Harvard Electricity Policy Group 3 February 2021

NET-ZERO AMERICA

PRINCETON UNIVER

POTENTIAL PATHWAYS, INFRASTRUCTURE, AND IMPACTS

E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020. Full report available for download at https://environmenthalfcentury.princeton.edu/.





andlinger center for energy+the environment



High Meadows Environmental Institute

Carbon Mitigation Initiative

FIVE MODELED LEAST-COST PATHS TO NET-ZERO IN 2050 SHOW IMPLICATIONS OF DIFFERENT APPROACHES





BIG, BUT AFFORDABLE, TRANSITION: SHARE OF GDP SPENT ON ENERGY IS BELOW HISTORICAL LEVELS





CHALLENGE 1: MOBILIZING CAPITAL (AND LABOR); 2.5 T\$ OF ADDITIONAL CAPITAL SPENT OVER THE NEXT DECADE



Total additional capital invested, 2021-2030, by sector and subsector for any of the net-zero pathways vs. REF (billion 2018\$)



Includes capital invested pre-financial investment decision (pre-FID) and capital committed to projects under construction in 2030 but in-service in later years. All values rounded to nearest \$10b and should be considered order of magnitude estimates. Incremental capital investment categories totaling less than \$5B excluded from graphic. **Other potentially significant capital expenditures** *not* **estimated** in this study include establishment of bioenergy crops, decarbonization measures in other industries besides steel and cement, non-CO₂ GHG mitigation efforts, and establishing enhanced land sinks.

CHALLENGE 2: TRADEOFFS, NOT AGGREGATE COSTS; MORE REAL OPTIONS MEANS GREATER PROBABILITY OF SUCCESS



Carbon

Mitigation

Initiative



SOLAR AND WIND ARE CORNERSTONES FOR EACH PATH





EXTENSIVE SOLAR, WIND & TRANSMISSION BUILD ACROSS U.S.





Note: Transmission expansion is visualized along existing rights of way (>160 kV); paths are indicative not definitive.

Total

Direct

70.5

▶ 70.5

EXTENSIVE SOLAR, WIND & TRANSMISSION BUILD ACROSS U.S.





Note: Transmission expansion is visualized along existing rights of way (>160 kV); paths are indicative not definitive.



E+ RE- has ~50% less wind, solar & transmission build, but requires unprecedented rates of nuclear (and/or other clean firm resource) deployment





2002)

USA

expansion

nuclear

-year

ecord

10

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CHALLENGE 3: ALL POLITICS IS LOCAL; DECISION SUPPORT NEEDS



MOST STATES SEE NET GROWTH IN ENERGY-RELATED EMPLOYMENT, BUT MAJOR SHIFTS IN LOCAL ECONOMIES MUST BE MANAGED



Note: Spatial redistribution of solar and wind manufacturing facilities and increasing the domestic manufacturing share offer opportunities to ameliorate losses in fossil fuel extraction states. For assumptions used here in siting solar and wind manufacturing jobs.

CLEAN ELECTRICITY AND ELECTRIFYING VEHICLES DELIVER LARGE AIR QUALITY AND PUBLIC HEALTH IMPROVEMENTS ACROSS STATES





Coal Plants

premature deaths per county (log scale)

300

• Coal power plant

Motor Vehicles

premature deaths per county per 100,000 people



200,000-300,000 PREMATURE DEATHS AVOIDED THROUGH 2050 BY A NET-ZERO TRANSITION (~\$2-3T IN DAMAGES)



