COMMITTEE ON ENERGY AND COMMERCE: SUB-COMMITTEE ON ENVIRONMENT AND CLIMATE CHANGE (116TH CONGRESS)
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HEARING ON: BUILDING A 100 PERCENT CLEAN ECONOMY: PATHWAYS TO NET ZERO INDUSTRIAL EMISSIONS

RESPONSES TO FOLLOW-UP QUESTIONS: SUBMITTED ON OCTOBER 30, 2019

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The Honorable Paul Tonko (D-NY)

1. What recommendations do you have for NIST, in consultation with DOE, EPA, or other federal agencies, to develop industrial product performance standards to encourage greater use of low-emissions products?

RESPONSE: In general, it is critically important that low-carbon products are not perceived as a compromise compared to traditional / equivalent / similar products that are available today. Thus, low-carbon products must meet or exceed the (engineering, functional) performance requirements of current products – which are assessed/evaluated using industry accepted protocols – while offering a greatly reduced embodied carbon intensity (eCI); i.e., the carbon emissions that result from raw materials extraction and manufacturing operations. This promotes a basis of functional replacement, i.e., to create "drop in" low-carbon alternatives for existing products. It is herein critically necessary that federal agencies, e.g., NIST and others, develop robust methods for measuring, analyzing and quantifying the eCI of manufactured materials and products; across their entire lifecycle. While this includes the curation and creation of a more robust, and flexible basis for lifecycle analysis (LCA); it also demands innovation and technical improvements to develop a unified and authentic basis by which LCA assessments can be carried out, realistically, without ambiguity, and transparently for processes and materials which are both produced at scale today; and which will be in time to come. This nature of assessment would augment current industrial performance standards that are in place today; that traditionally only consider assessments of the engineering properties or functional attributes of products and materials.

Furthermore, special focus should be paid to understand the contributions and distributions of carbon intensity (CI), and how it accumulates across the different steps ranging from raw materials extraction and manufacturing ("embodied carbon intensity"), to the time a material or product is placed in use ("operational carbon intensity: oCI"). Such information is needed not simply to rank and order materials and products in terms of their CI; but also to chart specific and influential innovations that are needed to reduce the CI of a material or a product as compared to the status quo. Importantly, tabulated metrics of eCI and oCI offer a basis for strategic procurement actions codified by government agencies across all levels (federal, state, city, and so on) wherein the selection and use of materials and products in publicly funded projects is established not simply on the basis of lowest cost, but also the lowest carbon

intensity (e.g., California's Buy Clean Act) – thereby promoting, and creating market-pull in support of low-carbon materials, products and processes.

Moreover, it is important that agencies such as NIST develop publicly accessible repositories, tools and simple to use platforms ("apps") which allow corporations, members of the public (i.e., individual consumers), and public agencies to secure and source information related to specific materials and products; and to thereby establish how material and product selections, and changes therein can, result in better awareness, and decision making in support of low-carbon selections, that are foundational to the creation of a low-carbon economy.

2. While the hearing focused on cement, what other industrial goods would benefit from development of a low-emissions performance standard?

RESPONSE: A wide range of materials and products that are produced by heavy industry sectors would be amenable for inclusion in, and the development of low-carbon performance standards. This includes both primary materials, and down-stream products produced using: glass, iron and steel, hydrocarbon-derived petrochemicals (which form a base feedstock in the production of plastics, and other polymers), cement and concrete, etc. That said, it is important to develop an economy-wide basis to develop low-carbon performance standards so that manufacturers, specifiers and consumers/users are all equally incented to make decisions to produce and consume low-carbon impact materials, and products.

The Honorable John Shimkus (R-IL)

1. Raising energy and production costs in energy intensive or trade exposed industries can be harmful for communities in terms of lost jobs and economic output, especially if the developing world is unable to make the same changes to their energy and manufacturing systems.

a. What are the risks of leakage of U.S. industrial jobs to other nations if cost of energy or processing is increased compared to international competitors?

RESPONSE: It is often surmised that the implementation of higher standards (e.g., to reduce energy use, and carbon emissions) in the U.S., by trade exposed industries would compromise their competitiveness, and result in job losses. This is true only if the U.S. did not take other simultaneous steps to prevent such an outcome. Broadly speaking, the U.S. can protect its workers, its markets, and its competitiveness in a variety of ways. This includes: (a) by implementing border tax adjustments (BTAs) whereby materials and products that enter the U.S. are assessed a tax/tariff upon their entry into the U.S. whose magnitude is proportional to the extent of dissimilarity (e.g., in terms of embodied carbon intensity) with similar materials and products that are manufactured in the U.S., (b) by implementing low-carbon performance standards on an economy wide basis that promote strategic procurement decisions, e.g., made at the city-, state- and federal-government levels that ensure the consideration of embodied carbon intensity as a basis of selection and specification of materials and products, on an equal footing, as cost, and (c) by offering leadership on the world-stage to ensure the adoption of uniform standards, and a basis to reduce carbon dioxide emissions, globally – by developed, and developing nations.

While leakage is indeed a concern, often, the costs (and in time, the associated carbon intensity of fossil-fueled transportation modalities) of transportation (may) hinder leakage since, for example, it is most desirable to utilize commodity materials as close as possible to the point of consumption. Nevertheless, even if leakage is to occur, the steps outlined above can combat the negative attributes of leakage thereby ensuring that U.S. based manufacturers compete with internationally based manufacturers, on an equivalent basis, and in time as the world transitions to a low-carbon state, on an even more competitive basis.

b. What are the impacts on technical skills, supply chains, R&D and innovative capacity in U.S. manufacturing and industries exposed to relatively high energy or production costs?

RESPONSE: Base manufacturing sectors, e.g., cement, steel, glass and petrochemicals production, that feature high energy and production costs, and that feature large carbon-exposure would indeed be challenged, initially, to transform, adapt and empower their industries for a low-carbon world. However, a challenge of this nature has been long foreseen by the base manufacturing sector, which has been preparing, albeit incrementally, for this transition. As such, provision of clear guidance, i.e., in terms of legislative policy, regulatory and enforcement certainty, and the development of economy-wide low-carbon standards would accelerate and catalyze these sectors including their supply chains, R&D and innovation capacity, and the skillsets of their technical and non-technical workforce. In fact, the current mismatch of U.S. (federal) policy vis-à-vis state, and city level, and international actions with regards to carbon management is the single biggest detriment to the transformation of manufacturing practices in the U.S. This is major disconnect that needs to be overcome.

In addition to clear guidance, the U.S. should greatly expand federal R&D programs in the general theme of carbon management with special focus on programs that have the ability to catapult already developed, although not-yet-commercial scale technologies, to the point of commercial adoption. Some examples of this nature include the creation of technology demonstration and deployment programs that could be implemented by the Department of Energy in Carbon Capture, Utilization and Storage (CCUS) systems which are foundational to ensure and expand the U.S.'s global leadership and capacity for innovation of low-carbon technologies. These actions are especially important to ensure that the U.S. is not left behind in the development, deployment and commercialization of low-carbon technologies vis-à-vis the rest of the world; an outcome which, in time, would far more dramatically compromise the competitiveness of U.S. industry than U.S. industry's adoption today of decarbonization technologies.

c. What policy options have been proposed to prevent leakage, to what extent have they been examined for impacts on specific industries, and to what extent will this require international cooperation? Please elaborate.

RESPONSE: Absent global consensus and agreement; i.e., regulatory, evaluation (standards), and enforcement based, the most straightforward means of preventing or dis-incentivizing leakage involves the imposition of a border tax adjustment (BTA[*]). In the absence of international cooperation, the U.S. can protect its workers, its markets, and its competitiveness in a variety of ways. This includes: (a) by implementing border tax adjustments (BTAs) whereby materials and products that enter the U.S. are assessed a tax/tariff upon their entry into the U.S. whose magnitude is proportional to the extent of dissimilarity (e.g., in terms of embodied carbon intensity, or other ESG "environmental, social, governance" metrics) with similar materials and products that are manufactured in the U.S., and (b) by implementing low-carbon performance standards on an economy wide basis that promote strategic procurement decisions, e.g., made at the city-, state- and federal-government levels that ensure the consideration of embodied carbon intensity as a basis of selection and specification of materials and products, on an equal footing, as cost.

[*] A border tax adjustment (BTA) is a tariff which is imposed, for example, based on the carbon footprint of a material or product. Thus, materials like cement or steel that are produced inefficiently overseas (e.g., where they result in a high embodied carbon intensity of production) would incur a tax whose magnitude is proportionate to the extent of dissimilarity, e.g., in embodied carbon footprint, to similar materials that are produced in the U.S.; albeit more efficiently. The objective is to apply a tax on imported goods as related to their carbon footprint to provide protection to domestic industry that pursues decarbonization. In combination with strategic low-carbon procurement domestically, a BTA would incent foreign producers that seek to supply the U.S. market to become more efficient (from an energy- and carbon-basis) thereby harmonizing and transitioning production processes globally, to a low-carbon paradigm.

In addition to a BTA and low-carbon procurement standards, to encourage the purchase and integration of low-emissions products, incentives like revenue recycling could vastly increase the sale of low-carbon products by individuals, private- and public-entities. Revenue recycling is a significant mechanism since it offers a means to redistribute – very granularly, i.e., citizen by citizen if so desired – the income generated from carbon pricing mechanisms (e.g., taxes, penalties, etc.) to be returned back to society; an important need to create public support for carbon pricing mechanisms.

Generally speaking, international cooperation is very important to achieve harmonization in carbon management policies globally. This is needed to ensure equity in standards, regulations, penalties, and their enforcement across international jurisdictions. Such equity and harmonization is needed, for example, to offer corporations which operate globally a similar basis of improvement (i.e., rather than a dissimilar basis which may encourage leakage, and promote bad-actors), and evaluation – across national boundaries – as they seek to decarbonize their manufacturing operations. For this reason, it is critical that the U.S. engage with other nations to enact a globally-based and mutually agreed upon strategy and pathway for carbon emissions reductions.

2. What work has been published to your knowledge of the economic costs, the impacts on prices and supply, or employment impacts from reducing emissions in the industrial sectors? What work has been done to evaluate the legal, economic, and socio-economic impacts of deep decarbonization of the industrial sector?

RESPONSE: A substantial body of work published in both the peer-reviewed and non-peer reviewed literature has sought to articulate the economic, supply chain and employment impacts that are associated with decarbonizing the industrial sector. A sample of relevant (recent) studies is noted below for further consideration. And, if additional specific questions may arise we would be pleased to assist the committee in securing, evaluating and examining the conclusions of such work.

*(1) Deep Decarbonization Pathways Project. Pathways to Deep Decarbonization-2015 Report. SDSN - IDDRI **2015**.*

(2) de Pee, A.; Pinner, D.; Roelofsen, O.; Somers, K.; Speelman, E.; Witteveen, M. Decarbonization of Industrial Sectors: The Next Frontier; McKinsey & Company, 2018; p 63.

(3) Gerrard, M.; Dernbach, J. C. Legal Pathways to Deep Decarbonization in the United States; Environmental Law Institute, 2019.

(4) Sustainable Development Solutions Network (SDSN); Fondazione Eni Enrico Mattei (FEEM). Roadmap to 2050: A Manual for Nations to Decarbonize by Mid-Century; 2019; p 139.

*(5) Bataille, C.; Guivarch, C.; Hallegatte, S.; Rogelj, J.; Waisman, H. Carbon Prices across Countries. Nature Clim Change **2018**, 8 (8), 648–650.*

(6) Bataille, C.; Åhman, M.; Neuhoff, K.; Nilsson, L. J.; Fischedick, M.; Lechtenböhmer, S.; Solano-Rodriquez, B.; Denis-Ryan, A.; Stiebert, S.; Waisman, H.; et al. A Review of Technology and Policy Deep Decarbonization Pathway Options for Making Energy-Intensive Industry Production Consistent with the Paris Agreement. Journal of Cleaner Production 2018, 187, 960–973.

(7) Rosemberg, A. Embedding Just Transition in Long-Term Decarbonization Strategies: Why, What, and How; World Resources Institute, 2018.

*(8) Mayer, J.; Bachner, G.; Steininger, K. W. Macroeconomic Implications of Switching to Process-Emission-Free Iron and Steel Production in Europe. Journal of Cleaner Production **2019**, 210, 1517–1533.*

(9) Friedmann, S. J.; Fan, Z.; Tang, K. Low-Carbon Heat Solutions for Heavy Industry: Sources, Options, and Costs Today; Columbia SIPA | Center on Global Energy Policy: New York, NY, 2019; p 100.

(10) Bernstein, P.; Montgomery, W. D.; Ramkrishnan, B.; Tuladhar, S. Impacts of Greenhouse Gas Regulations on the Industrial Sector; NERA Economic Consulting: Washington, DC, 2017.

3. According to a recent report by the Energy Futures Initiative, many "subnational decarbonization strategy and road-map reports contain insufficient detail for establishing effective and efficient implementation policies and programs."

a. What should be done to develop a more in depth understanding of the cost and economic impacts of state and regional (subnational) decarbonization policies, particularly in the industrial sector?

RESPONSE: More expansive thinking in terms of incentive mechanisms and (economy wide) market implications is needed for establishing and implementing effective and efficient policies and programs that granularly reward, incent and motivate decarbonation across public-, private, and jurisdictional domains. For example, rather than simply try to decarbonize specific industries, or sectors, public- and private entities need to: (a) democratize the implications of carbon-emissions by informed, thoughtful and purposeful citizen-by-citizen education and awareness building actions, at city, state and national scales, and (b) create support structures and systems that benefit both early-stage technology innovators and established corporations; both to work independently, and in collaboration with direct and quantifiable benefits. Furthermore, more work is needed to quantify and assess the economic impacts that may result, e.g., for heavy industry, based on its adoption and leveraging of incentives such as the 45-Q tax credit or California's low-carbon fuel standard. Such activities are needed not only to address potential deficiencies in existing policies and incentives but also to identify the lowest overhead pathways by which (business-to-business) industries that do not have consumer-level exposure can transition their business model to profit/grow in a low-carbon world.