



Boston University Institute for Sustainable Energy



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Center for Manufacturing Innovation

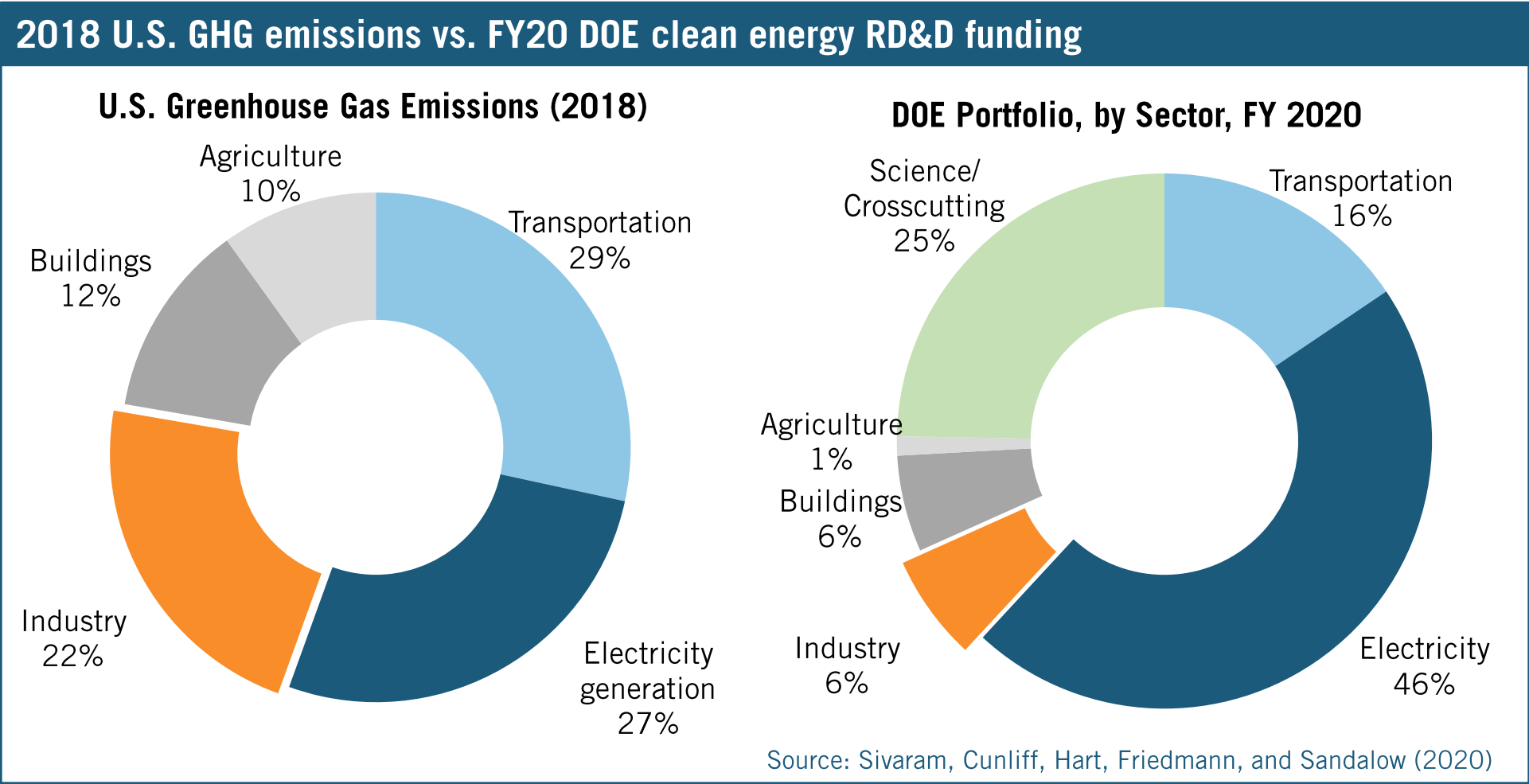


Information Technology
& Innovation Foundation

Greening High-Temperature Manufacturing: Toward an RD&D Agenda

Part of a virtual workshop series *Widening the Lens on Innovation for Clean Manufacturing*

Industrial emissions: the forgotten climate wedge



Why are emissions from heavy industry hard to abate?

Challenge #1: High-temperature heat for industrial processes relies on fossil fuel combustion

Challenge #2: “Process emissions” from chemical transformations cannot be eliminated by switching to clean energy

Calcination: $\text{CaCO}_3 + \text{heat} \rightarrow \text{CaO} + \text{CO}_2$

Cement



Iron and Steel

Chemicals



Goals for Session 1: Crosscutting Topics

- What are the most critical cross-cutting research, development, and demonstration (RD&D) priorities in high-temperature systems to meet climate targets and advance manufacturing competitiveness?
 - Electrification for heating, electrochemical processes
 - Clean hydrogen as feedstock, reductant, or fuel
 - What are the tradeoffs between electrification and hydrogen?
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Greening High-Temperature Manufacturing: Agenda (Wednesday, January 27, 10AM to 1PM EST)

Topic	Speaker	Eastern Time
Welcome & Introduction	Colin Cunliff	10:00 to 10:05 AM
Session 1: Cross-cutting Topics		
Electrification	Ali Hasanbeigi	10:05 to 10:20 AM
Hydrogen industrial applications	Mark Ruth	10:20 to 10:35 AM
H2 vs electrification tradeoffs	Mark Johnson	10:35 to 10:50 AM
Response + discussion	all participants	10:50 to 11:20 AM
5 min break		
Session 2: Sectoral Topics		
Hydrogen production	Everett Anderson	11:30 to 11:45 AM
Chemicals	Karthish Manthiram	11:45 to 12:00 PM
Iron & Steel	Marlene Arens	12:00 to 12:15 PM
Cement	Maria Juenger	12:15 to 12:30 PM
Response + discussion	all participants	12:30 to 1:00 PM

Cross-cutting priorities for clean manufacturing RD&D: Topics for discussion

1. RD&D priorities for:
 - industrial applications of hydrogen (ignore H₂ production)
 - electrification of heat (> 150°C)
 - other options (novel processes, CSP)
 2. How mature is each approach? Where (**what innovation stage**) should government invest? What program structure?
 3. What **innovation targets** should a federal RD&D program pursue?
 4. What **other policies** would complement RD&D investments?
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5 min break
Resume at 11:25

Sectoral priorities for clean manufacturing RD&D: Topics for discussion

1. RD&D priorities for:
 - hydrogen production (e.g. roll-to-roll electrolyzer manufacturing)
 - chemicals production (e.g. novel electrochemical processes, resistive heating)
 - iron & steel (hydrogen-DRI, direct electrolysis)
 - cement (SCMs, kiln electrification, CCS)
 2. How mature is each approach? Where (**what innovation stage**) should government invest? What program structure?
 3. What **innovation targets** should a federal RD&D program pursue?
 4. What **other policies** would complement RD&D investments?
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What other federal policies would complement federal RD&D investments?

- Tax incentives for manufacturers or investors
 - Contracts for differences
 - Loans or loan guarantees for manufacturers
 - Regulatory reform
 - Codes and standards
 - Government procurement of end products (through GSA, DOD, DOT, USACE)
 - Workforce development
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At what innovation stage should government invest?

What RD&D investments are most useful?

- Publicly-funded, investigator-initiated basic research?
 - Publicly-funded, targeted applied R&D at labs and universities?
 - Cost-shared pilot-scale facilities run by public agencies?
 - Cost-shared commercial-scale demo projects carried out by manufacturers?
 - Publicly-supported, industry-led manufacturing consortia that focus on targeted challenges/sectors (e.g. roll-to-roll manufacturing of electrolyzers)?
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