



MIT Energy Initiative



## Selected Research Publications

### **Two-Way Trade in Green Electrons: Deep Decarbonization of the Northeastern U.S. and the Role of Canadian Hydropower**

Emil Dimanchev, Joshua Hodge, and John Parsons

February 2020

### **Challenges and Opportunities for Decarbonizing Power Systems in the US Midcontinent**

Pablo Duenas-Martinez, Karen Tapia-Ahumada, Joshua Hodge, Raanan Miller, and John E. Parsons

July 2021

### **Electricity Pricing Problems in Future Renewables-Dominant Power Systems**

Dharik S. Mallapragada, Cristian Junge, Cathy Wang, Hannes Pfeifenberger, Paul L. Joskow, and Richard Schmalensee

November 2021 (revised February 2022)

### **Properties of Deeply Decarbonized Electric Power Systems with Storage**

Cristian Junge, Cathy Wang, Dharik S. Mallapragada, Howard K. Gruenspecht, Hannes Pfeifenberger, Paul L. Joskow, and Richard Schmalensee

February 2022

### **Electricity Sector Policy Reforms to Support Efficient Decarbonization**

Howard K. Gruenspecht, Hannes Pfeifenberger, Paul L. Joskow, Richard Schmalensee

April 2022

### **Electricity Retail Rate Design in a Decarbonizing Economy: An Analysis of Time-of-Use and Critical Peak Pricing**

Tim Schittekatte, Dharik Mallapragada, Paul L. Joskow, and Richard Schmalensee

October 2022

MITEI: Our mission

# The Future of Energy Storage

An Interdisciplinary MIT Study



Think different.

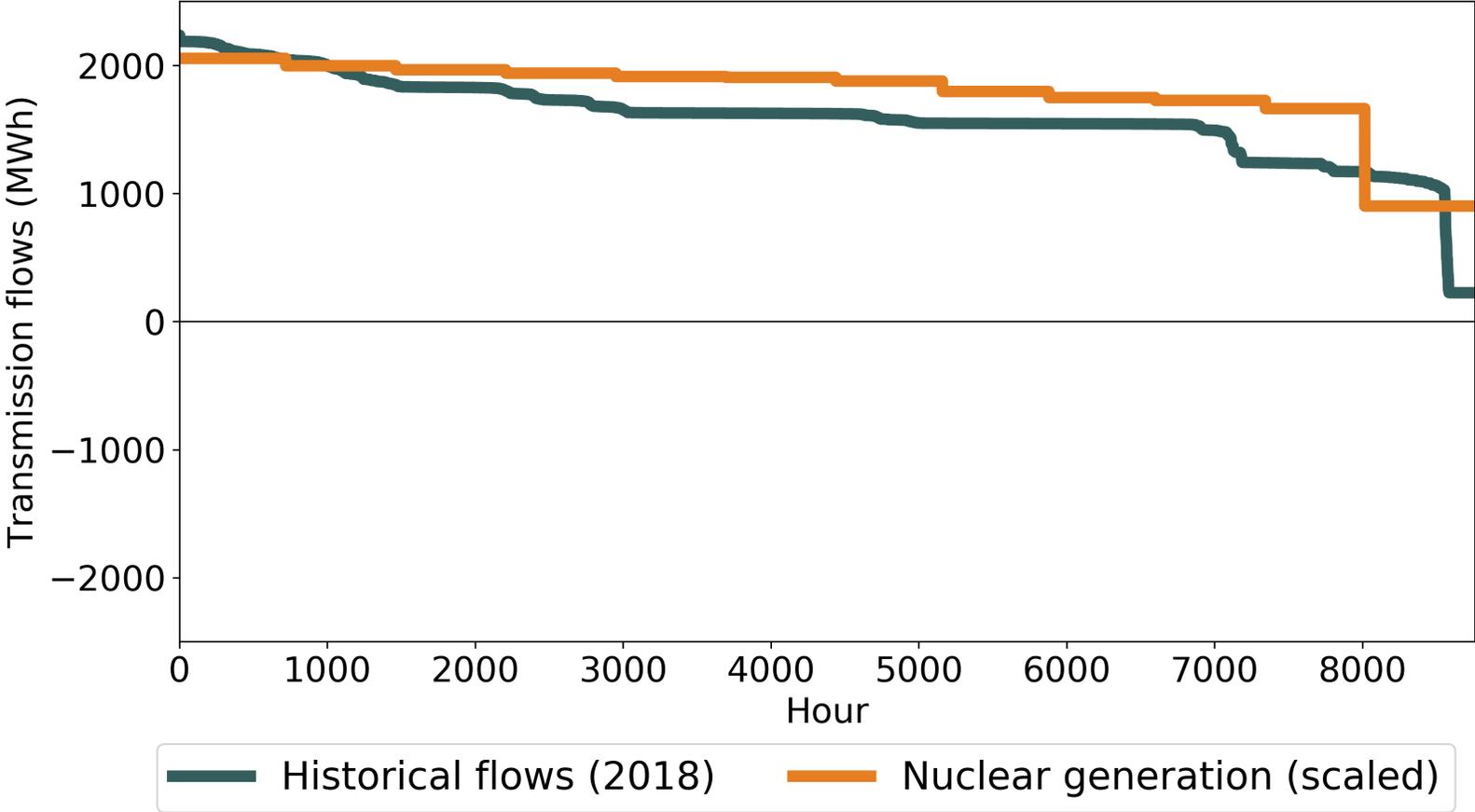


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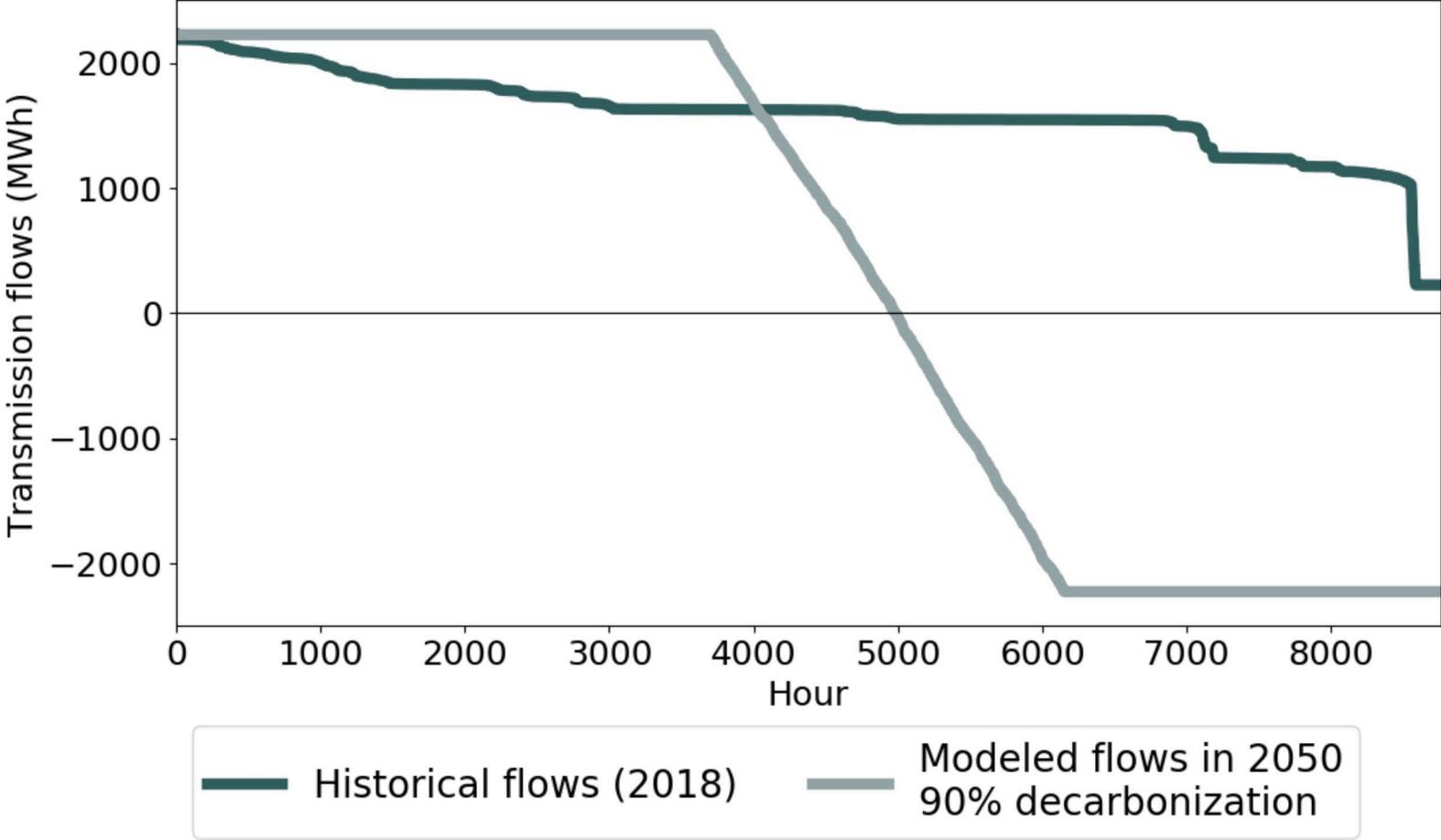
# Two-Way Trade in Green Electrons



# Current Policy Approach: Canadian Hydro as Baseload to US



# Deep Decarbonization Needs 2-Way Utilization

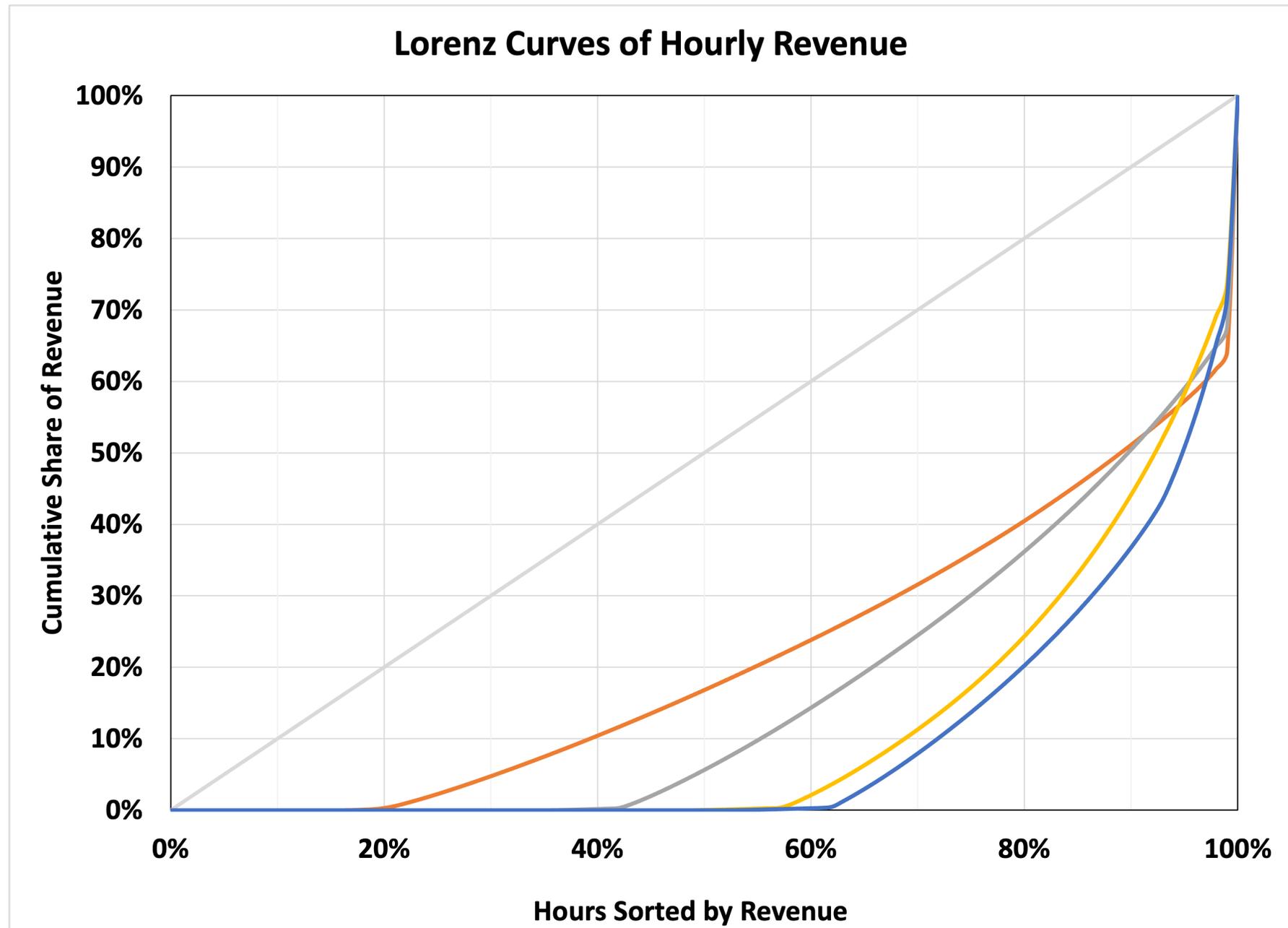


# Deep Decarbonization and Economic Change

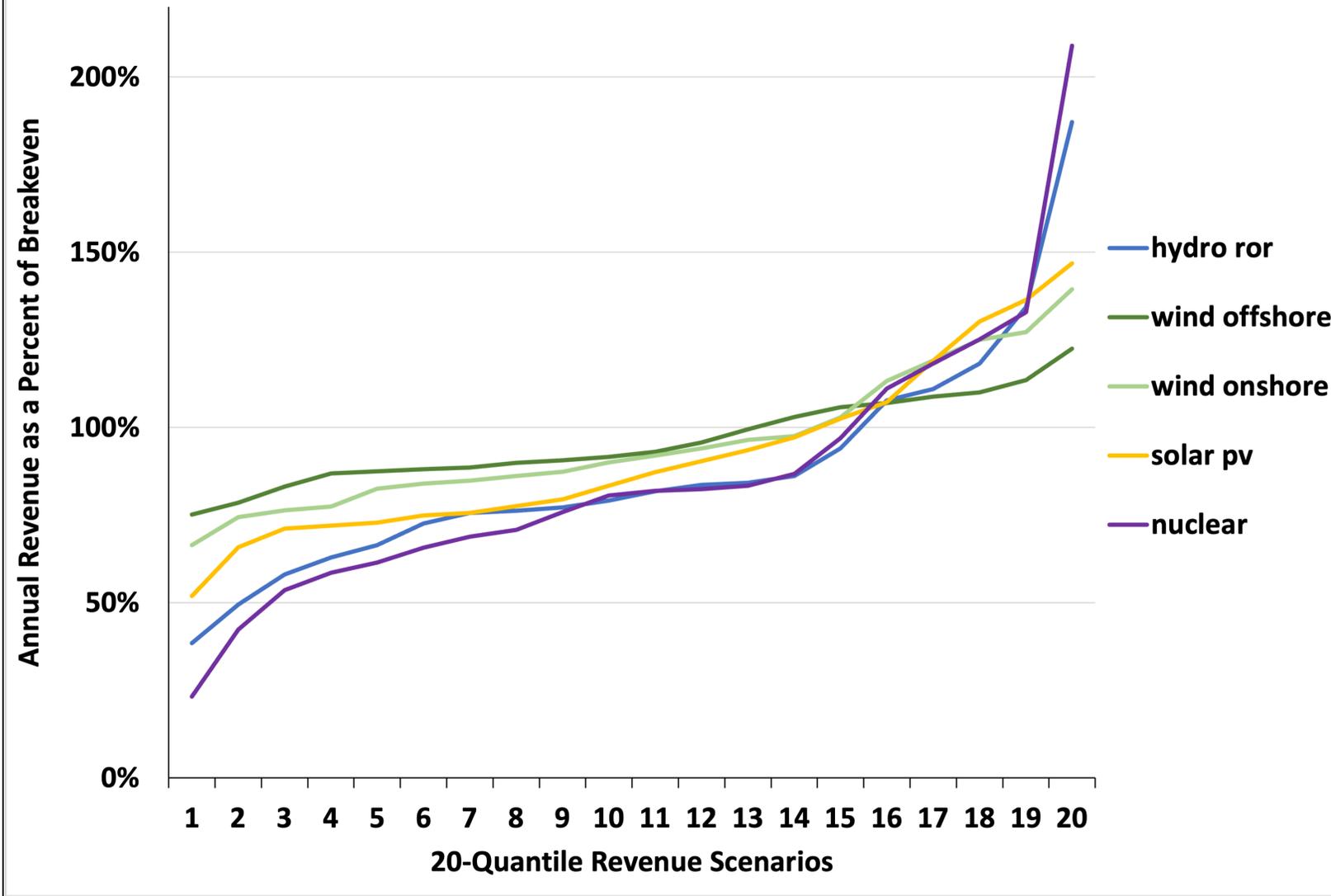


- Power system will increasingly rely on capital intensive investments and less on the consumption of fuel.
- Greater up front costs, lower ongoing, variable costs.
- Changing distribution of the hourly value of electric energy.
  - Many hours of very, very low prices.
  - A very few hours of extremely high prices.
  - Interannual variability in profitability – many years of losses, and a few years of large profits.

# Revenue Compression



# Interannual Revenue Variation



# Natural Gas-fired Generators

- Capacity is more valuable
  - ... in the midcontinent, decarbonization scenarios had a 50% increase in capacity
- ...but they are run less often
  - from an average capacity factor of 30%, they go down to an average c.f. of 17%



DIVE BRIEF

# ISO New England floats 'energy reserve' to ensure grid reliability, access to LNG at Everett terminal

Published Aug. 31, 2022



# Electrification of Home Heating



# The Boston Globe

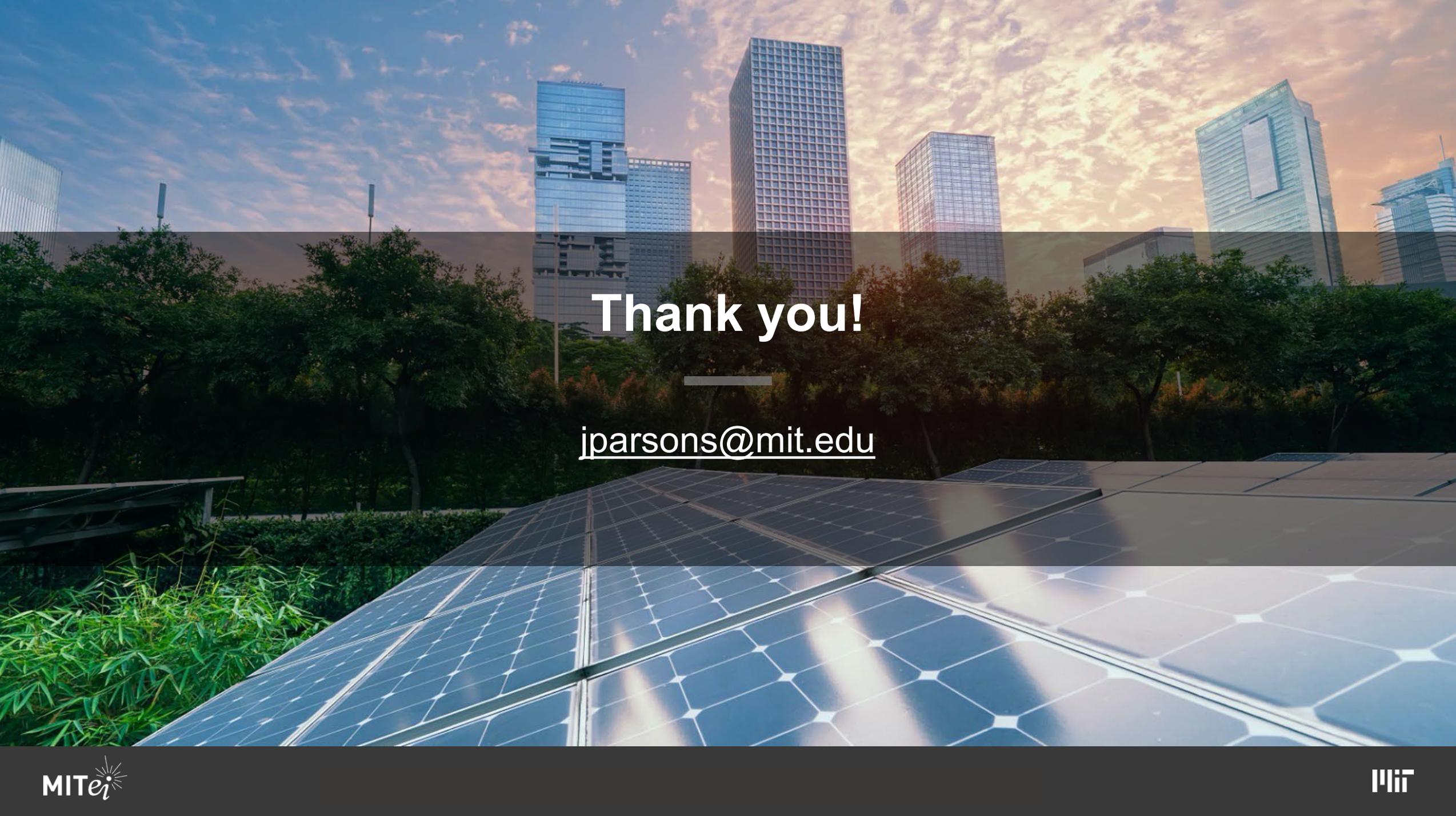
## Your electric bill shouldn't be so high. Here's how to fix it.

The effect of the state's flawed electricity pricing system on incentives to electrify is enormous.

By Christopher R. Knittel Updated March 29, 2023, 3:00 a.m.



Total Charges for Electricity	
Generation Service Charge	1058 kWh X .
Subtotal Supplier Services	
<b>Delivery</b>	
Customer Charge	
Distribution Charge	1058 kWh X .0
Transition Charge	1058 kWh X -
Transmission Charge	1058 kWh X .
Revenue Decoupling Charge	1058 kWh X .
Distributed Solar Charge	1058 kWh X .0
Renewable Energy Charge	1058 kWh X .
Energy Efficiency	1058 kWh X .
Subtotal Delivery Services	
<b>Total Cost of Electricity</b>	



Thank you!

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