ENERGY **WORKFORCE** & **TECHNOLOGY** COUNCIL

January 14, 2022

Dr. Geraldine Richmond
Under Secretary of Science and Energy
U.S. Department of Energy
Docket ID No. DOE-HQ-2021-0020
1000 Independence Ave SW
Washington, DC 20585

RE: U.S. Department of Energy (DOE) Notice Titled "Request for Information (RFI) on Energy Sector Supply Chain Review," Docket ID No. DOE-HQ-2021-0020, 86 Fed. Reg. 67695 (November 29, 2021)

Dear Under Secretary Richmond,

On behalf of the 450 companies employing over 650,000 energy workers, manufacturers and innovators represented by the Energy Workforce & Technology Council we respectfully submit comments in response to the Department of Energy (DOE) "Request for Information (RFI) on Energy Sector Supply Chain Review."

Energy Workforce & Technology Council (EWTC) Member Companies are at the forefront of meeting global energy demand through the development of technologies and processes to make the energy supply chain cleaner and more efficient. Carbon Capture Utilization and Storage (CCUS) and wind energy are just some of the ways Energy Workforce Member Companies are innovating and adapting to lead the way in the energy transition. The development of these complex technologies requires a diverse set of components, often times necessitating the use of certain products and raw materials that can only be sourced through specific providers. A strong energy sector industrial base is vital to the advancement of emerging clean energy technologies; however the intricacies of many clean energy technologies should be considered when developing energy supply chain policy. Attempts to decarbonize every aspect of the supply chain too quickly may threaten the implementation and scaling of major clean energy technologies in their final stages of development. A robust energy supply chain simplifies the procurement of components needed to bring these technologies to market to support net zero emissions goals.

Area 1: Crosscutting Topics Relating to the Energy Sector Industrial Base

- U.S. has the engineering capabilities and talent, but we are short on manufacturing. Historically (for past 50+ years), the industry has been challenged by the fact that key components for equipment – such as hydraulic components – are primarily built in Europe (mainly Germany).
- As we transition to newer energy-efficient technologies, there is insufficient manufacturing capacity in the US for technical components of these new technologies.
- For example, EWTC Member Company Solaris Oilfield Infrastructure has designed, built, and patented a revolutionary electric frac blender unlike any other design currently used in the industry. However, the

electric motors needed for this technology have to be imported from Finland. The top drives have to be sourced from Canada, and other technical components are only manufactured in Germany or Italy.

- The overall impact is long lead times (12-20 weeks) for components. Longer lead times result in slower production schedules, which can stall or even inhibit adoption of newer, energy-efficient technologies.
- Incentives for companies to bring certain manufacturing of technical components to the U.S. would be welcome. While U.S. manufacturing likely comes at higher labor costs, it could be offset thru near-term incentive-based programs and longer-term international trade deals where we can export.

Area 3: Wind Energy Technology

1. What are the current and future supply chain vulnerabilities as we scale up the adoption and use of wind energy technologies? Of these vulnerabilities, which are the most crucial for the U.S. to address and focus on and why?

Constraints with shipyards, steel availability, labor for building vessels, foundations, towers, blades, nacelles. Additional constraints include access to rare earth metals – critical to these technologies. This may be facilitated with more ocean mineral extraction.

We recommend a balance between cost and local content. For example, Europe has enjoyed government support in setting up supply chain, both onshore and offshore for years, and the U.S. manufacturing base will be climbing a hill to catch up. Manufacturing tax credits should be available for all wind-related manufacturing in the U.S., especially cranes and vessels. Key areas that can benefit are floating and fixed offshore foundation manufacturing, transportation and installation vessels, equipment such as cranes, and offshore energy storage.

2. Where in the wind energy technology supply chain does it make sense for the U.S. to focus and prioritize its efforts both in the short-term and the long-term, and why? Where in the supply chain do you see opportunities for the U.S to build domestic capabilities of wind energy technology manufacturing? What areas of the supply chain should the U.S. not prioritize for attraction or expansion of domestic manufacturing capabilities, and why? For areas in the supply chain where U.S. opportunities to build domestic manufacturing capabilities are limited, which foreign countries or regions should the U.S. government prioritize for engagement to strengthen/build reliable partnerships, and what actions should the government take to help ensure resilience in these areas of the supply chain?

In the short term, the U.S. should focus on domestic capabilities: Installation vessels fall under the Jones Act and there is a limited fleet available in U.S. therefore this needs to be a short-term focus with domestic manufacturing. Nacelles, large installation cranes, towers, and blades should be the focus for local manufacturing.
Long term it would be cost effective and practical to import sub-structures of foundation from Asia or Mexico for floating wind, and then complete assembly and commissioning of high value items in U.S.
Additionally, we would recommend partnerships with the EU, especially for U.S.-based companies that have affiliates in EU that are leading land or offshore wind development.

3. What challenges limit the U.S.'s ability to realize these opportunities to attract or expand land-based or offshore wind energy technology manufacturing in the U.S.? What conditions are needed to help incentivize companies involved in the wind energy technology supply chains to both attract and expand wind energy technology manufacturing in the U.S.?

Limiting challenges:
- Port and shipyard capabilities
- Non-existing fleet for installation of offshore wind turbines that continue to increase in size.
- Energy storage and grid integration.
- Higher hub heights for land wind projects.

Conditions to incentivize:
- Pipeline of contracted projects is needed to justify investment in the supply chain, but a supply chain is needed to enable projects
- Finance construction of ITC (already approved for wind farms) to be extended to vessels.
- Grants and RD&D funding for innovation in energy storage beyond batteries, for example offshore volumetric mega scale storage.

4. How can the federal government help the private sector and interested communities attract and expand land-based or offshore wind energy technology manufacturing in U.S.? What investment and policy actions are needed to support domestic manufacturing of wind energy technologies?

- Port facilities and other infrastructure (see Point 7c for more details)
- Approve pipeline of projects with committed financing and regulatory certainty on leases.
- US content and Manufacturing tax credit on capital equipment such as cranes and towers.

5. In implementing policy to support expansion of the domestic wind energy technology supply chain, how should the federal government prioritize tier 1 (major components such as nacelles, blades, towers, or offshore foundations) and lower-tier (other components, subcomponents, raw and processed material inputs) manufacturing? Do you agree with this tiering? If not, why?

Yes, EWTC agrees. We also highly recommend including offshore vessels and cranes (both onshore and offshore) in Tier 1.

6. What specific skills are needed for the workforce to support wind (onshore and offshore) energy technology manufacturing supply chains? Of those skills, which ones are lacking in current education/training programs? What resources (including time) and structures would be needed to train the wind energy workforce? What worker groups, secondary education facilities, and other stakeholders could be valuable partners in these training activities? What new education programs should be included (developed?) to prepare the workforce?

Existing Skills: engineering, project management, marine operations, safety, logistics, digital technologies. Basic skills exist within the oil and gas industry and need minor repurposing to support wind projects (offshore or land). EWTC companies like NOV and others have been pioneers and technical leaders in this area. The EWTC and its members would be happy to support community colleges and engineering universities in education and upskilling endeavors.

7. How can the federal government most effectively expand and improve logistics networks for large wind energy technology components, both land-based and offshore? For land-based wind energy technology, how could the federal government ease transportation of large components across jurisdictions (e.g., R&D to modularize components, funding for permit harmonization, funding for specific infrastructure improvements to allow for greater throughput and/or movement of larger components)? For offshore wind energy technology, how can the federal government best support the development of Jones Act-compliant vessels and necessary port infrastructure?

For land wind projects, component size is always a critical factor. Supporting technologies that will reduce logistics (mobile manufacturing, for example), will significantly ease the logistical challenge with moving towers, blades, etc. Streamlining permits for movements across jurisdictions would likely be a large value add.

Many different countries planning offshore wind projects on a similar timescale requiring the same support vessels, including installation vessels that take time to design and build. This is further complicated with the ever-increasing size of turbines. EWTC recommendations are:

- A pipeline of contracted projects is needed to justify investment in the supply chain, but a supply chain is needed to enable projects.
- Financing construction of ITC (already approved for wind farms) should be extended to vessels.
- Include Tier 1 O&G suppliers (especially those based out of US) in port re-engineering efforts (such as those in NC, NY, NJ, ME, CA, DE) for offshore wind energy.

8. How can the federal government most effectively support increasing circularity (collection and reuse, remanufacturing or refurbishing, and recycling) in wind energy technologies and supply chains, especially for rare-earth element magnets and hard-to-recycle components such as blades?

- Opportunities with vessel reuse from oil and gas to offshore wind can be incentivized for economic benefits and carbon footprint reduction.
- Research dollars to support repurposing of ground up blades (limited use to date in the U.S. – primarily as an additive in cement.

9. What other input should the federal government be aware of to support a resilient supply chain of this technology?

- EWTC would support a DOE loan program to facilitate U.S. based consortia for Floating Wind. LPO to entertain a utility scale Floating Offshore Wind Proposal from consortia including US-based utilities, developers, Tier 1 suppliers, shipyards. Extend to specific site challenges and opportunities such as Gulf of Mexico. Such incentives were created for EU-based companies who now have a head start of 20 years or so and are leveraging it in US market.
- Perform installation solutions suitability study for given site with respect to water depth, port infrastructure, pipeline of projects and resulting requirements/ constraints for installation. For example, NYSERDA study performed in 2017 by NOV. Extend scope of these studies to the overall East Coast OW ambitions and installations requirements.

Area 12: Carbon Capture, Storage, and Transportation Materials

1. What are the crucial materials and potential substitutes?

- Regarding oil country tubular goods (OCTG) – critical problems can be those related with corrosion (because of CO2-containing impurities) in those areas were water (from reservoir or because of condensation) can appear. Because of low temperatures generally expected on this injection wells, toughness is also something to be looked at. We see this industry looking into high chloroprene rubber (CR) materials such as Duplex and Super Duplex (ex.: our VM 25S 80) for most critical strings. In other less critical applications, Super13CR (ex. VM 85 13CRSS) can be assessed case by case, or we even see some operators looking into traditional carbon steel + coatings (e.g. epoxys like FBE / GRE or metal coatings). Aside from materials, the need to have qualification testing on mechanical connections will be key to validating that they can handle the extreme temperature differentials underload and potential shut-in as well as the coatings that may be applied. Additionally, attention should be paid to some coatings that could change the operating and running behavior of some mechanical connections.

- For CCUS transport lines, we can see that internal corrosion, HIC, brittle fractures, and RDF drive the need to perform research to deepen our understanding on the impact of impurities on free water drop-out, hydrate/acid formation, corrosion rates, HIC performance at very low pH and with traces of H2S, saturation pressure during CO2 decompression in case of failure/rupture and the related leakage, which drives running ductile fracture etc. in Carbon API 5L steel grade pipe. Reinforced thermoplastic pipes and/or thermoplastic coatings could serve as a viable alternative to CRA cladded pipes. Here as well there are plentiful research & development opportunities to qualify reinforced thermoplastic pipe, and enhance coating and/or liner material to address mechanical integrity and stability).

- Safe design to prevent running ductile fracture (RDF) is another topic that is gaining attention, since the full-scale burst test database underlying Battelle Two-Curve Method has been generated using natural gas as fluid. Additional correction factors need to be applied to the TCM (as implemented in ISO 27913 and DNV-RP-F104) when applied to dense phase CO2 transportation pipelines. Further research using full-scale tests and advanced fracture mechanical approaches may be useful in future.

2. What is the global capacity for the products noted in point 1?

Materials are generally available but as they get higher in grade (>70 or >Super 13Cr) the cost and lead-times could get significant. Most recent information available from Rystad (December 2021) indicates that availability may tighten as demand from 2022-2025 remains constant or grows. Forecasts indicate that demand for Nickle and Duplex grades will grow from 30kt to 40kt from 2022 to 2025 while supply remains relatively stable at ~30kt with the majority of the market controlled by one player. In terms of martensitic steel (13CR to 17CR), we see that this market is more flat in the same period with a better distribution of supply (~90% held by 4 suppliers). There have been additional investments in RTP capacity over the past few years.

3. For utilization, what is the availability of catalysts and amines?

Regarding amines:
For carbon capture amines are currently the most mature and most promising technology that can capture large volumes of CO_2 required to battle climate change.

a) Commercial aspects and Competition

- There are few major suppliers of amine technologies (MHI, Fluor, Linde BASF and Aker).
- There are various SMEs are focusing on developing new amines/process configurations but they need to build track record and enhance their scalability (RTI, ION etc.)
- We need more competition, more amine verities, close attention to reducing the environmental footprint of amines e.g. their atmospheric emission, more process intensification and more vibrant market. Currently the capture market for amines is very tight, there is lack of trust to share information and the options are limited for tackling the massive CO_2 capture volumes needed.

b) Technical Challenges / Areas of R&D and Innovation: We need to build long-lasting, sustainable capture plants. Closing the deep knowledge gaps on material integrity issues is key.

c) Amine processes have a long history in oil and gas applications with a wealth of accumulated experience in material selection. Often analogies are made between amine processes in natural gas processing and CO_2 capture from industrial flue gases. Yet, capture processes present specific aspects that must be considered in material performance and selection.

d) Flue gases from combustion processes often contain high O_2 concentrations. Oxygen not only corrodes metals through oxidative corrosion but can degrade amines through oxidative degradation mechanisms. Degraded amines can be a cocktail of non-volatile organic compounds, heat-stable salts and sometimes suspended solids. Degradation products can in turn increase the corrosivity of the aqueous amine solution. High levels of oxygen and presence of impurities can have detrimental effects on the metallurgy of the amine plants for CO_2 capture.

In commercial scale CO_2 capture plants, such equipment failure must be prevented by stringent solvent management regimes and close monitoring of metal content in the amine solvents. Solvent analysis for degradation products and metal contents is costly but it should not be skipped. The consequence of undermining solvent hygiene is not only deterioration of capture performance but irreversible damages to the plant integrity and increased costs.

There is currently not sufficient data and understanding of interrelations between amine hygiene and material selection for capture plants. This needs increased focus on material of construction which are cost-efficient, resistant and sustainable.

For catalysts:

- A major attention area for CO2 utilization is catalyst development.
- There are a number of CO2 utilization companies with catalyst technologies (main proprietary aspect of their techs) that are still nascent (SeeO2 Energy, Twelve, Cemvita Laboratory, etc.)
- There is great room/need for investing in R&D to develop efficient catalysts and also provide the innovative technology developers sufficient opportunities to demonstrate their concepts on industrially captured CO2 streams
- Currently we certainly do not have a sufficient and vibrant market for catalysts.

4. What are the transport coating and lead-times?

CRA cladding and thermoplastic are options with lead times not more than 3-6 months from time of order.

6. What are the weaknesses for the CCUS ramp-up in the US and what should the DoE address first?

EWTC and its membership would recommend DOE should focus on:

- Material characterization modeling as well as testing on lower cost, “good enough” options such as coatings. Some of these topics will require a mix of time, money, and technology to achieve so time is of the essence.
- Downhole monitoring to prove that the sequestered CO2 is verifiably stored in the target reservoir.
- Acceleration of the carbon economy from tax / credit policy, to offtake infrastructure (both physical and commercial), and utilization opportunities leading to other products (CH4, O2, O3, industrial chemicals, and jet fuel to name a few).

7. What capture, conversion, transport, and storage materials that DoE should prioritize now?

Removing complexity and standardizing as much as possible in terms of geometry will help us develop solutions. Member Companies such as Vallourec as a steel, connection, welding, and services company have a clear grasp on those topics but would like to work collaboratively with all levels of the market (e.g. Government, End-Users, Service Providers, etc.) towards standardization.

8. What skills, training, etc. is needed from workforce to support this initiative?

The traditional oil and gas market has many of the skills needed to keep pushing this important topic, including the companies represented by the EWTC. Governmental, Industry, and Services will also need to adapt and educate so that the bright minds of the future continue to work in the energy sectors. Without proper outreach we could find that some needed skillsets, knowledge bases, and experience will exit and never return if some sectors are stigmatized. We encourage the Department and the Biden Administration to adopt policies that recognize that energy (in most of its forms) are necessary to keep the economy growing. We also have the chance to show the world that the US can help lead by creating the technology that can deliver clean, sustainable energy to OECD and non-OECD populations.

Energy Workforce & Technology Council companies stand ready to meet the shared goal of a clean energy future. We urge you to consider these important factors as you continue your analysis and development of energy supply chain policy.

Sincerely,

Tim Tarpley
Senior Vice President Government Affairs
The Energy Workforce & Technology Council