Technology Choice and its Implications on the Environment

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Abstract

Technologies have vastly extended human capabilities. We can do more, faster, and often, though not always, better with the help of technology. As our reliance on technology increases, our use of technologies has largely determined the way we interact with the environment. To that end, understanding how certain technologies are chosen by the market and, in turn, shape our interactions with the environment is crucial in developing the policy to mitigate human footprint on the environment. This presentation draws upon two decades of my interests on that inquiry. Technologies are chosen for a variety of reasons: economic, regulatory, and sometimes historical, personal, or luck factors play a role. For modern industrial technologies, however, cost of production is a major determinant of technology choice. And once chosen, a technology often imposes prolonged impacts--good or bad--on the environment. Environmental performance of a technology is, however, hard to measure: a technology, say battery electric vehicle, may look better for the environment in one stage of life-cycle, say use phase. However, depending on how electricity is generated, battery electric vehicles may emit more greenhouse gases than internal combustion engines. Such realization led to the development of life cycle assessment (LCA), an approach to measure environmental impacts considering the whole life-cycle of a product. My colleagues and I have used various scenario analysis techniques to envision the deployment of technologies and their environmental implications. Using scenario analysis, my colleagues and I have explored the future GHG emissions from plastics and the U.S. electricity grid. In addition, combining the concept of marginal cost of production and LCA, my colleagues and I developed the Technology Choice Model (TCM). TCM estimates the composition of technologies that fulfill certain additional demand assuming that the market fills up the available capacity of the least-cost producer first. The model has been applied to quantify the global potential of carbon capture and utilization (CCU) of the chemical industry, the potential for the global plastics industry to reach net-zero GHG emissions, and the potential GHG emissions from increased demand on maize. TCM can be applied to answering other questions. Additional research is needed to fully understand the choice of technologies and their environmental implications. For example, how non-financial factors such as regulatory and social factors influence the choice of technology? How can path-dependence in technology choice be modeled for choice of technology? Better understanding the process of technology choice and their environmental implications would help us design the policy aiming at deploying more benign technologies and facilitate low-carbon transition.

Bio

Sangwon Suh is a professor at the Bren School of Environmental Science and Management at the University of California, Santa Barbara. He earned his BS and MSc in environmental engineering at Ajou University, South Korea, and PhD in industrial ecology at Leiden University in the Netherlands. His research focuses on the sustainability of the human-nature complexity through the understanding of materials and energy exchanges between them. His work contributed to the theoretical foundations and practical applications of quantitative sustainability assessment in the areas of life cycle assessment (LCA) and industrial ecology. Dr. Suh served the International Resource Panel (IRP) of the United Nations Environmental Programme (UNEP) as a member and the Intergovernmental Panel on Climate Change (IPCC) as a Coordinating Lead Author. He received the McKnight Land-Grant Professorship from the University of Minnesota's Board of Regents, Leontief Memorial Prize and the Richard Stone Prize from the International Input-Output Association (IIOA), the Robert A. Laudise Medal from the International Society for Industrial Ecology (ISIE), Distinguished Teaching Award by the Bren School, and the Lifetime Leadership Award by the American Center for LCA. He is a fellow of the British Royal Society of Arts.