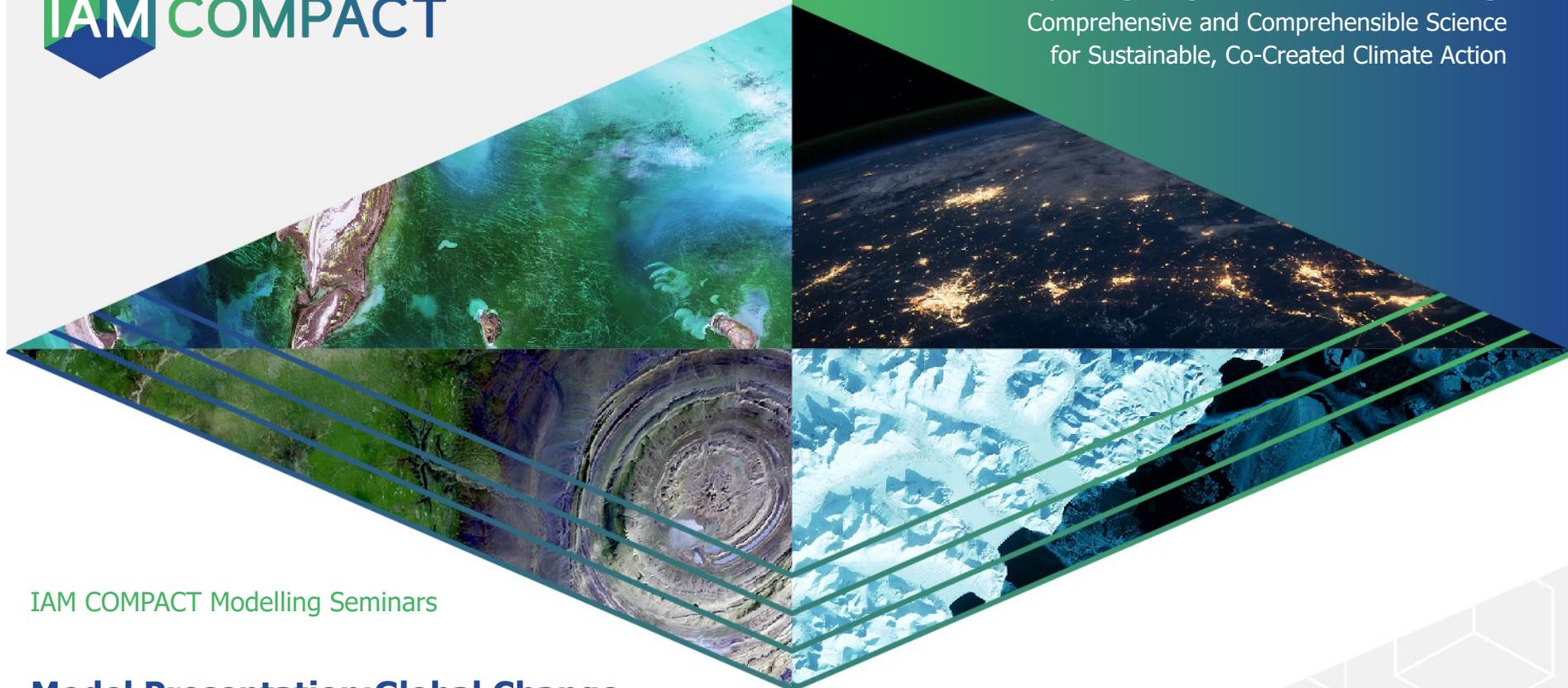




Expanding Integrated Assessment Modelling:
Comprehensive and Comprehensible Science
for Sustainable, Co-Created Climate Action



IAM COMPACT Modelling Seminars

Model Presentation: Global Change Analysis Model (GCAM-USA)

Center for Global Sustainability (CGS), University of
Maryland (UMD)



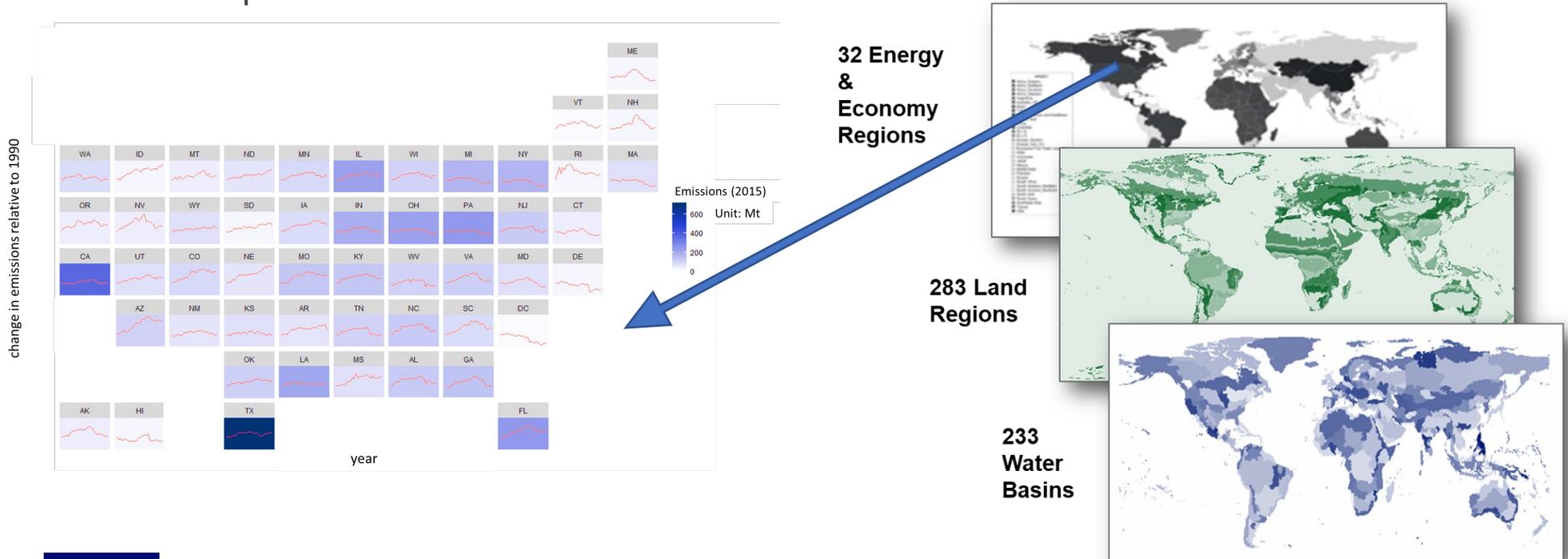
The IAM COMPACT project has received funding from the European Union's Horizon Europe Research and Innovation Programme under grant agreement No 101056306.

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- **The Global Change Analysis Model (GCAM)** is a partial-equilibrium multisector integrated assessment model of [economic](#), [energy](#), [land-use](#), [water](#), [emissions](#) and [climate](#) systems.
- It tracks emissions of 16 greenhouse gases and short-lived species across all economic sectors.
- It is one of roughly five major international IAMs used for understanding future emissions scenarios (including IPCC scenarios, SSP pathways, and several multisector multiscale studies and reports).
- GCAM is an open-source community model developed over 30 years and maintained at JGCRI (College Park, MD).



- **GCAM-USA** is a version of GCAM with 50 state-level resolution in the U.S. and is embedded within the global GCAM (available in the open-source version).
- In GCAM-USA, energy transformation (electricity and refined liquids production) and end-use demands are modelled at the individual state level; primary fossil energy production at the aggregate national level; and crops at the 22 U.S. water basins.
- GCAM-USA includes state-level emissions of air pollutants, and specification of non-CO2 GHG are under development.

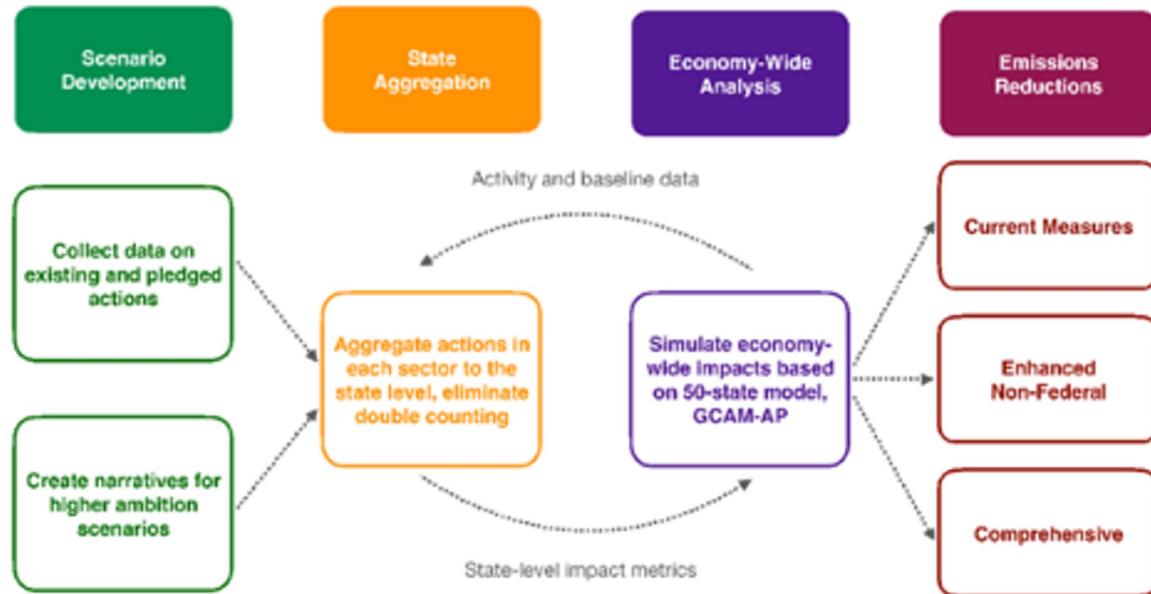


The All-In Climate Strategy:

Policy interactions contributing to 100% clean electricity



An All-of-Society approach has been and will be critical to achieve U.S. climate goals



- **Changing cost parameters**
 - e.g. Tax credits/rebates/subsidies
 - e.g. Investments in EV infrastructure
- **Setting a national constraint**
 - e.g. Coal phaseout
- **Modifying consumer preference/shareweights**
 - e.g. Bus electrification
- **Changing fuel efficiency**
 - e.g. Corporate Average Fuel Economy standards



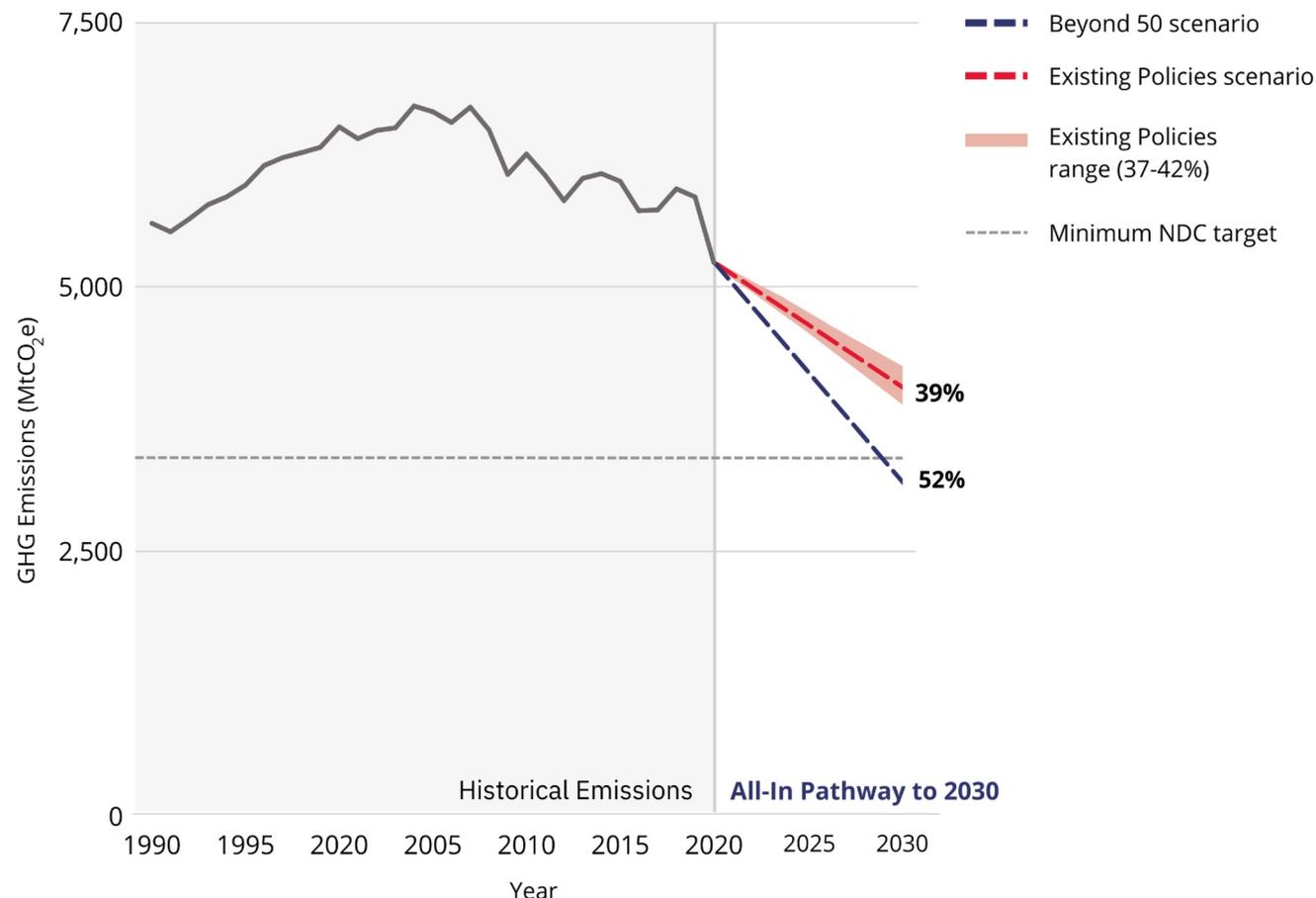
- **Step 1. Scenario development:** Collect data on current and potential state, city, and business climate actions.
- **Step 2. State-level aggregation:** Aggregate non-federal climate policy into state activity data for each sector.
- **Step 3. Economy-wide analysis:** Convert results of sectoral analysis into inputs for GCAM-USA to estimate economy-wide emissions.

Policy/ Action Area	State	City	Business
Binding GHG Caps	Economy-wide carbon caps	Not included	Not included
Renewable Electricity Goals	Renewable portfolio standards	Renewable energy targets	Utility-level commitments
Nuclear Fleet Retention	Zero-emissions credit/nuclear fleet maintenance	Not included	Not included
Transportation	ZEV mandates, VMT targets	Municipal fleet targets, VMT targets	Not included
HFCs	HFC SNAP/Phasedown Regulations and Refrigerant Mgmt Programs	Not included	Reductions reported through EPA GreenChill program
Building & Industry energy	Energy Efficiency Resource Standards (EERS), bans on gas hookups	Energy efficiency targets, bans on gas hookups	Not included



The existing policies scenario can achieve 39% reductions by 2030 from 2005 levels with potential for 42% reductions with accelerated implementation.

The Beyond 50 scenario uses an all-of-society, accelerated approach to a national climate strategy and shows a pathway for the United States to **achieve 52% emissions reductions from 2005 levels by 2030.**

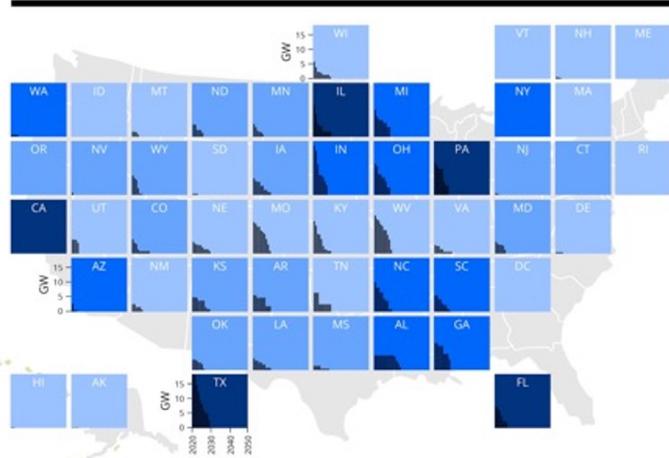


Zhao, A., S. Kennedy, K. O’Keefe, M. Borrero, K. Clark-Sutton, R. Cui, C. Dahl, G. Deye, J. Feldmann, K. Kennedy, H. McJeon, M. Moravec, D. Nilov, S. Rajpurohit, J. Rosas, C. Squire, and N. Hultman (2022). “An All-In Pathway To 2030: The Beyond 50 Scenario.” Center for Global Sustainability, University of Maryland and America Is All In. 16 pp.

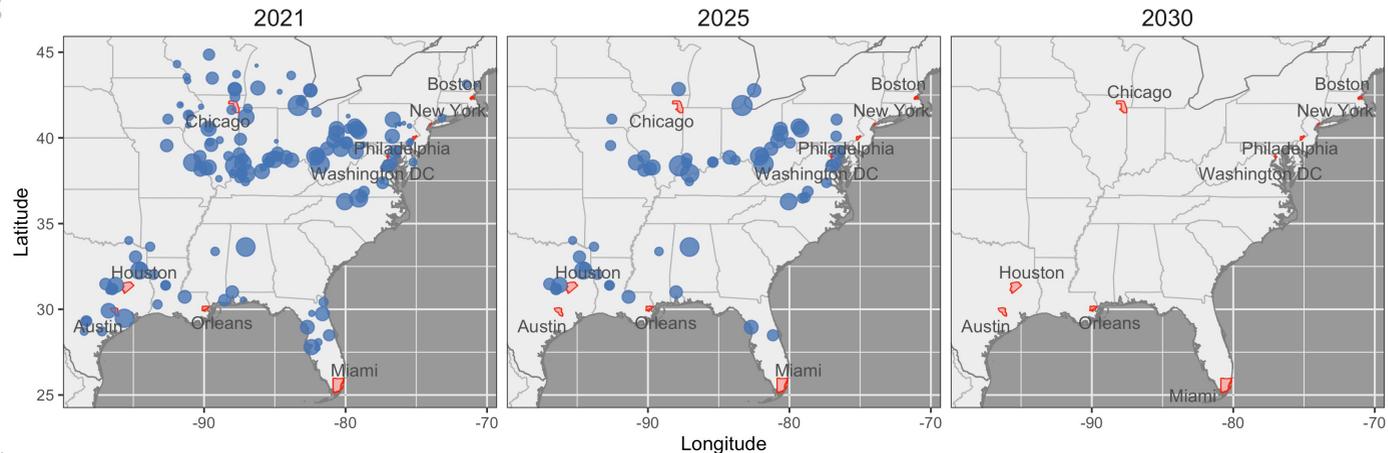
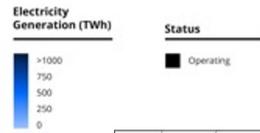
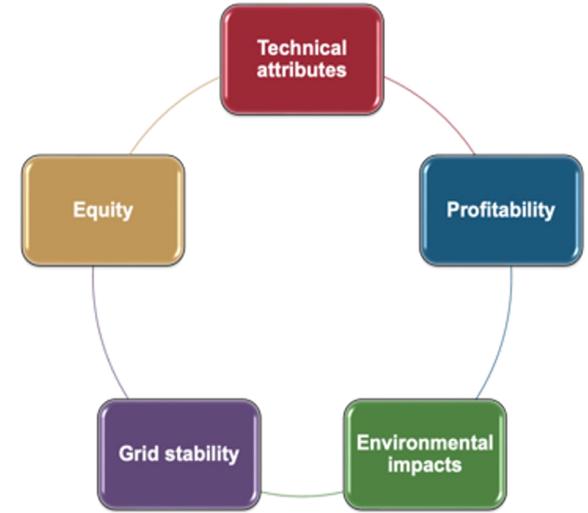


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Coal Power Phaseout Pathways by U.S. State



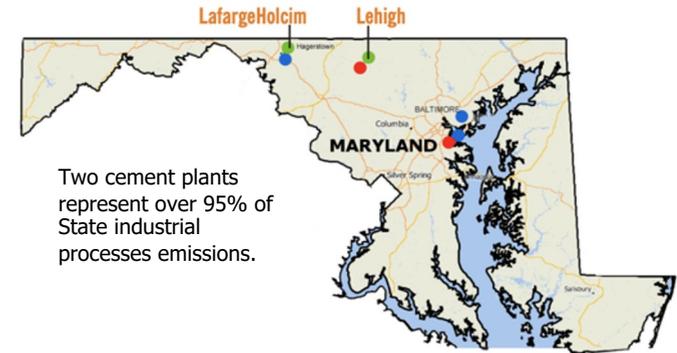
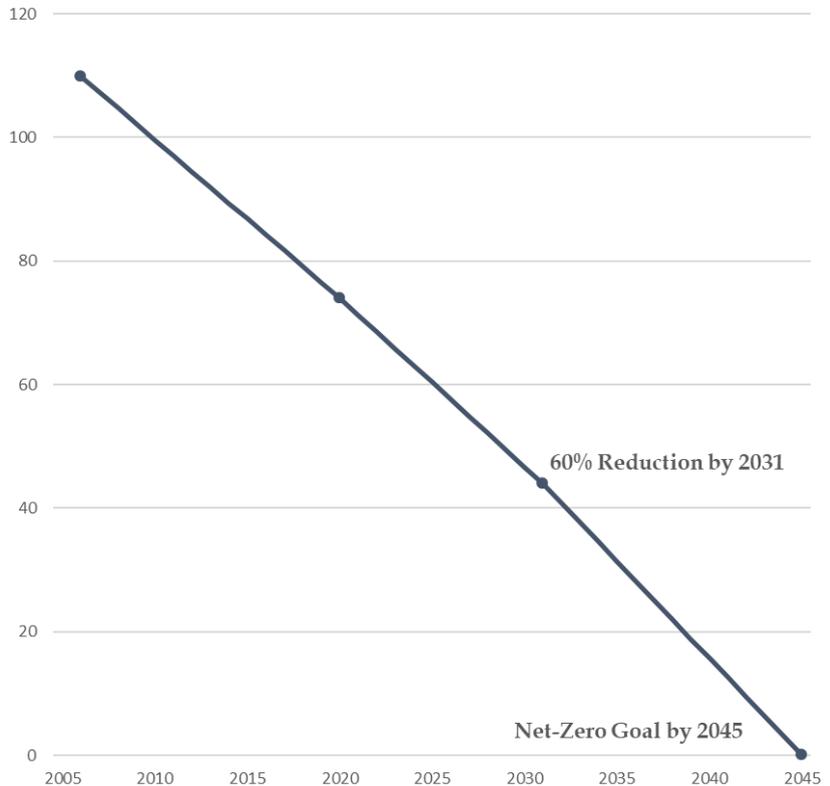
Structure high-ambition and feasible **plant-by-plant** coal retirement pathways, combining **top-down 1.5C scenarios from GCAM** and **bottom-up facility-level assessment**.



Cui et al. 2022. A U.S.-China Coal Power Transition and the Global 1.5C Pathway. *Advances in Climate Change Research* 13(2): 179-186.



Economy-wide progress towards Maryland's climate targets by 2006 levels



- Working with State, assessing emissions reduction strategies and impacts for the State’s manufacturing sector, which presents challenges due to difficult-to-decarbonize process emissions and employment concerns.
- Currently supporting the state through analysis of Maryland’s ambitious climate targets of 60% reduction in statewide emissions from 2006 levels by 2031 and net-zero by 2045, in the Climate Solutions Now Act of 2022.



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Kennedy, K.M., Williams, J.Z., Cui, R., Ku, A.L., Qiu, L., Dahl, C., Kennedy, S., Hultman, N.E. (2022). “Manufacturing Sector Decarbonization Strategies and Impacts in the State of Maryland.” Center for Global Sustainability, University of Maryland. 50 pp.

- U.S. NDC and LTS assessments (Hultman et al, 2021)
- All-of-society climate action in the U.S. (Hultman et al, 2019; Hultman et al, 2020; Zhao et al, 2022a, 2022b, 2022c)
- Policy designs (Peng et al, 2021)
- Energy system evolution and infrastructure development (Feijoo et al, 2018; Wise et al, 2019; Binsted et al, 2020)
- Air pollution and health co-benefits in U.S. (Shi et al, 2017; Ou et al, 2020)
- Water-energy-land interactions (Liu et al, 2015, 2019; Binsted et al, 2022)
- Energy access and impact distribution (Sampedro et al, 2022)



GCAM-USA documentation:

- GCAM-USA documentation: <http://jgcri.github.io/gcam-doc/gcam-usa.html>
- Github documentation: <https://github.com/JGCRI/gcam-doc>
- Model discussion site: <https://github.com/JGCRI/gcam-core/discussions>

Subset of relevant papers:

- Zhao, A., S. Kennedy, K. O’Keefe, M. Borrero, K. Clark-Sutton, R. Cui, C. Dahl, G. Deye, J. Feldmann, K. Kennedy, H. McJeon, M. Moravec, D. Nilov, S. Rajpurohit, J. Rosas, C. Squire, and N. Hultman (2022). “An All-In Pathway To 2030: The Beyond 50 Scenario.” Center for Global Sustainability, University of Maryland and America Is All In. 16 pp.
- Zhao, A., K. O’Keefe, H. McJeon, K. Clark-Sutton, R. Cui, J. Feldmann, Kathleen Kennedy, Kevin Kennedy, S. Kennedy, J. Meisel, D. Nilov, S. Rajpurohit, N. Hultman (2022). “An ‘All-In’ Pathway To 2030: U.S. Methane Sector Emissions Reduction Potential.” Center for Global Sustainability, University of Maryland and America Is All In. 16 pp.
- Zhao, A., McJeon, H., Cui, R., Cyrs, T., Feldmann, J., Iyer, G., Kathleen Kennedy, Kevin Kennedy, S. Kennedy, O’Keefe, K., Rajpurohit, S., Rowland, L., & Hultman, N. (2022). An “All-In” pathway to 2030: Transportation sector emissions reduction potential. Center for Global Sustainability, University of Maryland and America Is All In. Available at www.AmericaIsAllIn.com. 8pp.
- Hultman, N., L. Clarke, H. McJeon, R. Cui, P. Hansel, E. McGlynn, K. O’Keefe, J. O’Neill, C. Wanner, A. Zhao (2021). Charting an Ambitious US NDC of 51% Reductions by 2030. Center for Global Sustainability. 5 pp. Available at: go.umd.edu/ChartingNDC2030
- Hultman, N., L. Clarke, C. Frisch, K. Kennedy, et al, “Fusing national and sub-national climate action is central to rapid near-term decarbonization: The case of the United States.” Nature Communications. 11: 5255 (2020)
- Hultman et al. 2019. “Accelerating America’s Pledge.” The America’s Pledge Initiative on Climate Change and Bloomberg Philanthropies, with the University of Maryland Center for Global Sustainability, Rocky Mountain Institute, and World Resources Institute.





Thank you!



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