and to facility more efficient distributed energy resources to address the nation's ongoing electrification process.

So let me spend a few minutes discussing hydrogen, carbon capture and sequestration, and then take a few questions.

As with any new promising solution hydrogen, like renewables more broadly, have many major headwinds to overcome. Some of these are technical or matters of scale and will, over time, be addressed, others are issues of physics and will be harder to defeat. As always balance between common good, national security, and profit must be struck.

As you will see in a moment, at least in our region, natural gas will be a key component to the ongoing transition both as a hydrogen feedstock and the fuel used to create hydrogen and its attendant value chain.

Hydrogen is the most abundant element in nature and has great energy potential. However, it is an energy carrier and not an energy source itself. It is also highly reactive and so not found freely in nature. To get useable hydrogen it must be extracted from other compounds like coal, water, or natural gas. This is already done at scale globally mainly to produce hydrogen as an industrial feed stock for manufacturing.

Although hydrogen is a clean molecule itself to break it from its compound requires an energy intensive process that can produce significant emissions.

Still solutions are coming. As these challenges are resolved the hydrogen energy market is expected to grow to more than $1.0 trillion in annual revenues by 2050. (CNBC Bloomberg NEF).

Hydrogen can be produced in a number of different ways. Each way is referred to by a color. The overwhelming majority of hydrogen is produced today from fossil fuels. Brown hydrogen is made from coal in a process known as gasification. Grey hydrogen accounts for vast majority of production and is extracted from natural gas in a process known as steam methane reforming. A downside to both of these is that they emit large amounts of CO2 and are energy intensive processes.

Blue hydrogen is also made from fossil fuels but incorporates carbon capture and storage technology to greatly reduce CO2. With Blue hydrogen natural gas is both a feedstock and a fuel. It is a promising process for our region.

Another way to make hydrogen is through a process called electrolysis that uses energy to split hydrogen from water molecules. When the electrolyzer is powered with renewable energy green hydrogen is produced.

Pink Hydrogen is made by using nuclear power to break the hydrogen molecule. There are still more colors – but you get the point.

The first industry that hydrogen has the potential to transform as a power source is transportation where hydrogen can act as replacement of gasoline and diesel and holds some advantages over electric vehicles.

As I mentioned a minute ago because hydrogen is an energy carrier and not a fuel it must be converted to electricity by a fuel cell. The advantage of a hydrogen car is the possibility of zero carbon footprint – but if you have to go to the trouble of first making and then converting the hydrogen to electricity then why not just use electric battery cars. There are several considerations to this question.

On the one hand the hydrogen car will refuel in less than 5 minutes compared to 45+ mins for battery vehicles. It also has a longer range and much less weight than electric cars. Actually about 5-time better unit of energy storage per volume of weight. This could be especially important when it comes to long haul trucking and other transportation modes such as rail shipping, ocean shipping, and even long-haul air travel.

Currently there are effectively no hydrogen stations in the U.S. The systems to transport, store and dispense hydrogen is very much like gasoline but more costly as currently storing hydrogen must be done either under high pressure or at low temperatures. Many new solutions loom – some will work.

Other promising applications include using hydrogen fuel to power clean industrial production of steel, cement and other hard to abate processes. Also hydrogen base load power plants are already being established in our region. Further – as natural gas distribution systems begin to distribute hydrogen to their residential and commercial consumers regional CO2 emissions will drop dramatically as well. Global studies of hydrogen's impacts on pipelines, downstream installations, and home appliances are well underway. Reasonable regulation and education of society are important factors to consider. Labors' role in safely building, operating, and training must be included as well.

This brings us to another important point to make. A Hydrogen Hub is not so much a 1,000-acre $10 billion single investment that states compete to secure – but rather a series of distributed, yet interconnected nodes of production, transportation, storage and consumption in a regional system. There are challenges, not the least of which is the huge investment and then need for solid return on those investments before markets are in place. Also important is the cost on those already economically distressed by increasing energy prices.

Now to briefly cover carbon dioxide. CO2 is currently considered a greenhouse gas pollutant. It is a byproduct of most of all the above-described process.

Carbon dioxide is a heavy gas that can be transported as a compressed gas, liquid or even as a super critical fluid. It is a colorless, odorless and tasteless gas. Under normal conditions carbon dioxide is stable, inert and nontoxic.

The U.S. emits about 5,981 million metric tons – 2020 (EIA). The tri-state region emits about 301 million metrics tons per year (~5% of national emissions). PA emits about 44% - 132 million metric tons.

CO2 capture tech is well established with commercially available technologies in place for 90% or greater CO2 reduction from the industrial and power sectors are in place. (i.e. Amine). Direct Air Capture is being developed to remove CO2 from both the remaining stream and also from the atmosphere.

The storage part of carbon capture and storage (CCUS) most typically means injection into underground formations in a deep Class VI injection well. It can cost $2 to $4 per k/gm ($14 to $28 per mbtue) to remove CO2 from the hydrogen manufacturing process. Under the Bipartisan Infrastructure Bill ("BIL") and the Inflation Reduction Act of 2022 there are credits, that in certain situations can totally offset the costs of removing CO from the creation and movement of hydrogen. Including a federal tax credit for each ton of CO2 captured and geologically sequestered under 45Q and also under the recent Senator Manchin Inflation Reduction Act of 2022 section 57b also speaks of another $3.00 k/gm credit if scopes 1, 2 and 3 emissions are all addressed. This is a good way to jump start the removal of CO2 but eventually the markets will have to absorb these costs versus ongoing federal support.
Unfortunately, Pennsylvania does not have favorable subsurface geology to optimize significant underground storage solutions. This means that the captured CO2 will likely have to be piped to central Ohio for injection. This process has regulatory and public headwinds.

Otherwise, the expense to drive CO2 out of our energy and industrial processes will affect most those that can least afford it. However, as a counterbalance to this issue, these are the same people that are often disproportionately impacted by air pollution as well.

The opportunity facing Pennsylvania is both very tangible and also fairly urgent. Our state must move swiftly to create and legislate appropriate incentives and protection for our people and resources as we develop and encourage the production and consumption of CO2 free blue hydrogen in the Commonwealth as a way to secure our lead position in the global energy transition.

Thank you,

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June 3, 2022

Rich DiClaudio,
President and CEO
Carbon Capture and Sequestration information

What is CO2:

- Carbon dioxide is a heavy gas that can be transported as a compressed gas, liquid or even as a super critical fluid. Any CO2 put into a pipe would be effectively pure CO2 with only minor other constituents. It is a colorless, odorless and tasteless gas. Under normal conditions carbon dioxide is stable, inert and nontoxic. However, it is about 15 times heavier than air. When released it will sink to and collect in low points and can act as a simple asphyxiant when released in confined or enclosed areas. As such, it can displace breathing air and is considered hazardous. Carbon dioxide is also corrosive in the presence of water vapor.

CO2 emissions in the U.S. are:

- 5,981 million metric tons – 2020 (EIA)
    - 27% transportation
    - 25% electricity production
    - 24% industry
    - 13% residential and commercial
    - 11% Agricultural

CO2 emissions in Tri-state region (~5% of national emissions):

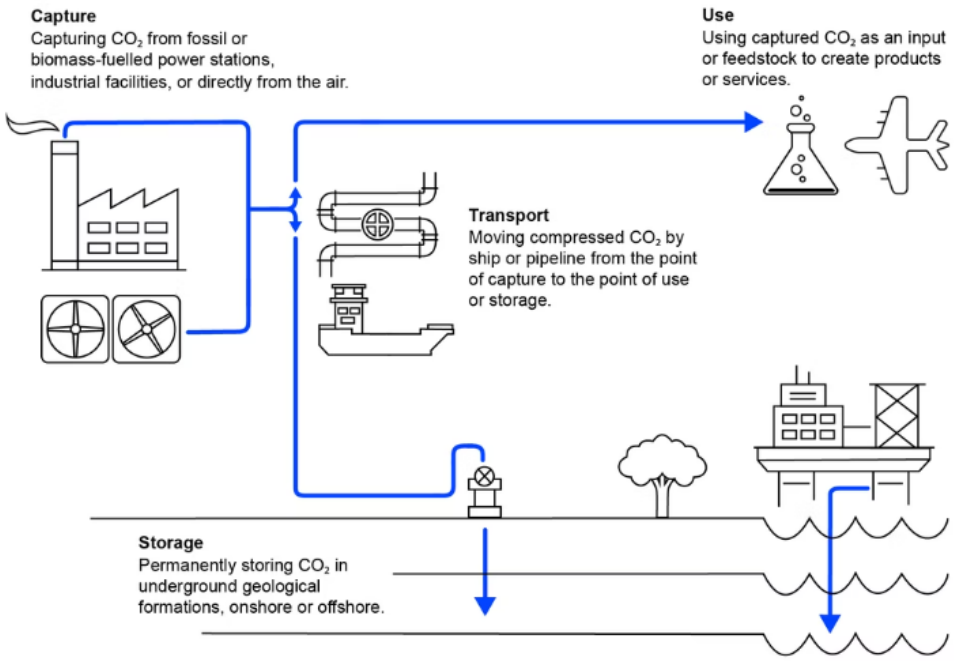
- 301 million metric tons 2019 not counting Ag (Appalachian Regional Alliance):
    - By State
        - OH – 39%
        - PA – 44%
        - WV- 17%
    - By Industry
        - 17% transportation
        - 62% electricity production
        - 12% industry

    - 8% residential and commercial
- CO2 capture tech for about 90% of emission is well established
    - Commercially available technologies for 90% or greater CO2 reduction from the industrial and power sectors. (i.e. Amine)
    - Direct Air Capture being developed to remove CO2 from both the remaining stream and also from the atmosphere.

- There is limited regulation on CO2 transmission in pipelines
    - Currently regulated:
        - Currently, the Pipeline and Hazardous Materials Safety Administration (PHMSA) regulates pipelines transporting carbon dioxide (CO2) in a supercritical fluid state under 49 C.F.R. Part 195 but does not regulate pipelines transporting CO2 in a subcritical liquid or gaseous state.
        - PHMSA has issued a NOPR to regulate CO2 in a gaseous state. The Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 (hereafter referred to as the Act) mandated that the Secretary of Transportation "prescribe minimum safety standards for the transportation of carbon dioxide by pipeline in a gaseous state." The Act also mandated that, in establishing those standards, the Secretary consider whether applying the existing minimum safety standards in Part 195 "for the transportation of carbon dioxide in a liquid state to the transportation of carbon dioxide in a gaseous state would ensure safety."
        - Several factors are driving the interest in development of CO2 pipeline infrastructure in the U.S., including:
            - To reduce the amount of greenhouse gases released to the atmosphere, Carbon Capture and Sequestration (CCS) projects are being constructed or planned. These projects involve the retrofit of equipment to sources of anthropogenic (man-made) CO2 such as natural gas and coal-fired electric power plants. The equipment would capture CO2 and transport it for use in enhanced oil recovery (EOR) projects or for sequestration in the most suitable geologic formations, most notably saline aquifers, and also including depleted wells or abandoned coal mines.

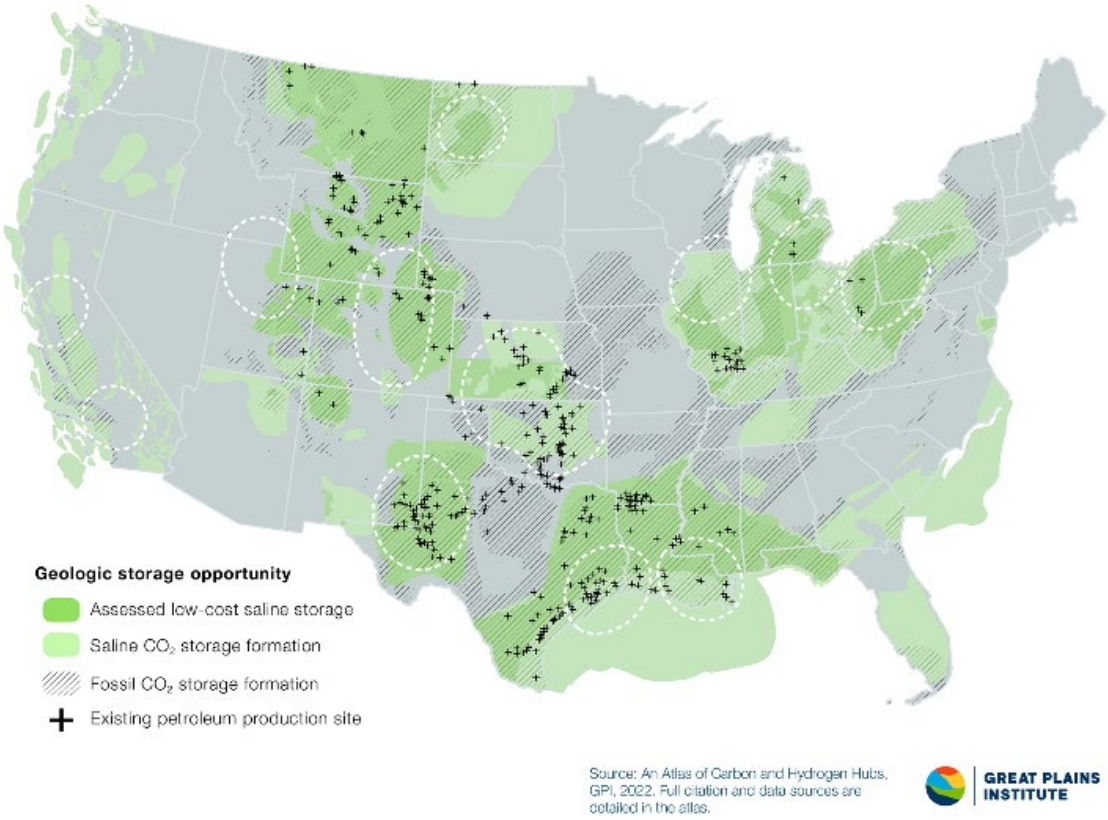
- The ongoing improvement in oil extraction technology is increasing demand for CO2 for use in EOR oil production.
- For technical and economic efficiency, PHMSA expects that most CO2 would continue to be transported in the supercritical phase, and thus would be regulated under the existing requirements of Part 195.

- The storage part of carbon capture and storage (CCUS) most typically means injection into underground formations:
  - CCUS projects may focus on:
    - Capturing CO2, compressing it, selling it, or using it for EOR.
    - Capturing CO2 and using it to make products.
    - Capturing CO2 and permanently storing it in deep underground Class VI injection wells, thereby receiving credits in return for reducing their carbon intensity.
      - A federal tax credit for each ton of CO2 captured and geologically sequestered is presently available to investors in CCS projects



- How CO2 can be permanently stored:
  - Class II wells are used to inject fluids (e.g., CO2 and brine) associated with oil and natural gas production.
    - Geologic storage of CO2 in such operations can be incidental, meaning that permanent storage of CO2 can occur in the context of injection undertaken principally for other commercial purposes.
    - The EPA estimates that more than 180,000 Class II wells are in operation across the United States and that over 2 billion gallons of fluid are injected underground each day.
  - Class VI wells are used to inject CO2 into deep geologic formations solely for the purpose of permanently storing CO2, which is often referred to as dedicated storage.
    - EPA established this well class separately from Class II to provide specific regulations for projects where the purpose is dedicated geologic storage.
    - EPA tailored Class VI program rules to address the permanent storage of CO2 and ensure that wells are appropriately sited, constructed, tested, monitored, funded, and closed once injection activities are completed.
    - There are some instances when a Class II well can be converted to a Class VI well but this is limited.

- Such injection can only happen where there is suitable Geology
  - The US Department of Energy (DOE) Carbon Storage Atlas details carbon capture and storage potential across the country.
  - GPI researchers used this DOE data to map and understand the opportunities for geologic storage associated with carbon management project deployment.
    - detailed studies are necessary to determine the suitability of subsurface conditions for CO2 sequestration



- Class VI injection well Primacy issues:
    - EPA can grant primary enforcement authority—referred to as primacy—to individual states, territories, or tribes, which delegates authority to administer certain well classes in the UIC program in accordance with federal standards. Importantly, states, territories, or tribes can be approved for this delegation of primacy only when their regulations meet or exceed the federal UIC requirements.
    - So far this is done only in two states: North Dakota and Wyoming, there are several dozen other states applying for Primacy now.

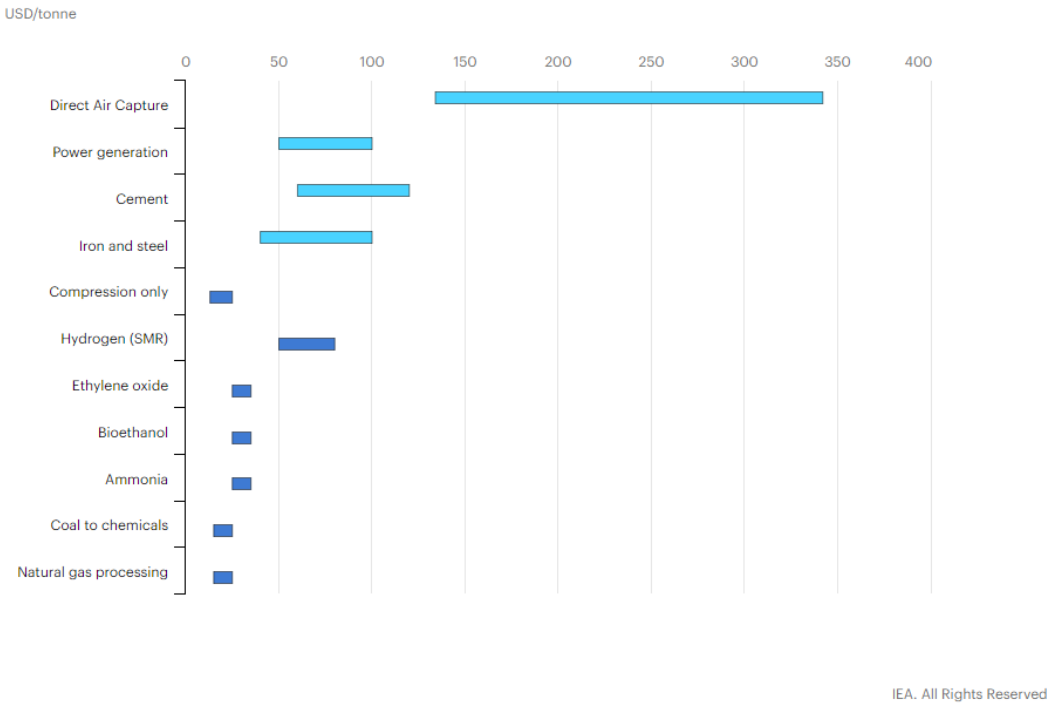
- CCUS systems currently in place:
    - Approximately 20 CCUS hubs worldwide (2021)
    - Another 30 facilities announced

Large-scale commercial CCUS projects in operation in 2020

Country	Project	Operation date	Source of CO_2	CO_2 capture capacity (Mt/year)	Primary storage type
United States (US)	Terrell natural gas plants (formerly Val Verde)	1972	Natural gas processing	0.5	EOR
US	Enid fertiliser	1982	Fertiliser production	0.7	EOR
US	Shute Creek gas processing facility	1986	Natural gas processing	7.0	EOR
Norway	Sleipner CO_2 storage project	1996	Natural gas processing	1.0	Dedicated
US/Canada	Great Plains Synfuels (Weyburn/Midale)	2000	Synthetic natural gas	3.0	EOR
Norway	Snohvit CO_2 storage project	2008	Natural gas processing	0.7	Dedicated
US	Century plant	2010	Natural gas processing	8.4	EOR
US	Air Products steam methane reformer	2013	Hydrogen production	1.0	EOR
US	Lost Cabin Gas Plant	2013	Natural gas processing	0.9	EOR
US	Coffeyville Gasification	2013	Fertiliser production	1.0	EOR
Brazil	Petrobras Santos Basin pre-salt oilfield CCS	2013	Natural gas processing	3.0	EOR
Canada	Boundary Dam CCS	2014	Power generation (coal)	1.0	EOR
Saudi Arabia	Uthmaniyah CO_2-EOR demonstration	2015	Natural gas processing	0.8	EOR
Canada	Quest	2015	Hydrogen production	1.0	Dedicated
United Arab Emirates	Abu Dhabi CCS	2016	Iron and steel production	0.8	EOR
US	Petra Nova	2017	Power generation (coal)	1.4	EOR
US	Illinois Industrial	2017	Ethanol production	1.0	Dedicated
China	Jilin oilfield CO_2-EOR	2018	Natural gas processing	0.6	EOR
Australia	Gorgon Carbon Dioxide Injection	2019	Natural gas processing	3.4-4.0	Dedicated
Canada	Alberta Carbon Trunk Line (ACTL) with Agrium CO_2 stream	2020	Fertiliser production	0.3-0.6	EOR
Canada	ACTL with North West Sturgeon Refinery CO_2 stream	2020	Hydrogen production	1.2-1.4	EOR

Note: Large-scale is defined as involving the capture of at least 0.8 Mt/year of CO2 for a coal-based power plant and 0.4 Mt/year for other emissions-intensive industrial facilities (including natural gas-based power generation). Source: GCCSI (2019), The Global Status of CCS 2019: Targeting Climate Change.

- Cost of large scale CCUS facilities – can vary widely
    - Capture Costs
        - $15 to $25 per/ton CO2 for highly concentrated industrial streams
        - $40 to $120 per/ton CO2 processed/diluted gas streams
        - Direct Air Capture (DAC) is even more expensive currently
    - Transport and Storage Costs
        - $2 to $14 per ton CO2
    - Total could be approximately $110 per/ton for CO2 or $110 million per year of extra costs per 1 million ton of CO2 captured and storage.



- What price would CCUS need to fetch to justify investment?
  - This is a developing issue, and the lead companies are closely guarding this information
  - CCUS can be less costly than other abatement approaches
    - The utilization aspect of CCUS is appealing since it decouples carbon capture from suitable geologic conditions. However, presently and for the foreseeable future the only profitable use case is using pressurized carbon dioxide to pump more oil out of aging oil fields (EOR)
    - The vast majority of that captured carbon dioxide is then sold to oil companies, which pump the gas into oil reservoirs to squeeze more petroleum out of the ground. The carbon dioxide stays underground permanently.

- How many tons of CO2 would a storage hub take?
  - To even begin to justify the investment a CCUS facility needs to be large scale (able to inject million tons per year at minimum)
  - The 30 projects in current planning stage would represent about $27 Billion of investment in total.

- Cost to drill a large scale (1.0 million tons CO2) class VI well
  - Depends heavily on geology but a good rule of thumb is $4 to $6 million
    - Actual costs depend on subsurface geology
  - It appears that a single injection well with favorable geology could handle in the range of 1.0 million tons per year of CO2
    - That geology is definitely in place in Gulf Coast region
    - Geology in Appalachia is less favorable so more than 1 well would be needed for same volume of CO2

- Why invest in CCUS today with so much uncertainty around the costs/economics
  - Two likely reasons:
    - A Company is an emitter and in a state that requires compliance - REGGI
    - OR an investor believes it could be an attractive investment
      - Q45 and Low Carbon Fuel Standards (LCFS) are critical to those expected economics
      - Expected premium for their zero carbon product in the near future is also part of the calculus of such investments
    - Or both of course

- CCUS can be a platform for low-carbon Hydrogen (H2) production
  - Hydrogen is a versatile energy carrier that can support the decarbonization of a range of sectors, including transport, industry, power and buildings (IEA, 2019a).
  - CCUS can facilitate the production of clean hydrogen particularly from natural gas, which is practically all hydrogen production today, and provide an opportunity to bring low-carbon hydrogen into new markets in the near term at least cost.
  - Today, the cost of CCUS-equipped hydrogen production can be around half that of producing hydrogen through electrolysis powered by renewables-based electricity (which splits water into hydrogen and oxygen).
  - The costs of electrolytized hydrogen will certainly decline over time, with cheaper electrolysers and renewable electricity, but CCUS-equipped hydrogen will most likely remain a competitive option in regions with low-cost fossil fuels and CO2 storage resources.

- CCUS also offers an opportunity to address emissions from existing hydrogen production that almost exclusively relies on natural gas and is associated with more than 800 MtCO2 each year.
- Today hydrogen is still too costly to displace natural gas in industrial and power applications, but hydrogen used for industrial processes such as the production of ammonia (fertilizer) can be decarbonized using CCS at costs that could be substantially covered by the federal tax credit and environmental attributes

FOR MORE INFORMATION PLEASE CONTACT

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Justice 40
a National Model for Rational Critical Infrastructure Solutions

Executive Summary: One of the United States' greatest strengths has been its leadership in energy resources, rigorous infrastructure, and our highly skilled and motived workforce. In this area, the Commonwealth of Pennsylvania has stood out not only as a national leader but also as a global leader of the energy and infrastructure industries since their inception 175 years ago in Titusville, PA near Pittsburgh.

Today, as the energy industry continues to transition to cleaner, more sustainable fuel sources and our infrastructure industries struggle to maintain and upgrade assets while also rebuilding a safe, diverse, and highly skilled and engaged workforce, the U.S. government has rolled out guidelines designed to support these needs under the title of Justice 40. What this program means is that all federal contracts and grant recipients or counterparties must work to achieve the goal of 40 percent of the overall benefits of federal investments flow to disadvantaged communities ("DACs") that are marginalized, underserved, and overburdened by the costs of energy transition and aging infrastructure.

At the Energy Innovation Center Institute, Inc. (a 501c3 organization) we don't see this as another affirmative action or philanthropic plan, but rather as good idea and as good business. We believe by providing innovative and stacked credentialed recruiting, vetting and training programming, we can help employers meet on of their most demanding needs: the need for well qualified human capital. This will have the added benefit of raising up DACs to help them move solidly into the middle class. Furthermore, our own mission to help energy transition applications benefit DACs with cleaner, safer, and cheaper energy sources will help build national models of innovative solutions.

The Energy Innovation Center institute, Inc. established more than 6 years ago, has this principle encoded into its own DNA. Our work is a combination of minority focused workforce development for the infrastructure and regulated utility industries, together with our mission to advance commercial applications of cost-effective energy transition technology with a focus in of helping Disadvantaged Communities. We have been building, first locally, now regionally, and soon a national model that would allow the EICI to be an innovative Justice 40 solutions provider to those looking to transact with the U.S government under these new mandates. The EICI's win-win formula will provide a national model to help our country develop the skilled and diverse workforce needed to rebuild and manage our aging infrastructure and transforming energy industry in ways that break cycles of poverty and

safeguard our national security and global leadership in these industries that are so foundational to our thriving economy.

The Energy Innovation Center Institute, Inc. ™ ("EICI") is a 501(c)3 organization created to help solve the world's most intractable problems by advancing equitable and carbon free resiliency for humans and energy systems. Our focus includes innovative workforce development programming and fostering commercialization of zero carbon energy technologies and systems through advances in energy transition activities with a focus on Disadvantaged Communities ("DACs").

Additionally, the EICI was created to develop and help direct the mission aligned programing and national convening authority of the ecosystem of the Energy Innovation Center ("EIC"), a 200,000 square foot innovation hub located in Pittsburgh's Hill District, an Opportunity Zone DAC community. Capitalized with over $100 million to date, the EIC currently has 23 tenants comprised of not-for-profit, for-profit, universities, and NGOs, mostly focused on various aspects of EICI's own mission. Through the EICI, the hub has established a nationally recognized convening authority on clean energy transition and innovative minority focused workforce development topics with an impact focus on DACs. To date we have hosted over 21,000 people from around the world at many mission-driven summits and conferences (see below for more information on the Energy Innovation Center hub). Most recently the EICI hosted the tristate region H2 Hub Summit attended by 104 energy industry CEOs from around the country, and later this fall will host the Mid-Atlantic Conference of Regulatory Utilities Commissioners (MACRUC) during which we will present on several Justice40 topics.

The EICI's predominate activities center around innovative and equitable workforce development with a focus on economically distressed minority communities (DACs). We connect the stranded talent in these communities to the prosperity and good jobs around then but from which they are often excluded. This allows us to simultaneously support our employer partners need for well qualified and diverse workforce and upskilling.

Established 6 years ago, the EICI has grown to become one of Pennsylvania's largest and most effective post-secondary workforce development training and upskilling organizations. We work directly with regional employers to design and run programs that recruit, vet, train, onboard and support new minority employees at meaningful volumes (none of our training is spec – all cohorts are designed to graduate students to fill open positions of our employer partners). Our unique approach to workforce programing has been designed to scale into a national model, currently in progress, and fits well into the developing Justice 40 parameters of the U.S. Federal Government and the 52 Pa. Code §§ 69.801-809 of the PA PUC.

To date 2,608 of our graduates have been employed with the following Key Performance Indicators (KPI's):

- 91% People of Color
- 92% below the 2-times U.S. poverty level
- 28.6 years - average age of our graduates
- 86% graduation rate
- 84% employment rate with as much as 74% six-month retention rates
    - Our programs have helped reduce employer partner turnover rates from 57% to 12%
- $47.8 million aggregate compensation of our graduates since 2016
- All training is free to our students and most classes offer either hourly or small daily stipend pay to help offset the cost of living while training
    - These costs are paid for by our employer partners as the EICI has demonstrated that the cost/benefit of underwriting these expenses is measurable and positive. Also, under many state utility regulations some or all of these costs can be covered under rate cases
- All cohorts are sized to graduate qualified students for open positions of our employer partners
- We deploy effective multimodal pedagogies in our programming including AR/XR training, gaming, instructor lead, computer-based training, and simulation training
- Under current contracts the EICI recruits, vets, trains, and helps place over 875 people per year with a heavy focus on minorities, veterans, and others with meaningful barriers to workforce entry. Current offerings include training curriculums in eight different 70-to-120-hour programs:
    - Energy, Utilities, Healthcare, Banking, Building Facilities Management
    - All jobs are full-time, full benefits, defined career ladders, and opportunities for over-time. Most offer participation in labors unions as well.
    - Starting full compensation range from $43,000 to $85,000 per year
- Offered across all our trainings, the EICI's successful Training for Human Thriving ™ success skills programing is designed to help minorities integrate effectively into workforces that don't otherwise have significant current minority participation
- The EICI is a certified registered apprenticeship organization under the PA Department of L&I
    - 174 registered apprentices approved in 2021, 83 to date in 2022
- The EICI is also Federal SNAP qualified trainer
- We have also trained/upskilled over 1,820 people in our incumbent worker training programs
- The EICI is a radically collaborative organization that has developed national relationships with many mission aligned organization including recruiting relationships with over 300 community partners in western PA.
    - We are rapidly expanding our workforce development programming to support economically distressed minority communities in Ohio, West Virginia and more broadly in our region
    - Although created well before Justice40 and similar initiatives were established, the EICI tracks well with its objectives and layered collaborative approach to solutions

- Much of the teaching occurs at the EICI training and rapid prototyping facilities, however the plan was always to distribute the program around the region and nation under its Infrastructure Academy™ initiative (see below for more info) under which the EICI has begun the process of spinning up the first of many expected training facilities.
    - The first is in the DAC of Pittsburgh's Mon Valley region
    - More are expected to follow once additional funding is secured
- The EICI and its partners have invested more than $710,000.00 developing the Infrastructure Academy™ program including investing its own capital and grant and commercial support from Peoples Natural Gas, PA Department of Education, ARC, Bank of America, and others

The Infrastructure Academy ™

As part of its innovative model, in 2019 the EICI created the Energy Innovation Center Infrastructure Academy™ (the "Infrastructure Academy", "IA or "EICIA") as an initiative to address the need to both diversify and upskill the regulated utility and broader infrastructure industries' workforce while also providing practical solutions to help address the need to support low cost and clean energy technology and systems in DACs, increase clean energy jobs, job pipeline, and job training for individuals from DACs, and to help reduce energy costs, increase energy resiliency, and address issues related to environmental burdens in DACs through innovative scope 3 emission reduction concepts.

Our workforce programming can be designed to go deep into required competencies and skill levels or provide more high-level day one apprentice ready capabilities based on the employer's needs. IA is also designed to assist natural gas, electric and water utilities in evaluating and enhancing Operator Qualification programs through risk management and safety culture planning for its incumbent workers as well. Additionally, all trainings utilize our Training for Human Thriving ™ curriculum, an innovative success skills curriculum that incorporates pedagogy to help minorities integrate successfully into workforces that are not otherwise well integrated.

Further, since part of the EICI/IA mission is to help advance the science, policy, and commercial application of zero carbon energy transition technologies and solutions, the IA has begun collaborating with established curriculum organizations and the National Safety Council to develop new training curriculums and deliver pedagogies for microgrids, DER, hydrogen, fuel cells, battery storage, carbon capture, transportation and storage solutions. This training will apply to both new and incumbent workers as well as contract workers. We have recently begun preliminary work with a large national group to plan a national roll out of IA programs over the next 2 years.

Moreover, both the EICI and IA are in advanced discussions to partner with a national leader in design, scope, development, and operations of DER assets with a heavy focus on EV charging infrastructure. This group is one of the nation's leading advanced manufacturers of "plug and play" hardware and

software systems for DERs, microgrids and EV charging infrastructure of all sizes and scopes as well as Flow Batteries and drop and play remote EV charging units for construction and hard to reach infrastructure developments. These relationships will continue to allow the EICIA to lead the nation with its innovative approach and offer a broad range of trainings suitable to address new skills needed for the ongoing clean energy transition. As such, IA can be a formal and effective Environmental, Social and Governance ("ESG") solution for regulated utilities, and other companies both in helping to effectively diversify workforces, advising on scopes 1, 2, and 3 emission reduction strategies, as well as broader clean energy transition tactics.

We believe these programming metrics allow the EICI to become a national solution for both regulated utilities and other critical infrastructure companies looking to aligned and comply with the U.S. Federal Government and the U.S. DOE's Justice 40 parameters. Additionally, the Infrastructure Academy has also been designed as a ready solution for regulated utilities looking to comply with Pennsylvania Public Utility Commission's recently enacted regulation requiring diversity outcomes and reporting (see - 52 Pa. Code §§ 69.801-809 set forth the goal of maintaining a diverse workforce and supply chain and include recommendations for the voluntary filing of diversity information by major jurisdictional utilities.)

Due to these and other growing affiliations, the EICIA is well positioned to help infrastructure companies in states pursuing Non-Wire Alternative ("NWA") policies - which include microgrids and other distributed energy resources that can help save money by avoiding construction of expensive new distribution systems or upgrades. Because non-wires alternatives are generally local, clean energy, they can also be more environmentally friendly and allow DACs to have access to clean more reliable and resiliency local energy. Currently NWA policies are place in Arizona, Maine, Massachusetts, New York, and Rhode Island, and are in the process of being adopted in Connecticut under their utility distribution system planning (17-12-03RE07). California is also considering NWA policies as well.

Energy Innovation Center ("EIC") Located in an Opportunity Zone DAC, the hub has been developed by Pittsburgh Gateways, Inc. (a 501(c)3 organization and capitalized with over $100 million to date, with about 65% of its 6 acres development completed. The center itself is a leader in green adaptive reuse of established large-scale commercial buildings and is widely considered one of the top global examples of how-to profitability bring old building stock into current clean energy standards. With its own dedicated CHP, solar and wind DER assets Siemens and other mechanical systems companies deploy the most advance building and data integrations systems at the EIC. The design of its building and grounds meets the highest standards of sustainability and energy efficiency, while preserving the historical character of the building.

Through an integrated design-build process, EIC designers and engineers innovated to optimize the performance of vendor components making the center a global leader on data capture and AI uses for managing energy consumption in large buildings. Also, with its listing on the National Register of

Historic Places and the Pittsburgh History and Landmarks Foundation Historic Landmarks, the EIC is perhaps the only LEED Platinum designed structure to qualify for Historic Tax Credits in the U.S.

As mentioned above, the EIC has a substantial and growing ecosystem of for-profit, not-for profit, universities, and NGO organizations. Of particular note and in formal relationships with the EICI are Exus Management Partners that develops and operates a growing international fleet over 21 GW of industrial solar and wind from the center and the Bedford Group focused on investing and developing sustainable low carbon energy and food infrastructure assets nationally. Also of note are University of Pittsburgh ("Pitt") labs at the EIC innovatively designed to advance the modernization of electric power grids, battery technologies, and high temperature materials. As a part of the Pitt Center for Energy, the Electric Power Initiative's at the EIC includes a 5,100 ft2 medium voltage power systems laboratory. Energized up to 13.8 kV designed to be rapidly reconfigurable to match immensely varied grid configurations and conditions, from traditional radial feeder systems to novel microgrid designs. Within it, the capability exists to perform AC or DC system technology development, test equipment as an independent third party, and enable power electronic design, rapid prototyping, and testing at the highest level. with aligned missions around several parameters and policy priorities of the Justice40 initiative of the U.S. Government.

For more information on the Energy Innovation Center Institute, its Infrastructure Academy initiative or the Energy Innovation Center hub please don't hesitate to contact us:

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