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POLICY DESIGN BRIEF

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A Technology-Neutral Emissions Standard for Clean Industrial Heat

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Globally, industrial facilities directly emit around a quarter of the world's greenhouse gas emissions, as well as conventional pollutants (like particulates) that cause hundreds of thousands of premature deaths every year. Most of these emissions are from burning fossil fuels to produce heat for industrial processes, such as melting metals, molding plastics, and cooking food. Policies supporting a transition to clean industrial heat can help countries achieve technological leadership, create high-quality manufacturing jobs, improve national security by onshoring supply chains, save lives, and achieve their climate commitments.

EMISSIONS STANDARD DESIGN CONSIDERATIONS

An emissions standard for industrial heat would set a declining limit on the amount of carbon dioxide (CO_2), nitrogen oxides (NO_X), sulfur oxides (SO_X), and particulate matter ($PM_{2.5}$ and PM_{10}) that may be emitted per unit of heat used in industrial processes. It should be simple to understand and administer, avoid the need for manual updates by regulatory agencies, and remain effective at driving a transition to modern, clean industrial processes year after year.

Note that these design guidelines are aimed at lawmakers—i.e., they are guidelines for new legislation, not for regulatory agencies acting under existing legal authority.

- **For manufacturing:** The standard should apply to heat used in manufacturing, defined as activities within the scope of North American Industry Classification System (NAICS) codes 31–33 or International Standard Industrial Classification (ISIC) codes 10–33.

- **Heat for industrial processes, not other uses:** The standard should apply only to heat used for industrial processes, such as melting materials or driving chemical reactions. Heating air for the comfort of workers or heating water for use in kitchens and bathrooms should not be covered, even in an industrial facility. Zero-emission industrial heating technologies are less mature and thus more expensive than zero-emission technologies for space and water heating in buildings, so a standard that is appropriate for industrial heating would be too lax for space and water heating (which should be covered by standards aimed at the buildings sector).

- **Delivered heat, not input energy:** The standard should be based on heat utilized by the manufacturing process. It should not be based on the amount of energy in the fuel or electricity used to create heat because that would penalize efficient technologies such as heat pumps, which deliver a large amount of useful heat per unit of energy they consume.

- **Useful heat, not heat losses:** The standard should limit emissions per unit of "useful heat," meaning heat used productively (such as to heat equipment, materials, or combustion air). The numerator should include all heating-related emissions, but the denominator should exclude heat that is lost from the system (such as in hot exhaust gases or latent heat in formed water vapor). Useful heat can be calculated by subtracting heat losses from the total heat generated. A standard based on useful heat would incentivize firms to use technologies that minimize heat loss (e.g., electrical heating) or recover lost heat.

- **New equipment versus existing equipment:** A standard may apply to newly installed equipment or existing equipment. Both types of standards should be used concurrently. A standard for new equipment is cheaper and easier to comply with, quickly spurs the commercialization of new types of clean industrial equipment, and prevents stranded assets. At the same time, a standard for existing equipment is critical for achieving meaningful emissions reductions given the long lifetimes of industrial heating equipment. By establishing an eventual limit to grandfathering of polluting facilities, such a standard would ultimately ensure U.S. climate commitments are achieved.

- **Adjust standards for heat temperature and power (delivery rate):** Not all heating technologies are equally emissions-intensive or equally easy to decarbonize. For instance, it is cheaper to produce zero-emissions steam at 100 °C for cooking food (which can be supplied by a heat pump) than to produce zero-emissions heat at over 1,000 °C for making glass or brick. Therefore, some distinctions should be made when setting the initial level of the standard (mass of CO_2 per unit of useful heat delivered) and the timeframe over which the standard declines to zero. However, there exist many types of industrial equipment, and making too many distinctions between equipment types could result in rules that are extremely complex and impossible to administer. One approach to make distinctions while limiting complexity is to define standards based on two factors: the useful heat's temperature and its power (the heat delivery rate, e.g., in millions of BTUs per hour). This could be done by dividing temperature and power into three to four bins each (resulting in nine to 16 standards), or better, by defining a smooth mathematical function based on temperature and power, avoiding stairsteps at bin boundaries.

- **Long time horizon:** Industrial firms plan for investments in new production lines and equipment years in advance, and industrial equipment can be used for decades. Therefore, a standard should be designed with these timeframes in mind. It should come into effect two to three years after enactment, and it should gradually decline to zero. In the case of new equipment, this decline should occur over 10–15 years, and for existing equipment, 30–40 years. These schedules may vary with heating equipment's output temperature and power (see previous bullet).

- **Set timeframes legislatively:** If necessary, the initial level of the standard for each equipment class may be determined by a regulatory agency possessing relevant technical expertise (such as the United States Environmental Protection Agency, the European Environment Agency in the European Union, etc.). However, to ensure continued progress, the schedules over which the standards decline to zero should be set legislatively at the time of enactment rather than requiring agency rulemaking to periodically tighten the standard, as agencies often fail to act in a timely manner and may sometimes act in ways contrary to the intent of the legislation.

- **Only consider direct emissions from industry and use complimentary policies to clean up the electricity sector:** To ensure that it targets emissions from industrial heat rather than from power plants, the standard should be based on direct emissions from the industrial facility (called "scope 1" emissions) and should disregard emissions associated with purchased electricity ("scope 2" emissions). Including scope 2 emissions could discourage firms from electrifying their heating processes, or it could cause them merely to purchase clean electricity without changing their own processes or equipment. Also, including scope 2 emissions would necessitate including a "three pillars" test (i.e., new clean supply, hourly matching, and deliverability) to evaluate whether the electricity qualifies as zero-emissions. Such a framework can be politically contentious and complex, and it may not be possible for an electricity buyer to determine the degree to which its purchased electricity qualifies. Instead of attempting to accomplish everything with a single policy, separate policies that clean up the electric grid should be used as a complement to a clean industrial heat emissions standard.

- **Technology-neutral:** The standard should be technology-neutral (e.g., it should not specify what technologies or energy sources an industrial firm should use to comply with the standard), both to allow industrial firms to identify the lowest-cost solutions and so that electrification or fuel switching can be a method of compliance.

A well-designed standard for clean industrial heat would drive private-sector investment in clean and modern manufacturing technology, create jobs, improve public health, and help a nation attain its climate goals.